Drivers and Perceived Sustainability of Soy-Maize Cropping among Smallholder Farmers in Central Malawi: A Socio-Technical and Livelihoods Analysis

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Abstract

Smallholder farmers in Central Malawi are increasingly growing soybean alongside maize in contexts of variable rainfall, unstable markets, and recurrent food insecurity. Soy-maize cropping is often promoted as a way to improve income, climate resilience, and livelihoods, but its sustainability is often assumed rather than examined directly once farmers adopt it. This thesis asks under what conditions soy-maize cropping moves from being adopted to supporting sustainable smallholder livelihoods, examining both what drives adoption and whether the practice is socially, environmentally and economically sustainable under increasing climate variability. Using a qualitative case study of Kasungu, Mchinji, and Lilongwe districts, the study draws on 30 farmer interviews with adopters and non-adopters, 14 stakeholder interviews, and a Food Insecurity Experience Scale survey. The data are analysed through the Multi-Level Perspective (MLP) and a critical Sustainable Livelihoods Framework (SLF).

The findings show that soybean is not replacing maize, but is being added to a maize-centred farming system. Farmers use soybean income to support maize production, buy fertiliser, and meet household needs, a pattern the thesis identifies as a reinvestment cycle. Through the MLP, this is understood as a form of reconfiguration that strengthens rather than weakens the existing regime, conceptualised here as regime extension. The SLF shows that the benefits of soy-maize are conditional and uneven. Outcomes depend not only on household assets, but also on support from organisations and on the market channel through which farmers sell their crop, especially the difference between cooperative and vendor-dominated markets. Sustainability is therefore not an automatic result of adoption but depends on the production and marketing conditions that surround the crop. The thesis contributes to socio-technical transitions and critical livelihoods scholarship by showing that smallholder farmers are active agents in regime change.

Keywords: Soy-maize cropping, smallholder farmers, sustainable livelihoods, socio-technical transitions, multi-level perspective, regime extension, climate variability, food security, agricultural diversification, Central Malawi.

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Abbreviations

Abbreviation	Description
ADD	Agricultural Development Division
ADMARC	Agricultural Development and Marketing Corporation
APES	Agricultural Production Estimation Survey
CIMMYT	International Maize and Wheat Improvement Center
DAES	Department of Agricultural Extension Services
DeSIRA	Development Smart Innovation through Research in Agriculture
DFID	Department for International Development (United Kingdom)
ENSO	El Niño Southern Oscillation
EPA	Extension Planning Area
FAO	Food and Agriculture Organization of the United Nations
FEWS NET	Famine Early Warning Systems Network
FIES	Food Insecurity Experience Scale
FISP	Farm Input Subsidy Programme
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IPC	Integrated Food Security Phase Classification
LEG4DEV	Legumes for Development
MLP	Multi-Level Perspective
MT	Metric Tonnes
MVAC	Malawi Vulnerability Assessment Committee
MWK	Malawian Kwacha
NASFAM	National Smallholder Farmers' Association of Malawi
NEEF	National Economic Empowerment Fund
NGO	Non-Governmental Organisation
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
RQ	Research Question
SIMLESA	Sustainable Intensification of Maize-Legume Systems for Eastern and Southern Africa
SLF	Sustainable Livelihoods Framework
SLU	Swedish University of Agricultural Sciences
THRIVE	Farm Concern International commercial-villages programme

1. Introduction

This thesis examines the drivers and perceived sustainability of soy-maize cropping among smallholder farmers in Central Malawi. It asks why farmers are adopting soy-maize systems and whether this practice supports their livelihoods across social, economic, and environmental dimensions under conditions of climate variability. These two concerns are closely linked. The study treats adoption and sustainability as two stages of the same process, asking under what conditions adoption leads to sustainable livelihood outcomes.

Soy-maize adoption may not work the same way for every farmer. The study asks how outcomes are shaped by the support systems, markets and environmental conditions around each household. At the same time, the study treats smallholder farmers as active decision-makers rather than passive recipients of change. It examines how farmers adjust their farming systems in response to soybean, rather than simply asking whether they adopt it.

1.1 Background

Rainfall seasons in Central Malawi have become less predictable, with recent El Niño conditions adding further pressure. National maize production fell to about 23% below the five-year average in 2023-24 (FEWS NET, 2024, p. 2). By the 2024/25 lean season, nearly 5.7 million people, around 28% of the analysed population, were projected to face Crisis (IPC Phase 3) or worse levels of acute food insecurity (IPC, 2024, p. 1). These shocks form part of a longer pattern of erratic rainfall, shorter growing seasons and dry spells. For smallholder farmers who depend on rain-fed farming, this has increased the need for crops that reduce the risk of relying on maize alone.

Soybean has become one of these crops. In Malawi, production is concentrated in the Central Region, especially in districts such as Lilongwe, Mchinji, Kasungu, Dedza, Ntchisi and Mzimba. These six districts account for over 80% of national soybean production (Tufa et al., 2019, p. 4). Its expansion has been supported by several actors. NASFAM has promoted soybean through farmer associations and collective marketing. Farm Concern International, through the THRIVE programme, has linked commercial villages to processors. IITA has supported soybean research and variety development, including through SIMLESA (Thierfelder et al., 2017). Afriseed has supplied improved seed, while Paramount Commodities and smaller traders have provided markets. Farmers also learned about soybean through neighbours, lead farmers and local conversations at trading

centres. Several respondents said these informal networks influenced their decision to plant soybean.

Across these actors, soy-maize promotion rested on four main claims: income, climate resilience, lower input and labour demands, and market demand. Soybean offered cash in a way that maize, mainly grown for household food, did not. It also matured earlier than maize, which made it attractive under uncertain rainfall. Compared with tobacco, soybean required less fertiliser, labour and curing infrastructure. It also had growing demand from processors, traders and regional markets. Together, these claims made soybean appear to be a practical and attractive crop for smallholder farmers in Central Malawi.

What is less clear is whether soy-maize actually supports farmers' livelihoods once they adopt it, especially under the climate conditions they face.
Smallholder farming is central to food security, rural employment, and economic development across Sub-Saharan Africa. Smallholder farmers produce a large share of agricultural output and support the livelihoods of millions of rural households (Morton, 2007). Malawi is among the land-constrained countries of the region, where smallholder farm sizes are small and declining (Jayne et al., 2014). Smallholder agriculture in Malawi continues to face serious challenges, including declining soil fertility, limited access to improved inputs, unstable markets, and increasing exposure to climate variability (Sheahan and Barrett, 2017).

In recent decades, soybean has been promoted across Central Malawi as a crop that can complement maize farming. Programmes led by the International Institute of Tropical Agriculture (IITA), the National Smallholder Farmers' Association of Malawi (NASFAM), and different NGOs have supported the spread of improved soybean varieties and agronomic advice to more than 80,000 smallholder farmers across over ten districts (Tufa et al., 2019, p. 2).

However, the spread of soy-maize integration has not been even. It has been shaped by the interaction of technology, organisational support, markets, and environmental pressures. Adoption of the recommended combination of improved varieties grown with double-row spacing remains partial; only about one-third of households (32%) take it up (Tufa et al., 2021, p. 11). This shows that making a technology available does not always lead to sustained use by farmers.

1.1.1 The LEG4DEV Project

This study was conducted as part of the Legumes for Development (LEG4DEV) project, funded by the European Union through the DeSIRA initiative. LEG4DEV is led by the University of Galway, in partnership with SLU, Wageningen

University and Research, the University of Hohenheim, IITA, CIMMYT and ILRI. The project supports the scaling of legume crops, including soybean, to improve sustainability, nutrition and livelihood resilience among smallholder farmers in Ethiopia, Tanzania, Zambia and Malawi (LEG4DEV, 2024).

This thesis is supervised through SLU, one of the LEG4DEV partner institutions. During fieldwork in Central Malawi, the author was attached to IITA at Chitedze station in Lilongwe. This attachment helped with introductions to extension officers, NGOs and processors, as well as fieldwork logistics in Kasungu, Mchinji and Lilongwe. It also shaped the position of the study. Since LEG4DEV supports legume scaling in Central Malawi, the thesis was written from within a project that has an interest in the topic. For this reason, the analysis needed to remain independent and critical. Chapter 3 discusses the methodological and ethical implications of this position.

1.1.2 Smallholder Agriculture and Climate Vulnerability in Sub-Saharan Africa

Smallholder agriculture remains important for food production and rural livelihoods in Sub-Saharan Africa (Giller et al., 2021; Hazell et al., 2010). However, many farmers still face constraints that limit intensification and adaptation. These include declining soil fertility, fragmented markets, limited access to inputs, and exposure to climate variability. In Malawi, these challenges are especially serious and well documented. Continuous maize monoculture has depleted soil fertility over several decades (Snapp et al., 2002). The Farm Input Subsidy Programme (FISP) has also reinforced the dominance of maize rather than supporting wider crop diversification (Sheahan and Barrett, 2017). At the same time, poor infrastructure and weak local markets continue to limit market integration (Jayne et al., 2014; Tufa et al., 2019). Together, these structural conditions form the regime-level context in which soy-maize innovation takes place.

These structural constraints are made worse by an increasingly unstable climate. Malawi has one main rainy season, from November to April, but rainfall varies greatly from year to year. This variation is linked to ENSO patterns and changes in Indian Ocean sea-surface temperatures (Jury and Mwafulirwa, 2002; Ngongondo et al., 2011). Both scientific records and farmers' own experiences point to rising temperatures, more frequent droughts, and less predictable rainfall (Zulu, 2017). El Niño events have also contributed to serious food crises. Following the 2015-16 El Niño, sharply reduced harvests left about 6.5 million people, roughly a third of the population, unable to meet their food needs (MVAC, 2016). The 2023/24 El Niño season continued this pattern. The projected food insecurity noted in Section 1.1,

classified as Integrated Food Security Phase Classification (IPC) Phase 3 (Crisis) conditions or worse for the October 2024 to March 2025 lean season, affected 19 of Malawi's 28 districts and all four major cities (IPC, 2024, pp. 1, 7).

In the Central Region districts of Kasungu, Mchinji, and Lilongwe, these climate patterns are seen through large differences in rainfall between seasons and more frequent mid-season dry spells during important stages of crop growth. Many smallholder farmers also have limited access to risk-management tools such as crop insurance, savings, and irrigation (Morton, 2007). As a result, climate shocks increase vulnerability over time, especially because farmers' ability to adapt depends on their livelihood assets, institutional support, and access to markets (Zulu, 2017).

Household-level evidence shows how serious these impacts can be. McCarthy et al. (2021), using panel data from the 2014/15 floods and the 2015/16 El Niño drought, found that drought reduced maize yields by 32–34% and crop production value per hectare by 42–44%. Flooding had even stronger effects, reducing maize yields by 54% and production value by 58%. Among the land management practices studied, only legume cropping offered significant protection under both drought and flooding. It reduced drought-related yield losses to 14–18% and removed yield losses entirely under flooding. However, adoption of legume cropping declined during the study period. Wealthier farmers with larger plots were more likely to adopt protective practices, while experiencing drought or flooding did not, by itself, lead affected households to adopt them. For this study, these findings show that the farmers most exposed to climate pressures are not always the ones adopting innovations that could protect them. This is the kind of unequal access and adoption pattern that the SLF helps to explain.

The link between climate variability and farmers' decisions is not simple. Coughlan de Perez et al. (2024) found that, in parts of Southern Africa, farmers often respond to El Niño conditions by reducing investment in farming rather than by changing to other crops. This challenges the assumption that climate stress automatically encourages farmers to diversify into legumes. In Malawi, the 2023/24 El Niño season led to a disaster declaration in 23 of the country's 28 districts (OCHA, 2024). This shows that climate variability is not just a background pressure. It actively shapes household decisions, market conditions, and institutional responses.

Within this context, soybean has become important in maize-based farming systems because it can fix nitrogen in the soil, diversify household income, and improve dietary protein (Vanlauwe et al., 2019; Tufa et al., 2019). However, soybean yields on smallholder farms in Malawi remain far below their potential (Van Vugt et al.,

2016). The benefits of soybean depend on farmers' access to improved varieties, good agronomic practices such as rhizobia inoculation, effective extension services, and reliable markets (Tufa et al., 2019). Farmer-participatory research also shows that outcomes vary widely. Doubled-up legume-maize systems can improve soil fertility and productivity, but their performance differs across farms depending on soil conditions, rainfall, and management practices (Smith et al., 2016; Tufa et al., 2019). This variation shows the need for an analytical approach that can explain how both structural and household-level factors shape the outcomes of the same agricultural technology.

1.1.3 Study Area

This study is in Central Malawi. Malawi is a landlocked country in southeastern Africa where agriculture remains central to the economy and rural livelihoods, employing over 80% of the population (World Bank, 2024). Smallholder farmers dominate the agricultural system and produce much of the country's food under mainly rainfed conditions, while a smaller estate subsector produces export crops such as tobacco, tea and sugar (Jayne et al., 2014). Agricultural extension is organised through eight Agricultural Development Divisions (ADDs), which cover different ecological zones across the country (Ministry of Agriculture, 2024).

Fieldwork was conducted across three districts, Kasungu, Mchinji and Lilongwe, located within the Kasungu and Lilongwe Agricultural Development Divisions (ADDs).

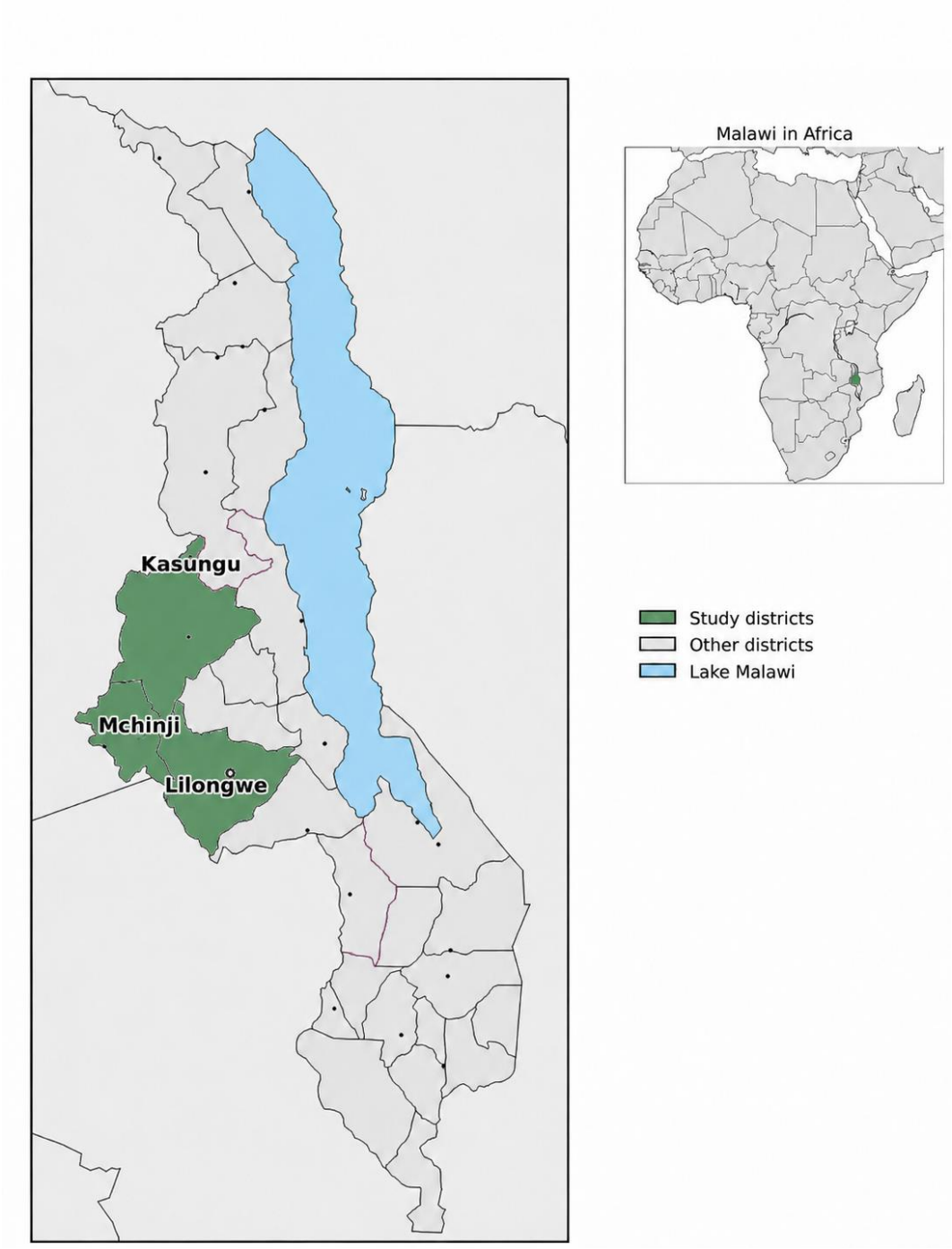

Figure 1. Study area map showing Kasungu, Mchinji and Lilongwe Districts in Central Malawi. (Map prepared by the author using Malawi district boundaries)

These districts were selected because they form part of Malawi's main soybean-producing belt and capture different positions within the soy-maize system. Kasungu provides insight into a major agricultural area where maize, tobacco, groundnuts and soybean are important crops. Mchinji provides insight into soybean promotion, structured market-access interventions and cross-border trade

dynamics. Lilongwe is important because of its institutional, research and market role, including Chitedze Research Station and major soybean market outlets (Tufa et al., 2019; Nzima and Dzanja, 2015).

1.2 Problem Statement

The literature on soy-maize cropping in southern Africa has examined adoption in detail, but it often treats sustainability as an expected outcome of adoption (Tufa et al., 2019; Thierfelder et al., 2017). In Malawi, soy-maize has often been promoted through climate-smart agriculture, but this framing can merge two different questions. The first is whether soy-maize is expanding as a crop system, supported by NGOs, research institutions, processors, value-chain actors and policy. The second is whether the same system improves livelihoods for smallholder households facing climate variability, unstable prices and labour constraints. These questions may lead to different answers. Soy-maize can expand through organisations' support while still creating or exposing risks within the households that adopt it.

This study therefore distinguishes between two meanings of sustainability. The first is regime-level expansion: whether soy-maize is growing as a value chain and institutional project in Central Malawi. The second, and the main concern of this thesis, is household-level sustainability: whether growing soy-maize supports smallholder livelihoods over time. This thesis examines household-level sustainability through three dimensions: social, economic and environmental. These are assessed through evidence on income, food security, assets, labour, group participation, soil and crop management, and farmers' ability to cope with climate and disease shocks. In this sense, sustainability is not simply about whether farmers continue planting soybean. A household may keep growing a crop while still losing income, labour capacity, food security or soil benefits. The thesis therefore treats sustainability as a question to be examined, not as an automatic result of adoption.

The study addresses this problem by combining two analytical frameworks. The Multi-Level Perspective (MLP) examines the wider conditions shaping soy-maize expansion, including organisations, markets, policies and promotion efforts, while the Sustainable Livelihoods Framework (SLF), informed by Scoones (2009, 2015) and Natarajan et al. (2022), examines whether soy-maize supports household livelihoods and how access and inequality shape who benefits. The rationale for combining the frameworks is developed in Chapters 2 and 3, and Chapter 5 brings them into dialogue with the findings.

1.3 Research Questions

The study is built around one main question, addressed through two sub-questions. The main question is: Under what conditions does soy-maize cropping move from being adopted to supporting sustainable smallholder livelihoods in Central Malawi? This question links the two parts of the study. The first part asks why farmers take up soy-maize cropping. The second part asks whether the practice supports sustainable livelihoods once they do. The study treats these as two sides of one process, because the same conditions that drive adoption also shape whether adoption improves livelihoods over time. The two sub-questions below address each part in turn, and the discussion chapter brings them back together.

RQ1. What is driving the adoption of soy-maize cropping among smallholder farmers in Central Malawi?

RQ2. Is the soy-maize cropping innovation socially, environmentally, and economically sustainable, as perceived by different actors, in contexts characterised by climate variability, including drought and high rainfall events?

This study has a clear and limited focus. It examines the social and institutional reasons why smallholder farmers in Central Malawi grow soybean alongside maize, and how farmers and stakeholders perceive its sustainability under climate variability. It is not an agronomic study, does not test soybean varieties, run field trials, or measure yields. The study reports how farmers and stakeholders understand soy-maize cropping, rather than measuring its biophysical performance.

1.4 Objectives

The study has three objectives:
1. To identify the key actors, organisations, markets and learning networks shaping the spread of soy-maize cropping in Kasungu, Mchinji and Lilongwe.
2. To examine why smallholder farmers adopt soy-maize cropping, and the conditions under which they continue, change or stop the practice.
3. To assess how farmers and stakeholders perceive the social, economic and environmental sustainability of soy-maize under climate variability.

1.5 Structure of the Thesis

The thesis is organised in six chapters. Chapter 1 introduces the study and its background, including the LEG4DEV project, smallholder agriculture and climate vulnerability, and the study area, before setting out the research problem, questions and objectives. Chapter 2 presents the theoretical background, covering the Multi-

Level Perspective and the Sustainable Livelihoods Framework and their integration. Chapter 3 presents the conceptual framework and methodology, including the research design, site selection, interview design, sampling strategy, data analysis and ethical issues linked to conducting research within LEG4DEV. Chapter 4 presents the results for both research questions, drawing on interview data from the three study districts and the FIES survey. Chapter 5 discusses the findings, develops the interpretation of soy-maize as a reconfiguration pathway, identifies the reinvestment cycle, and uses the SLF to explain uneven household outcomes. Chapter 6 concludes by drawing the arguments together and outlining implications for policy, practice and further research.

2. Theoretical Background

2.1 The Multi-Level Perspective and Socio-Technical Transitions

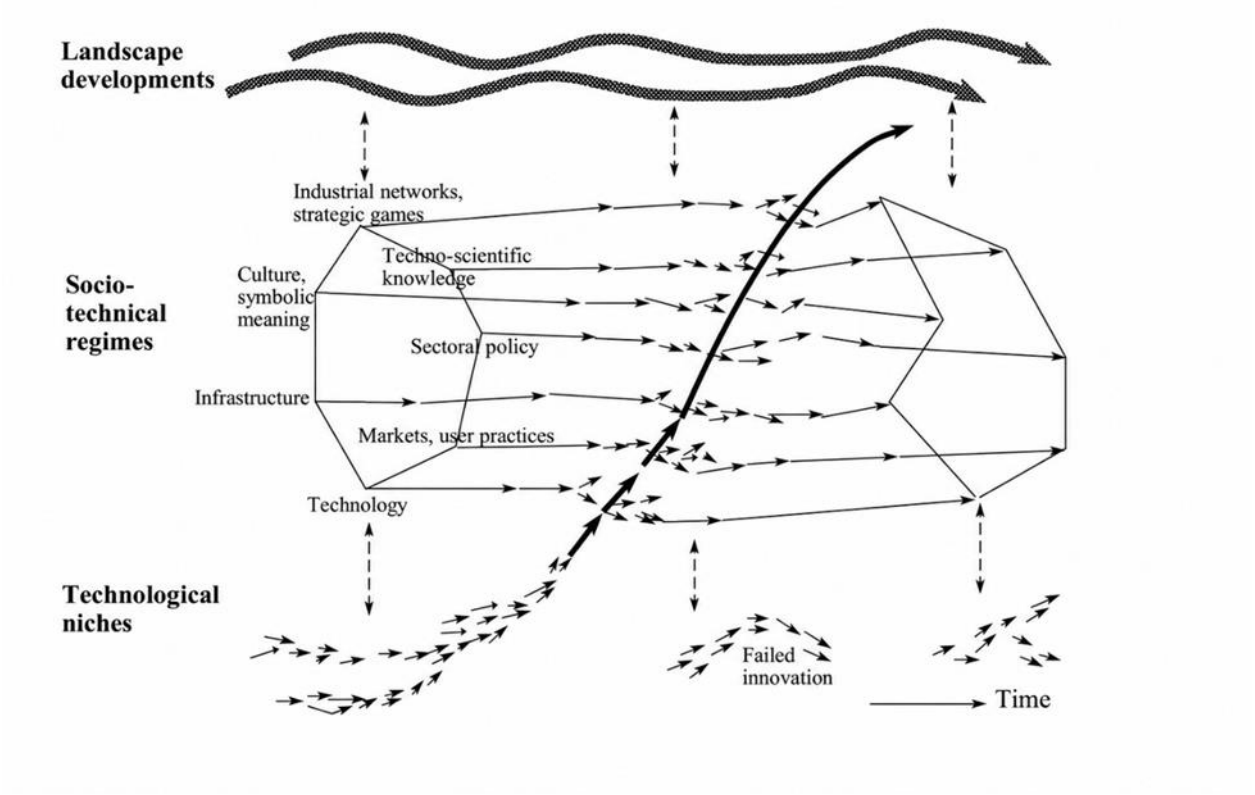

Figure 2. A dynamic multi-level perspective on technological transitions. Source: Geels (2002, p. 1263)

The MLP explains technological change through three connected levels: the landscape, the regime, and the niche. In this study, the landscape refers to wider socio-political and economic pressures such as development agendas and demand for soy, while biophysical climate variability is treated through the SLF vulnerability context. The regime refers to the dominant agricultural system, including FISP, maize-based farming, and extension services. The niche refers to newer spaces where soy-maize is being promoted, including programmes linked to IITA and NASFAM. Change becomes possible when these niche efforts respond to weaknesses in the existing system and to wider pressures such as climate stress or market demand.

2.1.1 Transition Pathways

Geels and Schot (2007, pp. 406–411) identify four transition pathways based on the interaction between landscape pressure, regime stability, and niche development. Transformation occurs when landscape pressure pushes the regime to adjust without strong niche alternatives. Reconfiguration occurs when niche innovations are gradually taken into the regime. De-alignment and re-alignment occur when regime breakdown creates competition among several niche alternatives. Substitution occurs when a mature niche replaces a weakened regime.

A key question is whether soy-maize integration in Malawi shows gradual regime adjustment, reconfiguration, or continued niche marginality. Although soybean adoption is growing, it has not fundamentally changed the institutions and markets that continue to support maize dominance (Tufa et al., 2019). Uptake also remains incomplete: while 56% of producers in the main growing districts planted an improved variety, only 32% combined it with the recommended double-row spacing (Tufa et al., 2021, pp. 4, 11). This suggests partial integration at most. The empirical analysis examines these early interpretations through the views of different actors within the system.

2.1.2 Applications to Agri-Food Systems and Critiques

The MLP has been widely used to study agri-food transitions, including organic farming, conservation agriculture, and alternative food networks (El Bilali, 2019). However, its use in smallholder farming contexts in the Global South remains limited. Elsner, Herzig and Strassner (2023), in a review of 58 articles published between 2018 and 2022, found that MLP agri-food research is still mainly focused on Europe. They also found that regime and landscape levels are often weakly explained. This is a major limitation in contexts where institutional weakness, donor dependence, and climate vulnerability strongly shape agricultural change. The few African applications of the MLP, including conservation agriculture in Uganda (Kaweesa, El Bilali and Loiskandl, 2020), agroecological transition in Senegal (Boillat, Belmin and Bottazzi, 2021), and cocoa agroforestry in West Africa (Kouakou et al., 2025), show that niches in these settings are often donor-supported, regimes are less stable, and landscape pressures are shaped by commodity prices and climate shocks rather than gradual policy change. To date, limited attention has been given to applying the MLP to legume-based intensification or soy-maize integration in eastern or southern Africa.

Three critiques of the MLP are important in the Malawian context. First, the niche concept assumes a degree of institutional stability that may not exist in donor-funded and project-dependent innovation systems. In Malawi, the soybean promotion niche is fragile and may weaken when project cycles end, as shown in

studies of climate-smart agriculture disadoption in Chikwawa (Khoza, van Niekerk and Nemakonde, 2022). Second, the MLP can underplay farmer-led innovation by treating innovation as something that mainly happens in organised and externally supported spaces. This matters because Malawian farmers have long managed complex legume-cereal systems before donor-supported soybean promotion (Snapp et al., 2002; Richards, 1985; Sumberg, 2005). Third, the regime concept assumes a more consolidated institutional system than may exist in Malawi. Maize dominance is reproduced through farming history, food preferences, and politically contested subsidy programmes rather than through one stable and coherent regime (Chinsinga, 2012; Chirwa and Dorward, 2013). This study therefore uses the MLP as a guiding analytical tool but combines it with the SLF to add a distributional lens. It also foregrounds actor perceptions through semi-structured interviews and includes both adopters and non-adopters to examine the limits of niche development.

2.2 The Sustainable Livelihoods Framework

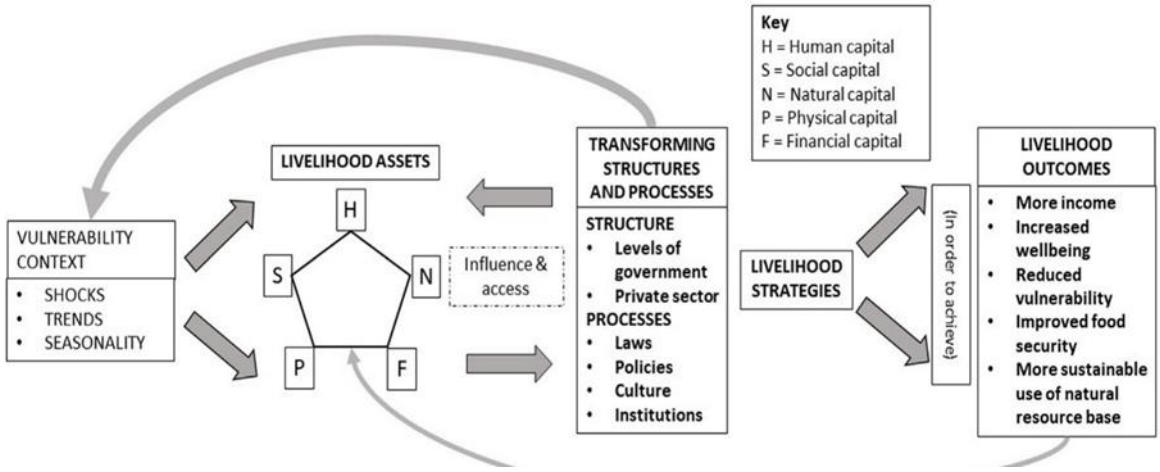

Figure 3. The Sustainable Livelihoods Framework. Source: Natarajan et al. (2022), adapted from DFID (1999)

The Sustainable Livelihoods Framework (SLF) is used as the secondary analytical lens in this study. Developed by DFID (1999) and informed by the work of Chambers and Conway (1991), the SLF explains household wellbeing through five livelihood assets: human, social, natural, physical, and financial capital. These assets interact with the vulnerability context, transforming structures, and livelihood strategies to shape livelihood outcomes (Figure 3).

Its focus on household assets makes the SLF useful for examining how soy-maize adoption affects wellbeing. Its vulnerability context is also relevant because it helps capture the climate variability and seasonal stresses faced by smallholder farmers in Central Malawi. Natarajan et al. (2022) offer an important rethinking of the SLF that is relevant to this study. They argue that the original framework does not fully address the political economy of asset access, multi-scalar livelihood dynamics, or the temporal dimensions of sustainability. This updated approach is useful for this study because the research includes several types of actors, including researchers, NGO practitioners, private sector, and government officials. These actors understand viability not only at household level, but also at wider system levels.

In Malawi, access to soybean markets, inputs, and extension is shaped by gender, geography, and NGO programme relationships. These distributional dynamics are not fully captured by the original SLF, but they are important for understanding who benefits from soy-maize innovation and under what conditions.

2.3 Integrating the MLP and SLF

The SLF has been criticised for paying too little attention to power, politics, and historical context. It also tends to treat the household as the main unit of analysis, which can hide wider structural constraints (Natarajan et al., 2022). Used on its own, the SLF may therefore explain household vulnerability mainly in terms of weak assets, without asking enough questions about the wider conditions that create that vulnerability.

The SLF and MLP are used together because each framework covers a gap left by the other. The MLP explains how the soy-maize innovation has developed, which actors support it, and why it has spread unevenly across places and actor groups. The SLF then shows how these wider changes affect households differently, depending on their assets, gender, and position as adopters or non-adopters.

This division also matches the study's two research questions. RQ1, which asks what is driving soy-maize adoption in Central Malawi, is mainly addressed through the MLP. This helps examine actor relationships, institutional dynamics, and the pathways through which innovation is spreading. RQ2, which asks whether soy-maize is socially, environmentally, and economically sustainable under climate variability, is mainly addressed through the SLF. This helps examine how farmers, extension officers, NGOs, and private sector actors assess soy-maize in relation to livelihoods, resources, and institutional priorities.

Recent work also supports using both structural and actor-centred perspectives. Blesh et al. (2023) offer a framework showing diversification is enabled by network and institutional pathways. Their findings suggest that diversification can continue even where wider institutional reform is limited. This supports the use of the MLP to examine institutional pathways, alongside the SLF to examine how farmers and other actors use their assets and relationships in practice.

The two frameworks do more than complement each other. They also help identify tensions in the evidence. The MLP may show that soy-maize is expanding as an innovation, while the SLF may show that this expansion is weakening some livelihood assets. In other cases, the SLF may show positive household gains, while the MLP shows that these gains remain fragile because the innovation still depends on donor support rather than being fully embedded in the wider agricultural system. Reading the findings through both frameworks therefore helps this thesis examine where soy-maize strengthens livelihood sustainability, where it creates new pressures, and under what conditions adoption becomes durable rather than temporary.

3. Conceptual Framework and Methodology

This chapter presents the conceptual framework and methodology used in the study. It first explains the integrated analytical framework, which combines the Multi-Level Perspective (MLP) and the Sustainable Livelihoods Framework (SLF). Each framework helped address one of the two research questions, while their combined use supported the wider discussion. The chapter then describes the research design, site selection, sampling strategy, interview design, and data analysis process. It ends by reflecting on positionality and ethical considerations. Together, the analytical framework and methodological decisions provide a clear basis for studying soy-maize integration as a socio-technical transition in Central Malawi.

3.1 Conceptual Framework

3.1.1 Rationale for a Dual-Framework Approach

As argued in Chapter 2, no single framework can address both research questions. RQ1 requires a systemic lens that examines how wider pressures, dominant institutions, and emerging innovations interact to shape adoption. RQ2 requires an actor-centred lens that captures how sustainability is perceived by different stakeholder groups, and how livelihood capitals shape household responses to climate stress and institutional change. The MLP (Geels, 2002; Geels and Schot, 2007) addresses the first, and the updated SLF (Natarajan et al., 2022) the second. The sections below set out how each framework was operationalised for this case.

3.1.2 The Multi-Level Perspective: Analytical Application

In this study, the MLP is used as a framework that provides a guiding lens rather than a fixed model (Geels, 2019). As argued in Chapter 2, the concepts of niche, regime and landscape need to be adapted to the Malawian context. The soybean promotion niche is treated as fragile and dependent on donor and project support, while the maize-dominated regime is understood as a loose mix of farming practices, subsidy politics and cultural norms. The MLP structures the analysis of RQ1 across three levels: landscape pressures such as development agendas and commodity dynamics; regime structures such as input subsidies, extension mandates and norms around maize; and niche dynamics such as NGO programmes, farmer networks, IITA projects and private sector actors. In Geels' framework the landscape refers to macro-level social, political and economic conditions rather than biophysical factors, so climate variability is treated here as part of the SLF vulnerability context rather than as an MLP landscape pressure. The transition

pathway typology developed by Geels and Schot (2007) is then used to describe the direction of soy-maize integration.

3.1.3 The Sustainable Livelihoods Framework: Analytical Application

The updated SLF (Natarajan et al., 2022) structures the RQ2 analysis through two linked lenses. At the household level, the five livelihood capitals, human, social, natural, physical, and financial, provide a way to examine how soy-maize adoption interacts with the resources available to farming households. They also help show how climate shocks and institutional conditions can strengthen or weaken these capitals. The vulnerability context in the SLF treats climate variability as part of the wider environmental conditions that shape livelihood outcomes.

At the multi-actor level, the updated SLF's attention to scale and power (Natarajan et al., 2022) supports an analysis of how extension officers, NGO staff, and private sector understand sustainability. Drawing on Beus and Dunlap's (1990) work on competing views of agricultural sustainability and Bebbington's (1999) work on NGO project-cycle accountability, the study treats sustainability not as a fixed technical outcome, but as a concept whose meaning differs across actor groups. Identifying and comparing these different framings is a central empirical aim of RQ2.

3.1.4 Integrating the Frameworks

The two frameworks are applied to one integrated set of analytical categories so that they inform a single analysis rather than developing separately. The interviews were designed to capture information relevant to both the MLP and the SLF, and the way the two frameworks are brought into dialogue is described in the discussion chapter.

For this case, the MLP categories were defined in relation to the Malawian soy-maize system. Landscape pressures included climate variability, donor and development agendas, and global commodity dynamics. The maize-dominated regime was understood through FISP subsidies, nsima[1] as a cultural staple, extension priorities around maize, and input markets organised around maize hybrids. The niche consisted of soybean and soy-maize integration efforts supported by NGOs, IITA programmes, farmer networks, and private buyers. The

[1] Nsima is a stiff porridge made from maize flour, consumed as the dietary staple across Malawi and much of southern and central Africa. It forms the basis of most meals and carries significant cultural and food security significance (Jayne et al., 2010).

SLF was extended using Natarajan et al.'s (2022) politically aware update, which treats power relations, institutional contestation, and processes across different scales as central to livelihood analysis.

The five capital assets were examined through interview questions on crop income, household spending, asset ownership, infrastructure access, training, knowledge, social networks, farmer-to-farmer learning, climate, and land use. The Food Insecurity Experience Scale (FAO, 2014) captured the vulnerability dimension by allowing standardised comparison across households.

3.2 Research Design

This study used a qualitative case study design (Yin, 2018). The adoption and sustainability of soy-maize systems in Central Malawi are shaped by specific institutional histories, market structures, and environmental conditions that cannot be captured through survey instruments alone. A qualitative approach also suited the study's interest in how different actors perceive, interpret, and construct the sustainability of soy-maize systems. These are questions of meaning that require detailed engagement rather than standardised measurement.

The study drew on critical realism and interpretivism (Sayer, 2000). It treats social and material structures as real, while recognising that they are understood through the perspectives of the people who experience them. In this study, socio-technical structures and livelihood conditions were treated as real processes. Soil fertility decline, subsidy allocation, and drought are material realities that shape agricultural practice. However, they were accessed through the situated accounts of farmers, extension officers, NGO staff, researchers, and private sector actors. The analytical task was therefore to interpret the soy-maize transition by comparing these accounts with one another and with secondary data. Geels (2011) argues that the MLP can work as a middle-range theory across different ontological traditions. This study therefore treats MLP structural dynamics as real, while studying them through interpretive methods.

The study did not seek to establish causal relationships between variables. Instead, it pursued analytical generalisation (Yin, 2018), developing theoretical insights about socio-technical transition dynamics and sustainability framings in smallholder farming contexts. These insights may inform understanding beyond the specific Malawian case, although they are not intended as statistically generalisable findings.

Semi-structured interviews were the main data collection method. These were supported by the Food Insecurity Experience Scale (FIES; FAO, 2014), which was

administered during farmer interviews. Secondary data, including district-level agricultural statistics, Government of Malawi APES Round 3 estimates, NGO programme reports, and rainfall variability records, provided contextual grounding and helped triangulate the interview findings.

3.3 Site Selection

Fieldwork was conducted in three districts in Malawi's Central Region: Kasungu, Mchinji, and Lilongwe. These sites were confirmed in consultation with IITA. According to Agricultural Production Estimates Survey (APES) Round 3 estimates, the Kasungu and Lilongwe Agricultural Development Divisions (ADDs) together accounted for about 78% of national soybean production in both 2022–23 and 2023–24 (Government of Malawi, 2023, 2024).

These districts were selected because they offered suitable conditions for examining soy-maize integration as a socio-technical niche. As major soybean production areas, they are also where niche-building activities have been most visible. NGO programmes, IITA research and demonstration activities, private buyer networks, and farmer cooperatives have all been active in this region over the past decade. This made the institutional, market, and knowledge structures supporting soy-maize integration easier to observe. The study could therefore examine niche dynamics where they are more developed, rather than only at the margins of the innovation system. Mchinji was included alongside Kasungu and Lilongwe to capture variation within the Central Region, including a district with lower production but active promotion activity. This allowed the study to compare different adoption trajectories.

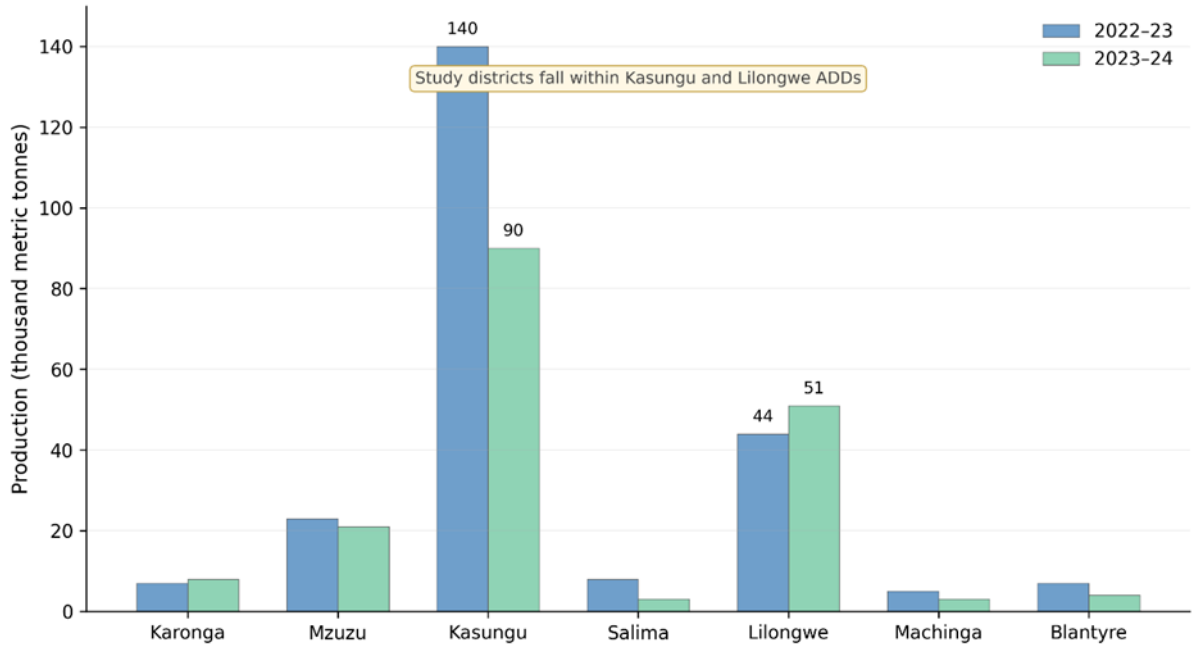

Figure 4. Soybean production by Agriculture Development Division (thousand MT), 2022-23 and 2023-24. Source: Government of Malawi APES Round 3 (2023,2024)

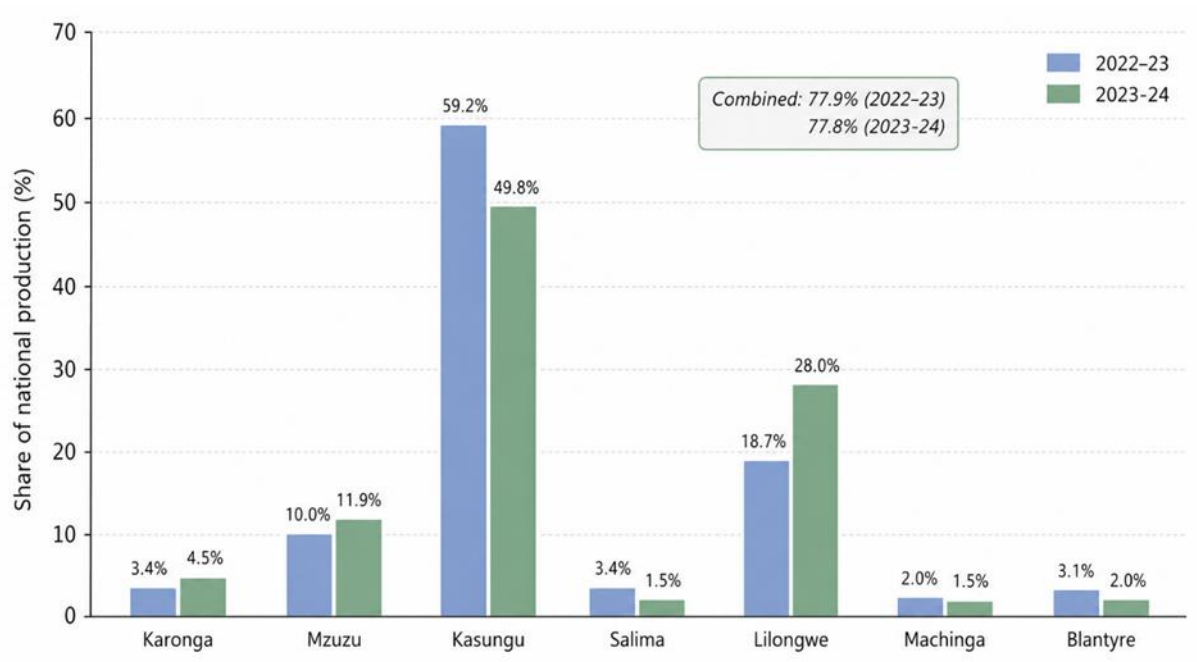

Figure 5. Share of national soybean production by ADD (%), 2022-23 and 2023-24. Source: Government of Malawi APES Round 3 (2023, 2024)

The three study districts were selected because they provide variation in rainfall, altitude and institutional context within Central Malawi. Kasungu represents the relatively drier end of the study area. District climate records report normal annual rainfall of about 720 mm, with recent seasonal totals ranging from about 573 mm to 897 mm, and altitude ranging from about 800 to 1,451 m above sea level. This makes Kasungu important for examining soy-maize adoption under more drought-exposed dryland farming conditions, where rainfall may fall close to or below the level generally considered unreliable for rainfed crop production. Mchinji provides an intermediate case, with annual rainfall generally reported between 750 and 1,000 mm and altitude around 1,200 to 1,829 m above sea level. Lilongwe represents a relatively higher-rainfall and more institutionally connected setting, with mean annual rainfall of about 800 to 1,000 mm and altitude mainly around 1,000 to 1,400 m above sea level. Since most rainfall in Malawi falls during the November to April growing season, these differences are directly relevant to the study's focus on climate variability and rainfed crop production. Together, the three districts allow the study to compare how farmers use soybean within maize-centred systems under lower, medium and relatively higher rainfall conditions. Lilongwe also offered access to research institutions, NGOs and private sector actors based in or near the capital region, including Chitedze Research Station, NASFAM and seed-sector actors, which supported the regime-level analysis under RQ1.

3.4 Interview Design

3.4.1 Guide A: Farmer Interviews

Guide A was designed for both adopter and non-adopter farmers and was organised into eight sections. Sections 1 to 6 were qualitative and audio recorded. They covered background and farming context, awareness and experience with soybean, drivers and barriers to adoption, farming practices and changes, climate variability and resilience, and farmers' practical understanding of sustainability. Section 7 administered the Food Insecurity Experience Scale, discussed in Section 3.5. Section 8 closed the interview with two open questions: one asking farmers about the main opportunities and risks they saw for soy-maize cropping in their area, and a final question inviting them to raise anything not already covered.

The questions were intentionally open-ended. Probes were used as flexible prompts rather than fixed follow-up questions. The questions were also aligned with the MLP dimensions of landscape pressures, regime constraints, and niche dynamics, as well as the SLF capital categories. This ensured that the interview data could support both analytical frameworks. Interviews were conducted in Chichewa where

needed, with support from two trained enumerators, Iness Gondwe and Richard Nyoni, and lasted up to 60 minutes.

3.4.2 Guide B: Stakeholder Interviews

Guide B was designed for institutional stakeholders and was organised into six sections. These covered role and experience, adoption dynamics, actors, institutions and power relations, climate pressures and system response, livelihood and social impacts, and sustainability as system viability. Differences in how actors responded to the sustainability questions provided important data for the RQ2 analysis of institutional sustainability framings. Stakeholder interviews lasted up to 60 minutes and were conducted in English.

3.4.3 Instrument Piloting and Revision

The interview instrument was piloted during the first five farmer interviews in Lilongwe district, during the initial fieldwork engagement at the Madzumbi Processing Unit. The pilot phase revealed two issues with the original instrument. First, several questions in Section 1, Background and Farming Context, produced responses about farming in general, especially maize and tobacco, rather than the soy-maize system specifically. As a result, the soy-maize dimension was underdeveloped in the early transcripts. Second, probes in later sections were too broad to generate enough comparable material across adopter and non-adopter accounts.

In response, the Section 1 questions were revised to focus more clearly on soybean and soy-maize practices. General farming background was retained only as brief context rather than as a main line of enquiry. Probes in Sections 2 to 5 were also tightened around specific varieties, seasons, market relationships, and climate events. The revised instrument was used for the remainder of fieldwork in Lilongwe, Mchinji, and Kasungu. The five pilot interviews were retained in the final sample of thirty farmer participants. For these participants, the soy-maize-specific material was drawn mainly from Section 2 onward, which was less affected by the revision.

3.5 Structured Livelihood Component

A structured livelihood component was administered as Section 7 of Guide A during all farmer interviews. This component used the Food Insecurity Experience Scale (FIES), an eight-item experience-based measure that captures the severity of

food insecurity experienced over the previous 12 months (FAO, 2014). It was administered in a bilingual Chichewa and English form, using the Chichewa wording developed through FAO's linguistic adaptation of the FIES in Malawi (FAO, 2013). For households with children under five, two additional child-referenced items were recorded; following FAO guidance, these items were used only to help interpret household food insecurity and were not included in the FIES score (Ballard et al., 2013). Each farmer's responses were summed into a raw score from 0 to 8 and grouped, for descriptive purposes, into four bands: food secure (0), mild (1-3), moderate (4-6) and severe food insecurity (7-8). This raw-score banding was applied only for within-sample comparison and does not correspond to FAO's Rasch-based estimation method.

The FIES provided a structured livelihood snapshot that complemented the qualitative data gathered in Sections 1 to 6. It was not a full survey and was not intended to produce statistically representative estimates. Its purpose was to place farmers' livelihood narratives in context and allow descriptive comparison across households. Other livelihood dimensions, including crop income, asset ownership, dietary patterns, and perceived livelihood change, were captured qualitatively through the narrative sections of Guide A.

Livelihood questions were asked sensitively. Farmers were not required to disclose exact income figures, and they were reassured that all responses were confidential and would not affect their access to extension services or NGO support.

3.6 Sampling Strategy

Thirty semi-structured farmer interviews (22 adopters and 8 non-adopters) and 14 institutional stakeholder interviews were conducted across the three districts using purposive sampling. Purposive sampling was appropriate for this study because the research questions required engagement with actors who occupy specific positions within the soy-maize socio-technical system, including farmers, extension officers, NGO practitioners, private sector actors, and agricultural researchers, whose knowledge and perspectives are relevant by virtue of their institutional roles rather than their statistical representativeness (Patton, 2015). The sample was designed to capture the main actor categories relevant to MLP analysis, especially niche and regime actors, while broader landscape pressures were examined through interviews and secondary data.

Throughout this thesis, participants are referred to by anonymised codes rather than names. Farmer codes combine a district prefix (KA for Kasungu, LIL for Lilongwe, MCH for Mchinji), an adoption marker (FA for adopter, NA for non-

adopter), and a sequential number assigned within the district; for example, KA-FA-06 is an adopter in Kasungu. Stakeholders are coded by actor category: EXT for extension officers, NGO for NGO practitioners, PRIV for private sector actors, and RES for researchers. A full list of participants is provided in Appendix 4.

Table 1. Purposive Sampling Frame

Actor Category	Rationale for Inclusion	Achieved N	Interview Guide
Smallholder farmers (adopters)	Core informants for RQ1 and RQ2; provided first-hand accounts of adoption drivers, agronomic practices, livelihood impacts, and climate coping strategies.	22	Guide A
Smallholder farmers (non-adopters)	Essential for identifying barriers to adoption and the limits of niche development; enabled comparison with adopter narratives.	8	Guide A
Agricultural extension officers	Regime-level actors who mediate between institutional mandates and farmer practice; provided insight into technology dissemination and adoption dynamics. In Malawi, extension officers are employed by the Department of Agricultural Extension Services within the Ministry of Agriculture and constituted the government-affiliated actor category in this study.	7	Guide B
NGO practitioners	Niche-creating actors whose programmes have structured soybean promotion; revealed institutional sustainability framings and programme limitations.	2	Guide B
Private sector actors	Input suppliers, aggregators, and contract farming intermediaries (including Afriseed, Paramount Commodities); illuminated market	3	Guide B

	integration dynamics critical to bundle coherence.		
Agricultural researchers / policy informants	Provided evidence-based perspectives on transition dynamics and sustainability; triangulated actor accounts with technical knowledge.	2	Guide B

Initial participants were identified through IITA's extension networks and NGO contacts in the study districts. Snowball referrals were then used to reach additional farmers and actors who were not directly accessible through institutional gatekeepers. This was especially important for reaching non-adopters, who were less visible within NGO programme networks.

The final sample size was guided by thematic saturation and information power, rather than by a fixed number of participants (Malterud et al., 2015; Braun and Clarke, 2021). Information power was relevant because the study had a focused aim, theoretically specific questions, and in-depth interview data. Analytical memos were written after interviews to record whether new substantive codes were emerging or whether the existing coding framework was sufficiently capturing the data. Among adopters, new substantive codes became less frequent after around the eighteenth interview, and later interviews mainly refined and confirmed existing themes.

Non-adopters were included deliberately because their perspectives were important for understanding the boundaries of niche development (Geels, 2011). However, recruiting non-adopters was more difficult. The final eight non-adopter interviews therefore represent the limit of accessible participants reached through institutional and snowball channels, rather than a full saturation point. Findings on non-adoption are therefore treated as indicative rather than fully saturated.

An asymmetry in the sampling design also needs to be acknowledged. Farmer interviews provided enough depth for thematic analysis, while the institutional interviews provided perspectives from relevant actor categories rather than group-level representativeness. Agricultural extension officers, employed through the Department of Agricultural Extension Services in the Ministry of Agriculture, formed the government-affiliated actor category accessed in this study. Higher-level policy actors at ministry and central government level were not directly accessible during fieldwork. Their perspectives were therefore approached indirectly through extension officer accounts, APES reports, ministry statistics, and published policy documents.

For the fourteen institutional stakeholder interviews, data sufficiency was assessed through actor coverage rather than saturation in the conventional sense. The aim was to ensure that each MLP-relevant actor category was represented by at least one informant whose account could be compared with other interviews and secondary data. This approach follows Braun and Clarke's (2021) caution that saturation should not be treated as a mechanical endpoint in reflexive thematic analysis. In this study, data sufficiency was treated as a researcher judgment based on the analytical richness of the interview material.

3.7 Data Analysis

3.7.1 Transcription and Preparation

All interviews were audio-recorded with participant consent. Recordings were transcribed verbatim. Chichewa-language interviews were translated and transcribed by the trained enumerators, and the researcher checked translation accuracy through back-translation where feasible. Transcription began during fieldwork where possible. This reduced the post-fieldwork workload and helped identify early themes that informed later interviews.

All transcripts were imported into Taguette, an open-source qualitative data analysis tool, for coding and data management. For a dataset of 44 transcripts, Taguette provided a clear and practical way to organise, code, and retrieve qualitative data.

3.7.2 Thematic Analysis

Qualitative data were analysed using thematic analysis, following Braun and Clarke's (2006, 2019) six-phase framework. The study used a hybrid approach that combined deductive and inductive coding. This was appropriate because the study was guided by theory, while also allowing new themes to emerge from the data. Naeem et al. (2023) argue that this kind of approach is useful in theory-informed qualitative research, where existing frameworks guide initial coding but do not close off new empirical insights.

The initial coding framework was drawn from the MLP and SLF categories shown in Table 2. These categories provided the first analytical entry points. Inductive codes were then added as new patterns appeared in the interviews. Reflexive engagement with the data remained central to the analysis. The MLP and SLF were therefore used as sensitising lenses rather than fixed classification grids. This made

it possible to be transparent about the study's theoretical starting points without claiming that the analysis was purely inductive.

The six phases of analysis, familiarisation, initial coding, theme searching, theme reviewing, theme defining, and report writing, were applied iteratively rather than in a strict linear sequence.

Table 2 presents the analytical framework. It links each research question to its main framework, coding approach, and key categories.

Table 2. Analytical Framework

Research Question	**Framework**	**Coding Approach**	**Key Analytical Categories**
RQ1: What is driving the adoption of soy-maize cropping in Central Malawi?	Multi-Level Perspective (Geels, 2002; Geels and Schot, 2007)	Deductive coding from MLP categories; inductive codes added iteratively	Landscape pressures (climate variability, donor agendas, market dynamics); regime structures (maize dominance, FISP, extension mandates); niche dynamics (NGO programmes, variety testing, actor alignment); transition pathway type (transformation, reconfiguration, substitution).
RQ2: Is the soy-maize cropping innovation socially, environmentally, and economically sustainable as perceived by different actors in contexts characterised by climate variability, including drought and high rainfall events?	Sustainable Livelihoods Framework (Natarajan et al., 2022)	Deductive coding from SLF capital categories; actor-group comparative analysis	Human capital (knowledge, skills, health); social capital (networks, farmer groups, trust); natural capital (soil fertility, water, land); physical capital (storage, tools, infrastructure); financial capital (income, savings, credit); vulnerability context (drought, flooding, market shocks); actor sustainability framings (farmer vs. NGO vs. state vs. market).
Integrative discussion	MLP + SLF in dialogue	Bridging questions; process-tracing memo;	Does niche support build SLF capital assets? Does regime inertia constrain adaptive capacity? How do landscape pressures interact with livelihood

		triangulation with secondary data	vulnerability? Where do actor sustainability framings converge or diverge?

3.7.3 Process-Tracing

Interpretive process-tracing was used to reconstruct the transition pathway of soy-maize integration in Central Malawi (Geels and Schot, 2007). While thematic analysis identified patterns across the data, process-tracing helped examine how the soybean niche emerged over time and interacted with the maize-dominated regime.

The process-tracing was interpretive rather than formal. It did not aim to establish strict causal conditions, but to build a plausible and evidence-based account of how the transition unfolded. This account drew on interview data, project histories, policy documents, and secondary sources.

A process-tracing memo was developed during analysis. It recorded key events, including IITA project phases, NASFAM market development, the formation of the Madzumbi Processing Unit, FISP reform, and the 2022/23 soybean rust outbreak in Kasungu. The memo also noted the evidence source for each event, compared different actor accounts, and assessed which Geels and Schot (2007) transition pathway the sequence most closely resembled.

Where interview accounts differed from secondary sources, these differences were noted rather than ignored. Such differences were useful because they showed how actors understood the same transition from different positions. The completed memo informed the RQ1 analysis by helping to connect interview accounts, secondary sources, and the Geels and Schot (2007) transition pathway typology.

3.7.4 Triangulation

Interview narratives were triangulated with secondary data to strengthen analytical credibility. These sources included Government of Malawi APES Round 3 reports, rainfall and climate records from the Malawi Meteorological Service, NGO programme reports from IITA and NASFAM, and published research on soy-maize systems in Malawi.

Triangulation was used for three purposes. First, it helped check factual claims made by participants, such as claims about programme reach, adoption levels, or price trends. Second, it placed individual accounts within wider agricultural, market, and climate dynamics. Third, it helped identify differences between actor

accounts and documented evidence. These differences were not treated only as errors, but also as useful evidence of how different actors understood the soy-maize system.

3.7.5 Trustworthiness and Research Quality

In qualitative research, trustworthiness is often assessed through credibility, transferability, dependability, and confirmability (Lincoln and Guba, 1985). Credibility was supported through triangulation across interview data, secondary sources, districts, and actor categories. It was also strengthened by attending to negative cases, including non-adopter accounts and perspectives that differed from dominant patterns.

Transferability was supported through detailed description of the study setting, institutional context, and sampling decisions, allowing readers to assess whether the findings may be relevant to similar contexts. Dependability was addressed through a clear record of the research process, including the codebook, analytical memos, process-tracing notes, and reflexive diary. Confirmability was supported through reflexive journaling and by setting out the analytical framework and bridging questions in advance, which helped reduce uncontrolled shifts in interpretation during analysis.

3.7.6 Sustainability Perceptions Analysis

Sustainability perceptions were analysed by comparing responses across actor groups. Drawing on The Sustainable Livelihoods Framework and on Beus and Dunlap (1990) and Bebbington (1999), the analysis examined how farmers, extension officers, NGO staff, private sector actors, and agricultural researchers understood the social, environmental, and economic sustainability of soy-maize systems.

The analysis focused on both shared and differing views. Shared views showed where actors had similar understandings of sustainability. Differences showed how sustainability framings varied according to institutional roles, market interests, or livelihood positions. The FIES results were used descriptively to place farmer livelihood narratives in context, rather than to produce statistical findings.

RQ2 focuses on whether soy-maize is sustainable as understood by different actors. The main concern is therefore perception: how farmers, extension officers, NGO staff, private-sector actors and researchers understand social, economic and environmental sustainability. These views are not analysed alone but they are

compared with reported evidence from the study, including income and sales accounts, FIES food-security scores, and experiences of rust and rainfall variability. This evidence is not used as a final measure of sustainability, since a single-season qualitative study cannot prove long-term outcomes. Instead, it helps ground actor perceptions and show where these perceptions match or differ from reported experience. The analysis therefore considers both what actors say about sustainability and what their accounts suggest about how soy-maize works in practice. These findings are treated as indicative rather than conclusive.

3.8 Positionality

The researcher is a Zimbabwean national enrolled at SLU. Fieldwork was conducted in Malawi under the institutional umbrella of IITA through the LEG4DEV project. These positions shaped the research process and required reflexive attention.

As a southern African researcher, the researcher had some familiarity with smallholder farming systems and climate variability in rain-dependent agricultural settings. This helped with rapport-building during fieldwork. At the same time, the researcher was not Malawian, and cultural and linguistic distance had to be managed carefully. This was addressed through collaboration with trained local enumerators and engagement with community gatekeepers.

The researcher's association with IITA also required reflection. Since IITA is involved in promoting soybean adoption in the study districts, some participants could have viewed the researcher as connected to soybean promotion rather than as an independent academic researcher. To address this, the researcher explained the academic purpose of the study during the consent process and made clear that critical views were welcome.

Gender dynamics were also considered. Where possible, women farmers were interviewed with support from a female enumerator. These positional issues were recorded in a reflexive diary throughout fieldwork.

3.9 Ethical Considerations

The study was conducted in accordance with the ethical requirements of SLU and IITA, with ethical approval obtained before fieldwork. Participation was voluntary, and informed consent was obtained using bilingual consent forms. Participants were told that they could withdraw at any time, and audio recording only began after

explicit consent was given. Participant identities were anonymised in data storage, analysis, and reporting, and data were handled in line with SLU data management policy.

The study also recognised that smallholder farmers in drought-exposed areas may face economic vulnerability. Livelihood questions were therefore asked carefully. Participants were not required to provide exact income figures, and no expectation of material benefit was created through participation.

A specific ethical issue concerned the researcher's association with IITA. Since IITA has supported soybean promotion in the study districts, some participants could have seen the researcher as linked to soybean promotion rather than as an independent academic researcher. This created a potential tension because the study examined both the benefits and limitations of soy-maize integration, including the fragility of donor-supported niches and the gap between institutional sustainability claims and farmer experiences.

This tension was addressed in three ways. First, the research questions and analytical framework were designed before fieldwork to examine both drivers and constraints of soy-maize adoption. Second, data analysis and writing were conducted under academic supervision, with IITA having no editorial control over the findings. Third, participants were informed during consent procedures that the study was an independent academic project, that participation was voluntary, and that their responses would remain confidential. They were also told that participation or non-participation would not affect their access to IITA-related services. These steps did not remove the tension completely, but they made it visible and managed it through clear ethical procedures.

3.10 Design Limitations

This study has four main limitations. First, the use of purposive sampling means that the sample is not statistically representative. The findings therefore cannot be generalised to all soybean-growing households in Central Malawi. Instead, the study pursues analytical rather than statistical generalisation (Yin, 2018).

Second, the Food Insecurity Experience Scale was administered to the same purposive sample of thirty farmers. It is therefore not used to estimate the prevalence of food insecurity in the wider population. Its purpose is to support descriptive comparison across households within the sample.

Third, initial recruitment through IITA's extension networks and NGO contacts may have created an access bias toward farmers already visible to formal promotion programmes. Snowball referrals were used to reach less visible farmers, including non-adopters. However, the eight non-adopter participants form a small sub-sample, so findings about non-adoption should be read as indicative rather than conclusive.

Fourth, fieldwork covered only one agricultural season. This limits what the study can say about year-to-year changes in rust pressure, rainfall, prices, and adoption persistence. A multi-season study would be better placed to examine these dynamics over time.

4. Results

This chapter presents results for the two research questions. RQ1 asks what drives adoption of soy-maize systems in Central Malawi. RQ2 asks whether the innovation is socially, environmentally and economically sustainable, as perceived by different actors under climate variability, including drought and high rainfall events.

4.1 Overview of district patterns

Table 3 summarises the main adoption patterns, strengths and constraints reported by farmers in each of the three districts.

Table 3. Summary of district-level patterns from the interviews

District	Main adoption pattern reported in the interviews	Main reported strengths	Main reported constraints
Lilongwe	Cooperative-linked soybean adoption	Value addition, collective marketing, processing, cooperative loans, business training and organised buyers	Climate risk, buyer dependence, machinery limits and unstable prices when farmers sell outside their groups
Mchinji	NASFAM-linked and farmer-network adoption, with soybean used for food, income and to buffer climate risk	Seed loans, training, demonstration plots, nutrition, school-fee support and diversification	Vendor dependence, price instability, seed shortages, disease, excessive rainfall and input-loan pressure

District	Main adoption pattern reported in the interviews	Main reported strengths	Main reported constraints
Kasungu	Mixed adoption through lead farmers, extension officers, SeedCo demonstrations and farmer experimentation	Strong knowledge of varieties and lead-farmer learning	Vendor dominance, rust disease, seed costs, weak structured markets, land scarcity and climate variability

Across the three study sites, soy-maize adoption took different forms. In Lilongwe, it centred on cooperatives, processing and value addition. In Mchinji, it centred on NASFAM support, seed loans and farmer networks. In Kasungu, it was more mixed, shaped by lead farmers, extension officers, SeedCo demonstrations and farmer experimentation.

4.2 Soybean adoption status across the sample

Figure 6 shows how the 30 farmer participants were distributed across adoption categories, from continuing adopters to non-adopters.

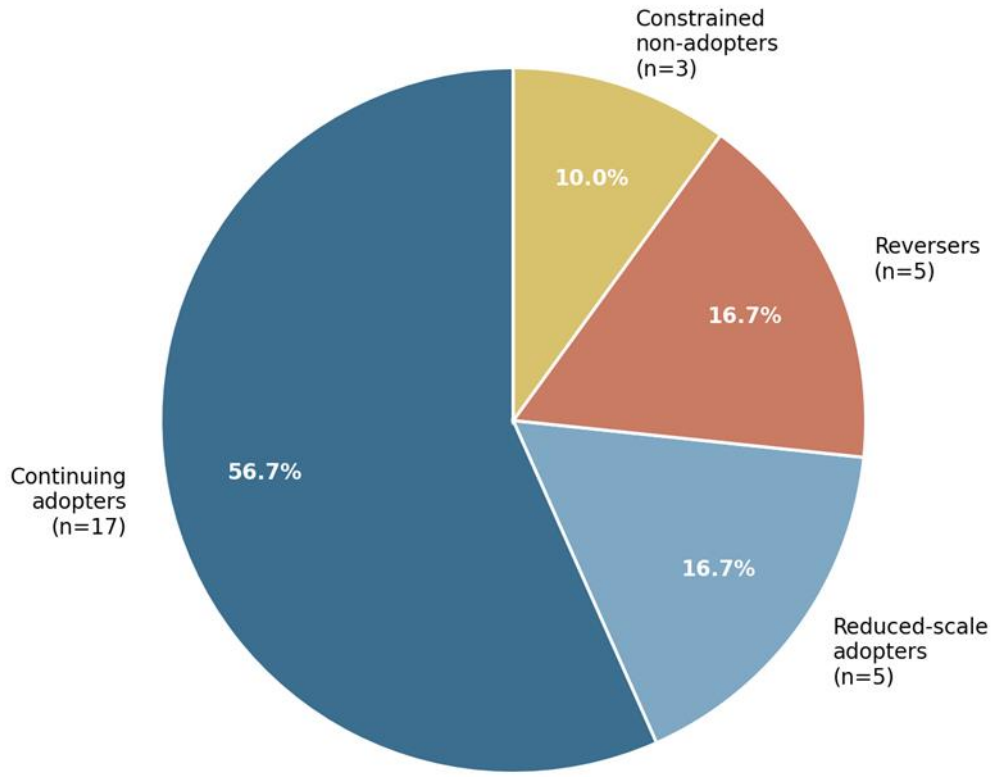

Figure 6. Soybean adoption status across the 30 farmer participants.

Seventeen were continuing adopters, growing soybean at a stable or expanding scale. Five were reduced-scale adopters, who still grew soybean but had cut back their area after the 2022/23 rust season. Five were reversers, who had stopped growing soybean altogether. The remaining three were constrained non-adopters, who had never grown soybean but wanted to. The first two groups together make up the 22 adopters in the sample, and the last two the 8 non-adopters.

4.3 Farmers' rationale for soy-maize cropping

Farmers explained their adoption of soy-maize systems mainly through the different roles the two crops play in the household and through the income soybean provides. These two linked rationales are presented in turn.

4.3.1 Maize for food security, soybean for cash and livelihood support

Farmers described maize and soybean as serving different but connected roles. Maize was mainly for household food, while soybean was mainly for cash, although soybean also contributed to food and nutrition. This pattern appeared across all three districts and among adopters farming at different scales (KA-FA-03, KA-FA-02, MCH-FA-07). LIL-FA-06 summarised this clearly:

"*Maize feeds the family, and soybean gives us money, but we need good markets and rains to succeed*." (LIL-FA-06).

The reference to "good markets and rains" introduces a theme that runs through the rest of the chapter. The cash value of soybean depended on conditions beyond the crop itself.

Soybean was not only a cash crop. Farmers also consumed it by milling it with maize to make porridge and cakes (KA-FA-02, MCH-FA-01):

"Part of the soybean is sold, and some is left for household consumption. We make porridge and cakes from soybean; soybean and maize are milled together." (KA-FA-02).

Even farmers who allocated more land to soybean than to maize still described maize as the more important crop because it provides nsima, the staple food (LIL-FA-03, LIL-FA-04). Soybean was valued for income, while maize was treated as indispensable for household food security. This pattern held regardless of how much land each crop received.

These accounts show that farmers were not replacing maize with soybean. Soybean was being added to a maize-centred farming system. Maize remained the main food-security crop, while soybean provided cash, supplementary food, and support for maize production and other household needs.

Figure 7 below summarises how farmers described soy-maize as a single household strategy rather than as two separate crops.

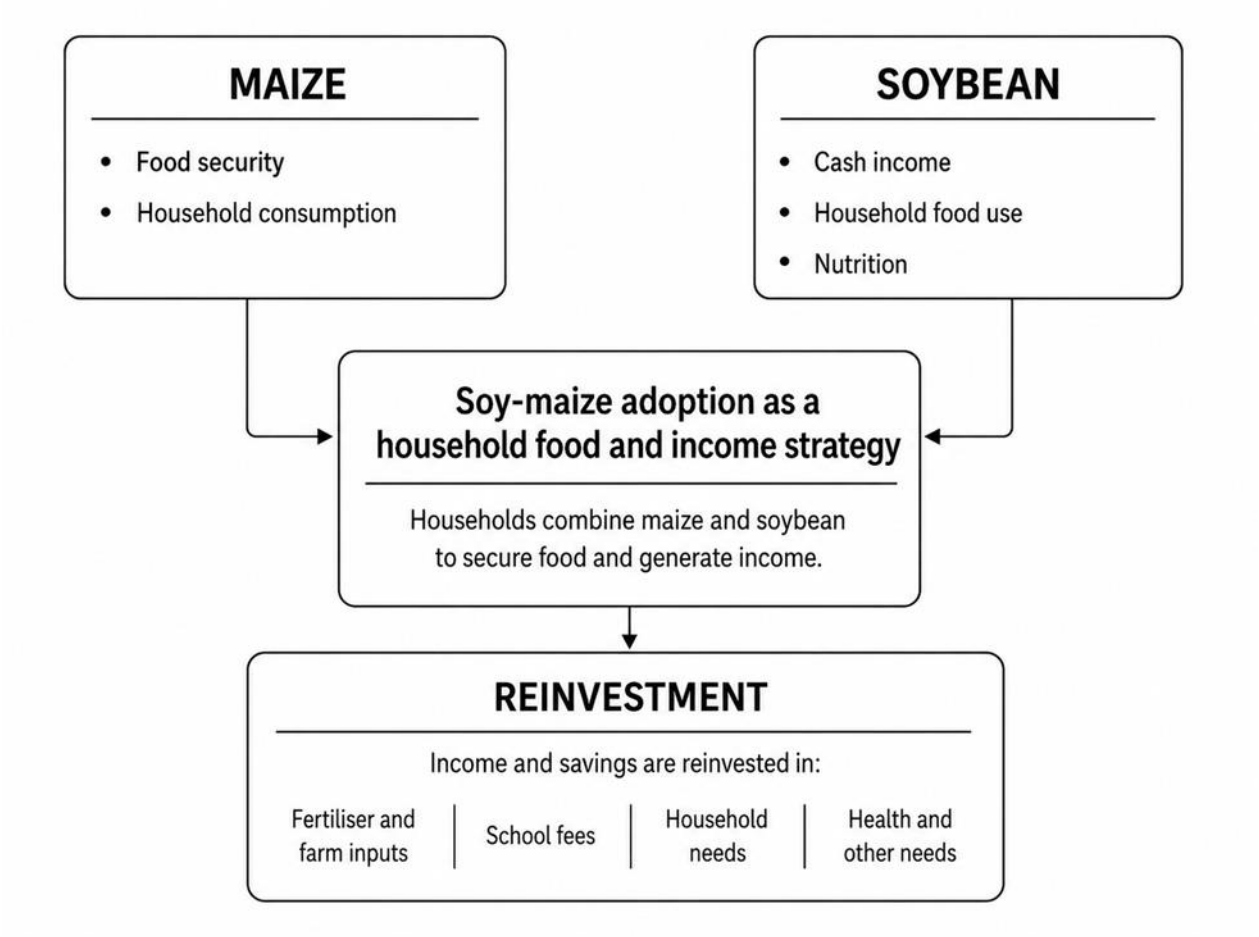

Figure 7. Soy-maize adoption as a household food and income strategy as described by interviewees.

4.3.2 Income, school fees and household needs as adoption drivers

Farmers identified soybean income as one of the main reasons for adopting soy-maize systems. Soybean was valued because it provided cash for both farming and household needs. Farmers reported using this income to buy fertiliser, pay school fees, improve houses, rent or sub-lease land, buy livestock, pay labour and meet daily needs such as food, soap, salt and clothing.

In Mchinji, MCH-FA-01 reported earning more than MWK 700,000 from soybean in the previous season:

"Last year I got over 700,000. I got 9 bags of soybean and sold the commodity. I bought fertiliser for my maize, paid school fees from soybean production and other household needs." (MCH-FA-01)

MCH-FA-04 also connected farming income to children's education:

"Through farming, I have managed to educate my children, and two of them are now at university." (MCH-FA-04)

Six of ten Mchinji farmers reported using soybean income to build assets and invest in their farms. Some used the income to buy livestock, while others used it to purchase fertiliser for maize or to meet household expenses. In Lilongwe, the Madzumbi Processing Unit was an important example of cooperative-linked soybean adoption. It is a farmer-owned cooperative based in Nkhoma, Lilongwe District, and it aggregates and processes soybean from smallholder farmers. Farmers reported that the cooperative received support from the THRIVE project, involving Farm Concern International, World Vision and Vision Fund.

Madzumbi-linked farmers reported wider livelihood changes from soybean income. One farmer started with low soybean production, used the income to buy fertiliser and improve maize yields, and later used soybean income for housing, land purchase, school fees, farm inputs and household assets. These cases showed that income benefits were stronger where farmers were linked to cooperative marketing and value addition.

In Kasungu, farmers also reported benefits from soybean income, although the reported amounts were generally lower than in the strongest Lilongwe cases. KA-FA-09 reported harvesting 10 bags of soybean in 2020 and earning around MWK 500,000, which he used to improve his house. KA-FA-04 reported using soybean income to sub-lease land, pay labour, build a better house and buy a bicycle. KA-FA-06 also reported using soybean income to buy fertiliser, although his case showed how vendor advance payments could reduce the income farmers received.

The findings indicate that soybean income was a major adoption driver in all three study sites. However, the reported benefits differed by district and selling channel. The strongest income outcomes were reported by cooperative-linked farmers in Lilongwe and some established farmers in Mchinji. Kasungu farmers also reported benefits, although these were more limited by vendor-dominated markets, lower prices and weaker collective selling structures.

4.4 Tobacco decline and changing crop choices

Seventeen of the thirty farmers, 8 of them in Kasungu, reported that soybean adoption was happening alongside a decline in tobacco farming. They said tobacco had become less attractive because it required more inputs, labour and cash before farmers could earn from it. Farmers mentioned fertiliser costs, curing barns, firewood, grass, labour demands and market problems.

KA-FA-03 gave the clearest account of this shift. She explained:

"I have stopped growing tobacco because of the related costs. For flue-cured or burley tobacco, you apply fertiliser twice, barn for curing tobacco, firewood. Even grass needs purchasing, which becomes costly. That is why I have switched to soybean." (KA-FA-03)

Lilongwe interviews showed a similar pattern. LIL-FA-03 reported that some farmers were moving from tobacco to soybean because tobacco payments often took too long. Soybean was seen as more attractive because farmers could access cash more quickly. The same farmer described soybean as more profitable than maize and less demanding than tobacco in terms of labour and capital.

Stakeholder accounts showed a wider pattern. NGO-01 described soybean as part of a longer shift away from tobacco, linked to weaker tobacco markets, government support for alternative crops and nutrition messages promoting soybean as a protein source. Extension officers reported that soybean covered more land than tobacco in some local areas. In one EPA, reported land allocation was 11,080 ha for maize, 3,094 ha for soybean and 1,382 ha for tobacco. In another section-level estimate, both maize and soybean were much larger than tobacco. Although these are local estimates, not district-wide statistics, they support the interview finding that soybean has become an important alternative cash crop in areas where tobacco has declined.

Tobacco decline appeared to create space for soybean adoption in some areas. Soybean was described as replacing or competing with tobacco as a cash crop, not with maize, especially where tobacco had become costly, labour-intensive or unreliable in payment.

4.5 Peer learning, lead farmers and local demonstration

Farmers in all three study sites reported learning about soybean through both formal training channels and farmer-to-farmer networks, though the balance differed by district.

In Kasungu, lead farmers and demonstrations were the most prominent route. KA-FA-06 started growing soybean after seeing another farmer succeed with the crop:

"I saw a farmer who made a fortune. I begged seed from him; that is when I started to grow soybean." (KA-FA-06)

The same lead farmer provided seed, hosted variety demonstrations and helped others access equipment, alongside extension messages from government staff and SeedCo. KA-FA-02 took part in FAO-supported variety preference trials, where farmers compared and ranked varieties against their own criteria, and visited

research station trials to observe crop performance directly. In these cases, demonstration was linked to practical learning about varieties and farmer preference, not only to promotion.

In Mchinji, informal networks carried much of the learning. MCH-FA-06 learned production methods from an experienced friend:

"I went to her house and sought advice from her because she was a seasoned grower. So, she is the one who taught me all the methods of soybean production." (MCH-FA-06)

MCH-FA-07 learned soybean farming from his parents, accessed seed through a friend who had received a NASFAM-distributed variety, and went on to test different spacing and planting arrangements in his own fields — showing that learning continued after adoption.

In Lilongwe, peer learning operated inside stronger cooperative and NGO structures. LIL-FA-02 reported that the THRIVE project established demonstration plots, while extension officers, NGOs and SeedCo supported improved practices and crop monitoring; cooperative group activities and collective marketing gave farmers further spaces to share knowledge.

Soybean knowledge therefore moved through several routes at once — NASFAM, FAO, Farm Concern, extension officers, Chitedze Research Station and SeedCo on the formal side; neighbours, relatives, friends and lead farmers on the informal side — with lead farmers most prominent in Kasungu, farmer-to-farmer learning alongside NASFAM support in Mchinji, and cooperative-embedded learning in Lilongwe.

4.6 Institutional support, seed access and organised adoption

Farmers and stakeholders identified institutional support as a major adoption driver, but its form varied sharply across the three sites.

In Lilongwe, support was strongest among farmers linked to the Madzumbi Processing Unit. Through the THRIVE project, Farm Concern provided training, farming-as-a-business advice, cooperative support, value addition, processing machinery, registration, licensing and market links. The cooperative produces Thanzi Lathu Porridge from soybean, maize and rice flour, sells it to institutions such as Nkhoma Hospital, buys soybean from member and non-member farmers, and shares profits according to member contributions. For these farmers, soybean was part of a cooperative processing system rather than a raw grain crop. Other Lilongwe farmers reported seed-recovery schemes through extension officers and NGOs, which gave access to varieties such as Tikolore, Serenado and Makwacha without full upfront payment; LIL-FA-02's first harvest of about 17 bags encouraged continued adoption. Cooperative membership also opened access to loans and organised buyers:

"We joined the cooperative so that we could access loans and start growing soybean to help with school fees and household needs." (LIL-FA-06)

In Mchinji, NASFAM was the main institutional actor. MCH-FA-02 began with a NASFAM seed loan of 15 kg, repaid 37.5 kg after a first harvest of 6.5 bags, and kept seed, sold grain and bought maize fertiliser from the remainder. Through NASFAM and Chitedze Research Station she learned a fuller production package: improved seed, early land preparation, inoculant use, fertiliser, double-row planting, hilling and rust-control chemicals.

In Kasungu, support was more scattered, running through FAO, government extension officers, Chitedze, SeedCo and lead farmers rather than cooperatives or NASFAM. Stakeholders, especially NGO-01, raised concerns about expired or fake inoculant from open markets; farmers spoke more about input cost than authenticity, suggesting the quality concern was clearer to stakeholders than to farmers. NASFAM- and Chitedze-linked farmers appeared to have more reliable inoculant access than those buying on open markets in Kasungu.

4.7 Farmer knowledge of varieties and agronomic practices

Farmers' knowledge of varieties and agronomic practices supported soy-maize adoption. They compared varieties, tested practices, saved seed and considered yield, maturity, grain weight and size, rainfall, disease risk, storage and market value. KA-FA-02 showed practical knowledge of soybean varieties through experience and observation:

"I know Makwacha, Tikolore, Serenado and Chitedze 4 soybean varieties. From observation I can tell which variety is which." (KA-FA-02).

The farmer also explained that grain weight was important when choosing a variety: *"For soybean, we prefer a variety which is heavier, weighs heavier on measurement scales. Tikolore is number one."* (KA-FA-02)

Farmers in Mchinji gave similar accounts. MCH-FA-01 preferred Tikolore to Serenado because Tikolore weighed more, even when the same bag size was used:

"Same bag of Tikolore and Serenado, Tikolore weighs more than Serenado. That's why we prefer Tikolore variety." (MCH-FA-01)

Farmers also showed practical seed knowledge. Some saved and reused seed instead of depending fully on formal seed systems. MCH-FA-06 reported using recycled Makwacha seed for many years without noticing a decline in performance:

"The seed I am using is recycled. I have recycled the seed since 2014. The crop has never lost vigour. It's called Makwacha." (MCH-FA-06)

Farmers also reported using practices such as crop rotation, early planting, spacing, seed selection, residue use, pest control, storage and timing of sales. MCH-FA-02 reported learning a more complete soybean production package through NASFAM and Chitedze Research Station. This included improved seed, early land preparation, inoculant treatment, fertiliser use, double-row planting, hilling and rust-control chemicals.

Research links were also visible in Mchinji. MCH-FA-02 reported contact with Chitedze Research Station, where soybean experts were testing new varieties in the area:

"This year, I got in touch with soybean experts from Chitedze who wanted to test varieties in our area… we were given resources to conduct demonstrations on the new variety called Chitedze 6." (MCH-FA-02)

Farmer knowledge of varieties and agronomic practices helped explain why some farmers adopted and continued with soy-maize systems. Farmers valued soybean more when they understood which varieties performed well, how soybean fitted into maize rotation, and how it could support their response to market and climate risks.

Figure 8 brings together the main drivers of soy-maize adoption that farmers and stakeholders described across the three districts.

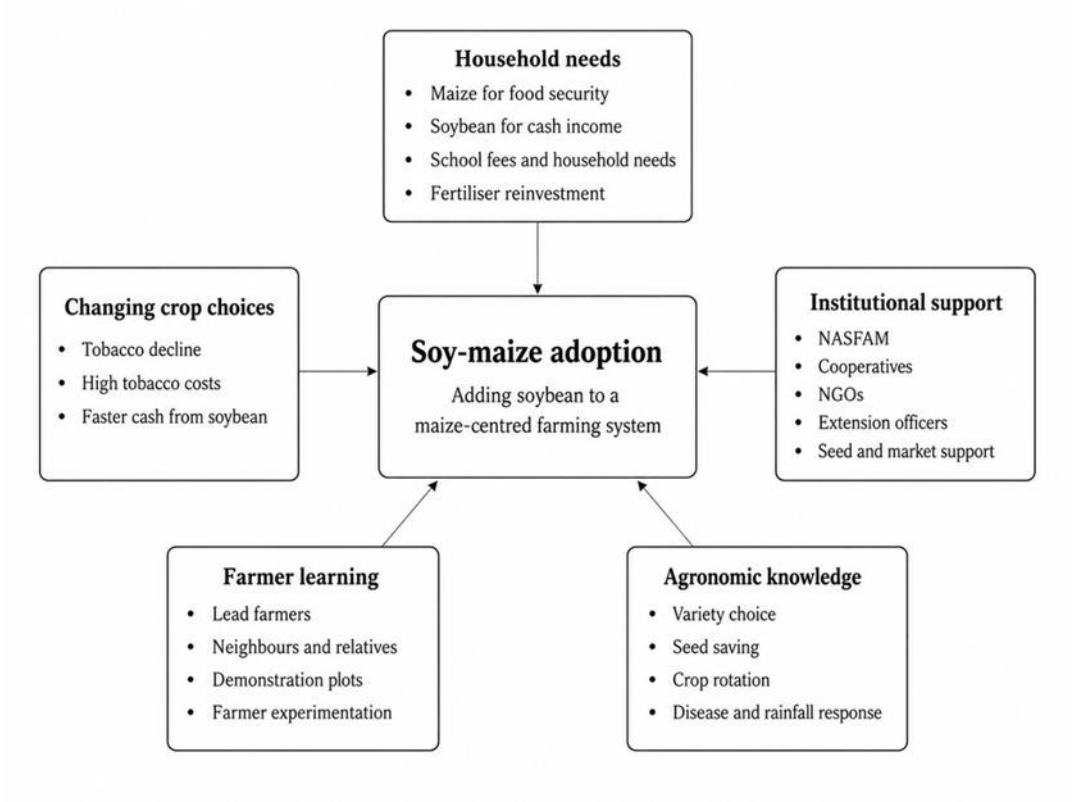

Figure 8. Main drivers of soy-maize adoption

4.8 Sustainability

This section examines how farmers and stakeholders perceived the social, economic and environmental sustainability of soy-maize systems under climate variability. Figure 9 summarises the conditions that shaped these three dimensions, which are then discussed in turn.

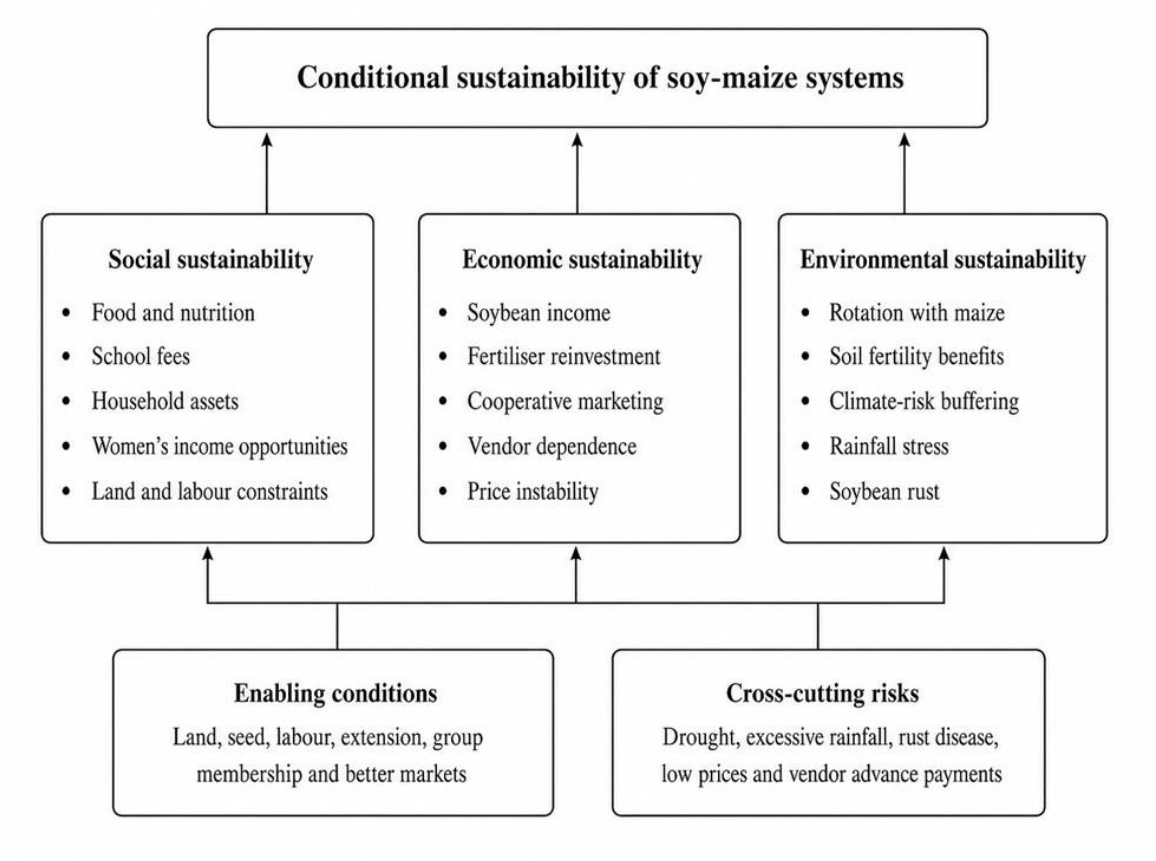

Figure 9. A summary of conditions shaping the social, economic and environmental sustainability of soy-maize systems identified by interviewees

4.8.1 Social sustainability

Farmers reported several social benefits from soy-maize farming, including support for school fees, food, nutrition, household needs, housing, livestock, land access and women's income activities. The strongest benefits were reported by farmers with enough land, seed, labour, group membership and access to better markets.

In Lilongwe, one Madzumbi-linked farmer reported that soybean income helped him buy fertiliser, improve maize production, build a house, buy land, invest in livestock and pay school fees. In Mchinji, farmers reported using soybean income for school fees, maize purchases, house improvements and daily needs such as soap, salt and clothes. Soybean was also used directly as household food. Farmers mentioned porridge, cakes, milk and flour mixed with maize. NASFAM stakeholders also linked soybean to better nutrition and household wellbeing.

Not all farmers were able to grow soybean. KA-NA-07 admired farmers who grew soybean but said he lacked land and money, including access to dimba land for off-season farming:

"I admire those who grow soybean but I do not have access to more land. I do not have access to dimba[2] land." (KA-NA-07)

He added:

"If I had enough money, I would buy land so that I go into diversification." (KA-NA-07)

Labour was also a challenge. Several farmers said soybean harvesting, threshing and winnowing were physically demanding tasks. KA-FA-06 described soybean threshing as difficult and risky for health:

"Soybean challenge is mainly during threshing. We suffer a lot. The dust created by this process can result into sickness and chest pains because of threshing." (KA-FA-06)

Stakeholders gave mixed views on gender. Extension officers often described soybean as becoming more accessible to women and young people, especially through training and nutrition activities. NGO and private-sector actors were more cautious. They reported that when soybean became profitable, men sometimes took more control over the income, while women continued to face limits in land access and household decision-making. Soy-maize adoption brought reported social benefits for some farmers, especially those with land, labour, group support and market access. At the same time, the benefits were uneven. Farmers with less land, less capital or less control over household decisions reported more limits.

4.8.2 Economic sustainability

Soybean income varied by site and selling channel. Cooperative-linked farmers reported the strongest benefits, especially in Lilongwe, while vendor-dependent farmers reported the weakest benefits, especially in Kasungu. Stakeholders linked these market patterns to the decline of ADMARC in soybean marketing. As ADMARC's role as a state-backed buyer offering floor prices has reduced, private vendors have expanded, while cooperatives such as Madzumbi have filled part of the gap through collective bargaining and processing. The vendor-dominated pattern in Kasungu and cooperative-led pattern in Lilongwe were therefore described as responses to this institutional vacuum, not signs of a fully structured market.

In Lilongwe, LIL-FA-05 reported receiving more than MWK 1 million after selling eight bags of soybean to the Madzumbi factory. He said the same harvest

[2] Dimba land refers to low-lying, moisture-retaining garden land, often near rivers, streams or wetlands, used for growing crops outside or beyond the main rainy season.

would have earned about MWK 250,000 if sold through vendors: *"Last year I surrendered 8 bags of soybean to the factory and got over MWK 1 million. If I were to sell through vendors, I could have received around MWK 250,000."* (LIL-FA-05).

He also explained that farmers encouraged each other to wait for better prices instead of selling quickly to vendors: *"Prices are not a big problem. As farmers we encouraged each other to keep our produce and sell at a reasonable price. It is more profitable to sell via the factory than sell through vendors."* (LIL-FA-05).

Other Lilongwe farmers gave similar accounts. LIL-FA-06 said: *"When these organisations buy from us, we do not face problems, but when we sell to vendors the prices are low and inconsistent."*

In Mchinji, the picture was mixed. Some farmers linked to NASFAM reported that they received seed, training and access to more organised markets. However, farmers also said they still depended on vendors when formal buyers were not available. MCH-FA-09 explained:

"Finding reliable markets for selling our produce is a challenge. We often end up selling to vendors at low prices because we have no other choice."

Kasungu farmers reported the greatest market challenges. Vendors were described as the main buyers. Farmers also spoke about advance payments, low prices and limited bargaining power. KA-FA-06 said he accepted MWK 40,000 in advance from vendors when his maize was not enough. He later had to sell soybean at the agreed advance price even though the market price had reached MWK 100,000 per bag:

"Last year, I received cash in advance from vendors because my maize was not enough. When I heard vendors giving advance cash, I got the money MWK 40,000. When it came to actual selling, soybean was selling at MWK 100,000 per bag. It really pained me." (KA-FA-06).

He also linked food security to bargaining power: *"If you have enough maize you cannot run into a temptation of receiving money in advance."* (KA-FA-06).

This food-access pressure was evident across the sample. The Food Insecurity Experience Scale (FIES) administered alongside the interviews recorded that 10 of the 30 farmer participants (33%) reported moderate or severe food insecurity in the previous twelve months, with a further 14 farmers (47%) reporting mild food insecurity. Only 6 farmers (20%) were food secure (Table 4).

Table 4. Food insecurity severity categories among surveyed farmers based on FIES raw scores (n=30).

Severity category	Raw score	Count	Percent of sample
Food secure	0	6	20.0
Mildly food insecure	1-3	14	46.7
Moderately food insecure	4-6	7	23.3
Severely food insecure	7-8	3	10.0
Total		**30**	**100.0**

Among the 9 farmers who reported selling soybean under pressure or accepting advance payments from vendors, 7 fell into the moderate or severe food-insecurity bands on the FIES. The convergence between the two data sources, what farmers described in interviews and how they scored on a standardised scale, strengthens the view that distress selling was connected to household food shortage rather than being an isolated case. The purposive sample cannot show how common food insecurity is across Central Malawi, but within this study most farmers who sold under pressure were also experiencing clear food-access stress.

Stakeholder accounts supported these findings. Extension officers, NASFAM and private-sector actors described soybean as a crop with strong demand from processors, feed producers, cooking-oil companies and soya-piece manufacturers. At the same time, they reported that farmers often remained in a weak market position. Stakeholders also reported price changes, sales below the gazetted price, and vendors buying early before price controls were enforced. Access to formal agricultural credit was also reported as limited. Farmers and stakeholders mentioned the National Economic Empowerment Fund (NEEF) as a state-backed credit channel intended to support smallholder production, but reported that disbursement, repayment terms and loan administration had created difficulties. Stakeholders described NEEF as inconsistently accessible and reported that earlier defaults had constrained subsequent rounds of lending. In the absence of reliable formal credit, farmers more often relied on cooperative loans in Lilongwe, NASFAM input loans in Mchinji, or vendor advance payments in Kasungu to finance soybean production.

Soybean income depended strongly on how farmers sold their crop. Farmers linked to cooperatives reported much higher returns than farmers who depended on vendors, even when their harvests were of a similar size.

4.8.3 Environmental sustainability

Farmers and stakeholders described two main environmental benefits of soybean: improved soil fertility through rotation of soybean with maize, and reduced risk when one crop performs badly. KA-FA-02 reported that rotating soybean with maize helps maize grow better:

"Crop rotation soybean and maize is beneficial. The maize does very well." (KA-FA-02).

He also said that soybean residues help improve the soil:

"Soybean plant leftovers act as fertiliser. This improves soil fertility. If you crop-rotate soybean then maize, the maize crop does very well." (KA-FA-02)

Farmers in Mchinji gave similar views. MCH-FA-09 explained that soybean can help households when maize does not do well:

"If maize fails due to bad weather, soybean may still do well. Then we sell the soybean and use the money to buy food for the household." (MCH-FA-09)

Stakeholders also supported these views. Research and extension actors said soybean can help with nitrogen fixation, crop rotation, use of crop residues, soil cover and reduced soil erosion. Extension actors also mentioned other climate-adaptation practices, such as manure use, box ridges, water harvesting and agroforestry.

At the same time, farmers reported that climate variability was a major challenge. They mentioned late rainfall, dry spells, too much rain, flooding and poor pod development. KA-FA-02 explained: "Rainfall pattern is not consistent. In some years we have good rains, in some years we receive poor rains." (KA-FA-02). KA-FA-06 reported that too much rain affects soybean: "If the rains continue for too long, soybean does not do well. The pods do not fully develop." (KA-FA-06). KA-FA-02 also said that maize handles dry spells better than soybean: "Maize is more tolerant to dry spells unlike soybean crop. For soybean, Tikolore is more tolerant than other varieties." (KA-FA-02)

Soybean rust was another major risk. KA-NA-01, a former soybean farmer, stopped growing the crop after rust badly affected his field. He said that in the 2023 season he planted soybean on three acres but harvested only one bag because of rust: "Soybean farming is very frustrating; that is why I stopped growing the crop. In 2023 season I grew soybean on a three-acre land and rust attacked my field and I harvested a bag of soybean. I was very disappointed." (KA-NA-01). RES-01 also identified soybean rust as a serious shock, especially after the 2022/23 season, and noted that rust-resistant soybean lines were still being tested. The 2022/23 season

was widely described as a turning point. Several farmers in Kasungu reported severe rust outbreaks that reduced harvests below seed and input costs, and some reduced soybean area or stopped production altogether the following season. Farmer responses varied by location and resource access. NASFAM-linked farmers in Mchinji reported using rust-control chemicals learned through training (MCH-FA-02). Kasungu farmers more often shifted to varieties they considered more tolerant, particularly Tikolore (KA-FA-02). Farmers without access to chemicals or alternative varieties were more likely to disengage from soybean production after the rust season.

Farmers reported several ways of responding to climate stress. These included early planting, using early-maturing varieties, crop rotation, manure, box ridges, mulching and choosing varieties that perform better under difficult conditions. KA-FA-08 explained the importance of early-maturing varieties: “If rainfall is low, we plant early maturing varieties so that the crop can mature quickly before the rains end.” (KA-FA-08). Farmers described soybean as environmentally beneficial when it was rotated with maize, used to improve soil fertility, or sold to support food access when maize performed poorly. At the same time, these benefits were not automatic. They depended on rainfall, disease pressure and access to suitable soybean varieties. Climate variability and soybean rust remained serious challenges for soy-maize farming.

5. Discussion

This chapter discusses the Chapter 4 findings against the two research questions: what drives soy-maize adoption in Central Malawi, and whether the system is socially, environmentally, and economically sustainable under climate variability. It argues that soy-maize is best understood as a conditional livelihood strategy. Two frameworks guide the analysis: the Multi-Level Perspective, which reads soy-maize as partial change within a maize-dominated regime, and the Sustainable Livelihoods Framework, which explains why the same innovation benefits some households more than others.

5.1 Soy-Maize Cropping as a Transition Strategy

Geels and Schot (2007, p. 411) identify several ways a niche can interact with an established regime, including substitution, transformation and reconfiguration. The Central Malawi case fits reconfiguration most closely because soybean is being added to a maize-centred farming system rather than replacing maize. Organisations also adjust around soybean rather than resist it. NASFAM supports adoption through seed loans and training, Chitedze Research Station contributes through improved varieties, and seed companies promote soybean through demonstrations.

This reconfiguration takes a specific form because of the place of maize in household and national food systems. Maize is the main food crop and has long been protected through subsidies and food policy (Chinsinga, 2012; Chirwa and Dorward, 2013). Farmers are therefore unlikely to abandon maize for a crop they treat as secondary. Soybean instead fills the cash role left by the decline of smallholder tobacco, which Prowse (2013) links to falling prices, tighter regulation and rising input costs. In this sense, soybean adoption strengthens the maize-centred system rather than weakening it.

The strength of adoption depended on organisational support. Adoption was strongest in Lilongwe, where the Madzumbi processing unit supported aggregation and collective selling. It was more moderate in Mchinji, where NASFAM provided seed loans and training. It was weakest in Kasungu, where support was more scattered through lead farmers, extension officers and demonstration sites. This shows that adoption pathways can differ within the same region, supporting Klerkx et al. (2012), who argue that innovation systems depend on the density and reach of supporting organisations.

The unusual finding is the direction of change. In many transition examples, a niche gradually weakens or replaces the regime it emerged from, as sailing ships gave way to steam (Geels, 2002). In Central Malawi the direction is reversed: the niche is absorbed into the maize-centred system in ways that help maize production continue. This thesis uses the term regime extension to describe this pattern. The term is not proposed as a new transition pathway, but as a case-specific form of reconfiguration. It describes a situation where a niche is absorbed into an existing regime and helps that regime continue. This is close to Smith and Raven's (2012) idea of fit-and-conform empowerment, where a niche succeeds by working within the existing system. In this case, soybean does not only fit within the maize-centred system; it also helps sustain it through the reinvestment of soybean income into maize production.

Geels and Schot (2007, pp. 411–413) explain reconfiguration mainly through organisations and technologies. In Central Malawi, households also drive the process. Farmers use soybean income to buy fertiliser for maize. At the same time, a good maize harvest allows them to keep soybean longer and sell when prices improve. Soybean income therefore strengthens maize production, while maize food security improves farmers' bargaining power in soybean markets. This household reinvestment cycle helps keep the maize-centred system in place.

Regime extension does not mean that niches always strengthen regimes. It appears to apply where the existing regime is politically protected, central to subsistence, or both. Maize meets both conditions, which helps explain why a profitable cash crop is absorbed into the maize system rather than replacing it. Where these conditions are absent, adoption may instead move toward substitution or transformation.

This finding also contributes to debates on food security and food sovereignty. Patel (2009), McMichael (2014) and Edelman et al. (2014) warn that cash crops can weaken household food production by drawing farmers into commodity markets. The Central Malawi evidence does not dismiss this concern, but it adds an important condition. Farmers are not necessarily being pulled away from food production. Many use soybean income to support maize, while still deciding what to plant, eat and sell. This only works where households have enough maize for consumption, access to cooperative buyers, enough labour, and freedom from distress sales. The key question is therefore not whether soybean helps or harms food autonomy in general, but under what conditions it strengthens the household food base.

The MLP explains what kind of change soy-maize represents, but it does not fully explain why the benefits are uneven. The Sustainable Livelihoods Framework helps with this. Scoones (2009, 2015) warns that the five capitals can become a checklist

if they are not linked to power and access. Natarajan et al. (2022) also call for a version of the framework that takes structure and environment more seriously. The findings support this view. Household gains depend not only on assets, but also on market access, organisational support, district-level differences, climate variability and disease pressure. Soy-maize is therefore an important innovation, but its benefits remain unevenly shared.

5.1.1 Key tensions

Four tensions run through the findings. The first is between opportunity and risk. Soybean brings cash for school fees, fertiliser and household goods, but it also exposes farmers to vendor dependence, advance-payment traps, rust, drought and waterlogging. The same crop can be both a livelihood asset and a livelihood risk, depending on a household's assets and the conditions of the season.

The second tension is that soybean's value as a cash crop appears to depend on how well the food crop performs. Farmers with enough maize for household consumption can wait for a better soybean price. Those without it often sell under pressure. The worth of the cash crop therefore rests partly on the success of the food crop, and any policy that treats the two separately misses how households actually manage them.

The third tension is between organisational promise and organisational unevenness. Organisations such as NASFAM, Madzumbi and Chitedze support adoption where they are present, but their reach is uneven. Lilongwe farmers gained processing and cooperative marketing, Mchinji farmers gained seed and training, and Kasungu farmers gained least and stayed most exposed to vendors. The innovation system is real, but spatially uneven.

The fourth tension is between commercialisation and equity. Soybean income can strengthen households, but it can also concentrate benefits among better-resourced farmers. Within a household, it can shift control over income toward those who already hold decision-making power. Without attention to these patterns, promoting soybean may deepen the very inequalities it does not set out to create.

5.1.2 Implications for practice and policy

Three implications follow from the analysis. The first concerns market infrastructure. The contrast between Lilongwe and Kasungu shows that soybean outcomes depend heavily on who farmers can sell to. Investment in cooperative

aggregation, transparent pricing, storage and contract enforcement may do more for soybean's sustainability than further yield-focused work alone. The Madzumbi model cannot simply be copied everywhere, but it shows the kind of organisational support that can turn soybean production into better income.

The second implication concerns the link between food and cash. Programmes that treat soybean only as a cash crop miss how farmers actually use it. Soybean works best when it sits alongside a maize harvest large enough to keep the household out of distress sales. Food-security support and cash-crop support should therefore not be designed as separate policy areas. They are two parts of the same livelihood strategy and work best when planned together.

The third implication concerns disease control and input quality. Soybean rust has already disrupted adoption in Kasungu and could do so again. Investment in rust-resistant varieties, early warning and inoculant quality control would help protect the gains made so far. Farmer training on rust management is necessary, but not enough on its own; regulation of inoculants and chemicals on the supply side matters just as much.

Underlying these three points is a wider design principle. Soybean promotion should start from the household's livelihood strategy, not from the crop alone. The question is not simply whether farmers can grow more soybean. It is what conditions allow them to gain more value from the soybean they already grow, without trading away food security or labour wellbeing for cash.

5.2 Sustainability

Whether soy-maize is sustainable cannot be judged from the crop alone. It depends on the social, economic and environmental conditions around it, and each of these works unevenly.

5.2.1 Social sustainability

The clearest social signal in the data was a disagreement between stakeholders about gender, and that disagreement is itself revealing. Extension officers described soybean as opening opportunities for women and young people, while NGO and private-sector actors reported that men often took greater control of the income once the crop became profitable. Rather than a weakness in the data, this gap reflects where each actor sits in the process. Extension officers observe soybean at the participation stage (who joins the group and plants the crop), while NGO and

private-sector actors observe it at the income stage, where decisions about money are made. They are not contradicting each other; they are seeing different moments in the same process.

This pattern is consistent with wider work on African agriculture. Doss (2001) and Razavi (2009) show that crops women can access often become contested once they earn income, with the labour staying female while control over the money shifts toward male household heads, and Tufa et al. (2022) document gender gaps in soybean technology adoption and productivity in Malawi itself. The Central Malawi findings cannot confirm this dynamic, but they fit it closely enough to warrant household-level study. Interpreted through the SLF, the social outcomes of soybean appear to depend less on the crop itself than on the conditions around it: access to land, training, farmer groups and a household's own decision-making power.

5.2.2 Economic sustainability

Economic sustainability depended mainly on market access. However, market access was also shaped by food insecurity, not only by price. Farmers who had little maize for household consumption said they could not wait for soybean prices to improve. They sold early, often to vendors who offered advance payments. Stephens and Barrett (2010) describe this as a distress sale, where food shortage reduces a farmer's bargaining power. In this study, market position and household food security were therefore closely connected. The least food-secure farmers often sold under the weakest terms.

This also reflects Malawi's wider marketing history. As ADMARC's buying role declined under structural adjustment, more cost and risk shifted from the state to smallholders (Chinsinga, 2012). This created more space for private vendors and, in some areas, cooperatives. Vendors should not be understood only as exploitative middlemen. Sitko and Jayne (2014), writing on grain trading in Zambia, show that traders can also provide cash, transport and a buyer of last resort. The Kasungu accounts support this view. Farmers sold to vendors not because they preferred them, but because they lacked the cooperative and processor options available to some farmers in Lilongwe. The main problem, therefore, was not simply the presence of vendors, but the absence of stronger and competing buyers.

5.2.3 Environmental sustainability

Environmental sustainability was the dimension farmers described most positively, although it is also the dimension this study can verify the least. Crop rotation was the most widely reported benefit. Farmers linked soybean residues to better soil

fertility and stronger maize performance. This is consistent with agronomic studies on nitrogen fixation in legume-cereal rotations (Vanlauwe et al., 2019; Tufa et al., 2019).

Two cautions are important. First, these are perceived benefits. This study did not measure soil quality. It is also difficult to separate the effect of rotation from the effect of fertiliser bought using soybean income. In farmers' own accounts, these two processes often happened together. Second, farmer-participatory research shows that the fertility benefits of legume-maize systems vary depending on soil conditions and management (Smith et al., 2016). For this reason, the rotation benefit should be understood as plausible and consistent with the literature, rather than directly proven by this study.

The more difficult finding concerns climate performance. Soybean is often promoted as a climate-resilience crop. Farmers in this study, however, described soybean as sensitive to both too much and too little rainfall. They said it failed under prolonged rain, especially when pods did not develop, and it performed worse than maize during dry spells. This partly challenges the way soybean is promoted.

McCarthy et al. (2021) found that legume cropping offered strong protection under both drought and flooding in Malawi. In this study, however, farmers experienced soybean as the more climate-exposed crop in their system, while maize appeared more reliable. This does not mean that one account is necessarily wrong. McCarthy et al. focused on the protective effect of legumes on overall production, while farmers in this study were describing the yield stability of soybean itself. This difference matters. A crop can help diversify household risk while also being risky as a crop. Farmers' planting decisions respond strongly to this second issue. This is consistent with Coughlan de Perez et al. (2024), who found that Southern African farmers often reduce investment under El Niño conditions, rather than diversify. It also agrees with Cooper et al. (2008), who argue that adaptation options under climate variability can bring both benefits and trade-offs. Farmers were therefore not choosing between a risky crop and a safe crop. They were choosing between different kinds of risk within their farming system.

Soybean rust was the clearest environmental shock. The responses to rust show why the Sustainable Livelihoods Framework is useful for this study. After the 2022/23 outbreaks, farmers followed three different paths. NASFAM-linked farmers in Mchinji used rust-control chemicals that they had learned about through training. Some Kasungu farmers with knowledge of varieties shifted towards Tikolore, which they considered more tolerant. Farmers who had neither chemicals nor alternative varieties reduced the area under soybean or stopped growing it

completely. This included KA-NA-01, who harvested only one bag from three acres and then stopped growing soybean.

The same shock therefore produced different outcomes. Better-supported households adapted, while poorly supported households reduced or abandoned soybean. This shows the environmental side of the conditional pattern running through the thesis. It is also consistent with Khoza, van Niekerk and Nemakonde's (2022) finding that disadoption of climate-smart agriculture in Malawi follows lines of vulnerability, not simply farmers' beliefs. In MLP terms, rust directly affects the soybean niche. Its wider effect is also about confidence. A niche that depends on visible success becomes weaker when farmers see that the crop can fail. The reduced-scale adopters and adoption reversals in this sample show this weakening.

Input quality adds another layer of risk. Stakeholders raised concerns about expired or counterfeit inoculant in open markets. Farmers, however, mainly spoke about the cost of inoculant. This gap is important. Technical actors see poor inoculant as a threat to nitrogen fixation and yield. Farmers experience it as another cost, and they may not know when it has failed. If soybean performs poorly, a farmer cannot easily tell whether the problem was rainfall, rust, seed quality, or ineffective inoculant. This means the environmental benefits of soybean can be weakened at the point of input purchase. Protecting the rotation and fertility benefits therefore requires better input regulation and clearer extension messages. It cannot depend on farmer effort alone.

Taken together, the environmental case for soy-maize is real, but narrower than often promoted. The rotation benefit is credible and valued by farmers. The climate-resilience claim was only partly supported and was sometimes reversed in farmers' experiences. The rust shock also showed that environmental sustainability, like economic sustainability, depends on the support system around the household. This raises an important question for further research. The issue is not whether legumes belong in the farming system, but how cropping portfolios can be diversified so that livelihoods are resilient to both disease and weather extremes, rather than exchanging one type of risk for another.

6. Conclusion

This thesis asked one main question: under what conditions does soy-maize cropping move from being adopted to supporting sustainable smallholder livelihoods in Central Malawi? The answer is that adoption and sustainability are governed by the same thing. They both depend on the strength of the support system around the crop. Where organisational support, market access and household food security are present, soybean is taken up and goes on to strengthen livelihoods. Where they are weak, soybean is still taken up, but it does less for the household and can add new risk. Adoption and sustainability are therefore not two separate outcomes. They are two points on the same path, and the conditions around the crop decide how far a household moves along it.

The study shows this through three linked findings. Soybean is not replacing maize but is being absorbed into a maize-centred system, a pattern the thesis calls regime extension. At household level, farmers use soybean income to support maize production, which the thesis describes as the reinvestment cycle. And the benefits of this arrangement are conditional and uneven, because they depend on the support system rather than on the crop itself. Together these findings answer the main question: soy-maize moves from adoption to sustainable livelihood support only where the surrounding conditions allow it.

The first research question asked what drives the adoption of soy-maize cropping. The findings show that adoption is shaped by five connected factors. The first is the different role of the two crops in household life. Maize is grown mainly for food, while soybean is grown mainly for income. The second is the decline of tobacco as a smallholder crop, especially because of its high labour and input demands. The third is institutional support from cooperatives, NASFAM, NGOs, extension officers and seed systems. The fourth is farmer learning through lead farmers, neighbours, relatives, demonstration plots and direct experimentation. The fifth is farmers' own agronomic knowledge, including their choice of varieties, seed saving, crop rotation, and their response to disease and rainfall. Together, these five factors explain the pattern of adoption observed across the three districts.

The second research question asked whether soy-maize is socially, environmentally, and economically sustainable. The answer is conditional. Soy-maize can support sustainability, but only when the wider conditions around the crop are strong enough. Social benefits are greater where farmers have access to groups, training and peer learning. Economic benefits depend not only on yield, but also on where and how farmers sell. Farmers linked to organised markets, such as the Madzumbi cooperative in Lilongwe, received stronger returns than farmers

selling mainly through vendors in Kasungu. Food insecurity also affected market choices. Households with little maize were more likely to accept advance payments and sell under pressure, which reduced their bargaining power. Environmental benefits were reported through crop rotation, residues and soil fertility, but these gains were weakened by rust disease, rainfall variability and poor-quality inputs.

The study has some limits. The FIES survey was given to thirty purposively selected farmers, so it cannot represent food security across the whole study area. Land allocation figures came from extension officer estimates rather than official district statistics. Evidence on soybean rust came from farmer and stakeholder accounts, not from formal disease surveillance. The study also covered only one season, which limits what it can say about changes over time. These limits show where the claims should be read carefully and where further research is needed.

The findings point to three practical implications. First, market infrastructure matters as much as production. Cooperative aggregation, transparent pricing and contract enforcement should receive more attention in soybean programmes. Second, food security and cash-crop support should be planned together. Soybean income helps households most when they have enough maize to avoid distress sales. Third, disease control and input quality need stronger investment. Research on rust-resistant varieties should continue, and regulators should address counterfeit and expired inoculants in open markets.

Further research should follow the same farmers across several seasons to understand how rainfall, prices, rust and household needs affect adoption over time. More research is also needed on gender. Some actors described soybean as creating opportunities for women, while others suggested that men may take more control when soybean becomes profitable. This household-level issue needs deeper study.

This study makes three contributions. First, it contributes to work on agricultural diversification and climate-resilient cropping in southern Africa by focusing on household-level sustainability, which many adoption studies treat only indirectly. Second, it contributes to socio-technical transitions research by interpreting soy-maize cropping in Central Malawi as a reconfiguration pathway, following Geels and Schot (2007, p. 411). Third, it contributes to critical Sustainable Livelihoods literature (Scoones, 2009, 2015; Natarajan et al., 2022) by showing that uneven soybean outcomes are not explained by household assets alone, but are also shaped by uneven access to organisations' support and by the market channels through which farmers sell. These contributions carry practical implications for NGOs, research institutions and government agencies promoting soy-maize cropping in Central Malawi, including LEG4DEV.

One case from the study captures the central point of this thesis. A farmer in Kasungu took a cash advance from a vendor because his maize was not enough, then had to sell his soybean at the agreed advance price even when the market price was far higher. Farmers in Lilongwe who sold through the Madzumbi cooperative did not face this pressure and received stronger returns. The crop was the same. What differed was the support around it. This shows that the value of soybean is not found in the crop alone. It depends on the market, institutions, household food security, disease control and the wider support system around farmers. Where this support is present, soybean can strengthen livelihoods. Where it is absent, soybean can become another point of vulnerability.

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Popular science summary

Smallholder farmers in Central Malawi are increasingly growing soybean alongside maize. Soybean is often promoted as a crop that can bring cash, improve soil, help farmers cope with climate stress, and make livelihoods more secure. This thesis asked whether that promise actually holds once farmers grow soybean in real household conditions.

The study was based on interviews with 30 farmers and 14 stakeholders involved in soy-maize farming across Kasungu, Mchinji and Lilongwe districts, together with a short food security survey. It found that soybean is not replacing maize. Maize remains the main food crop and the centre of the farming system. Soybean is being adopted because it brings cash: farmers grow maize for food and soybean for income, especially as tobacco has become more expensive to grow and more labour-demanding.

Soybean adoption is also shaped by support from cooperatives, NGOs, extension officers, seed companies and farmer groups. Farmers also learn from lead farmers, neighbours, relatives, demonstration plots and their own experiments. A key finding is that soybean income often goes back into maize production. Farmers use soybean money to buy fertiliser, pay for labour, cover school fees and meet household needs. This is the reinvestment cycle: cash from soybean helps keep the food crop going, while enough maize at home helps farmers avoid selling soybean too early or too cheaply.

Soybean can make farmers better off, but not automatically. Its benefits depend on the system around the crop. Farmers linked to organised markets, such as cooperatives in Lilongwe, earned more than those selling mainly to vendors in Kasungu. Households short of food were more likely to accept early cash advances and sell at low prices. Environmental gains from rotation and improved soil were also limited by rust disease, unreliable rainfall and poor-quality inputs.

The main message is that soybean is not a magic solution. A good crop needs fair markets, reliable buyers, good seed, disease control, extension support and food security.

Acknowledgements

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I wish to express my sincere gratitude to my supervisor, Michael Jones, whose constructive feedback and thoughtful guidance were instrumental in shaping this work at every stage. Equal thanks are due to Jennie Barron, whose supervision through the LEG4DEV project guided the fieldwork and data collection in Malawi. I am grateful to my IITA supervisor, Sika Gbegbelegbe, for her guidance and for the warm hospitality extended by the entire IITA team. Special mention goes to Adane Hirpa Tufa and John Omondi, whose published work I drew on extensively in this thesis and who generously gave their time to discuss the subject with me, a gesture I found both humbling and enriching.

I am deeply grateful to my two enumerators, Iness Gondwe and Richard Nyoni, whose skill, patience and care during interviewing and transcription were central to the quality of the data gathered. I owe a profound debt of gratitude to the many smallholder farmers who took part, and to the extension officers, NGO staff and other stakeholders across Kasungu, Mchinji and Lilongwe districts who gave their time and shared their knowledge and experiences. This thesis rests on their willingness to talk openly with me.

Finally, and most personally, I thank my wife, Sandra Nyika, who bore with patience and grace the many hours this research demanded of me, and whose encouragement sustained me through the most demanding stretches of this journey.

Appendix 1: Interview Guide A

Field Interview Guide A - Farmers (Adopters and Non-Adopters)

Drivers and Perceived Sustainability of Soy-Maize Cropping Innovation in Central Malawi

Mcleo Midzi · MSc Thesis, Swedish University of Agricultural Sciences (SLU) · LEG4DEV Project / IITA

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Enumerator quick reference

Interview duration: Maximum 60 minutes.

Structure: Sections 1–6 (qualitative, audio-recorded) → Section 7 (structured livelihood tools) → Section 8 (closing questions).

Before starting: Introduce yourself and the study, explain voluntary participation and confidentiality, confirm informed consent, request permission to audio-record, and emphasise there are no right or wrong answers.

Recording: Audio-record Sections 1–6 and Section 8. Use the tables and tick boxes in Section 7.

Non-adopters: Look for the shaded boxes throughout — these explain how to adapt each question.

Participant information

Participant ID	
District	
Village / EPA	
Adopter / Non-adopter	
Gender	
Age range	
Farm size (ha)	
Years farming	
Main crops	
Date	
Enumerator	

Section 1. Background and farming context

Q: ***Can you tell me about your experience growing maize and soybean on your farm?***

Probes:

- How long have you been growing maize? When did you start growing soybean, and what made you decide to try it?
- How much land do you allocate to maize and how much to soybean? Has this changed over time?
- Between maize and soybean, which crop do you consider more important to your household, and why?
- Apart from maize and soybean, what other crops or activities does your household depend on for income and food?

Section 2. Awareness and experience with soybean

Q: ***How did soybean farming first come into this area, and how did you come to learn about it?***

Probes:

- Who first introduced soybean farming to you or your community?
- What role did buyers, NGOs, extension officers, or other organisations play in promoting soybean?
- Was soybean promoted as part of a specific programme, project, or market opportunity (e.g. LEG4DEV, N2Africa, NASFAM)?
- How did you learn about the required technologies and practices (e.g. inoculants, spacing, varieties)?

Enumerator. *For non-adopters: probe what they have heard from neighbours, extension officers, or other sources, and whether they have considered growing soybean.*

Section 3. Drivers and barriers to adoption

Q: ***What makes it easier or harder for farmers in this area to grow soybean alongside maize?***

Probes:

- Markets: availability of buyers, price stability, contracts, and payment arrangements.
- Technologies: access to improved seed, inoculants, fertiliser, equipment, and storage.
- Institutions: government policies (e.g. input subsidy programme), NGO programmes, cooperative rules.
- Knowledge systems: training, demonstrations, extension advice, farmer-to-farmer learning.
- Social networks: influence of neighbours, lead farmers, and farmer groups.
- Risks and costs: debt, input dependency, market uncertainty, labour demands.

Enumerator. *For non-adopters: focus on barriers. Why have you not adopted soy–maize farming? What would need to change? What do you observe about neighbours who have adopted?*

Section 4. Farming practices and changes

[Adopters] *Since you started growing soybean, what has changed in the way you farm?*

Probes:

- What crops did you grow before, and what do you grow now?
- What new practices or technologies have you adopted because of soybean (e.g. rotation, inoculants, new varieties)?
- Do soy-maize systems fit easily into your existing farming system, or do they create challenges (e.g. labour, land allocation)?
- Did a buyer ever ask you to grow a particular variety or use a certain input?

[Non-adopters] *How has your farming system changed over time?*

Probes:

- What crops did you grow five years ago, and what do you grow now?
- Have you tried any new crops or practices in recent years? What prompted those changes?
- Are there crops or practices you have stopped using? Why?
- What would it take for you to try something new like soy-maize farming?

Section 5. Climate variability and resilience

Q: ***Have recent climate conditions, such as droughts or heavy rainfall, affected your farming decisions?***

Probes:

- Has climate variability (droughts, late rains, floods, heat waves) influenced your decision to grow or not grow soybean?
- Do soy-maize systems help you cope better with climate shocks compared to growing only maize? In which ways?
- What traditional or local farming practices have you used to manage climate variability? Have any changed since soybean was introduced?
- In your area, which crops are more resilient to climate stress: maize, soybean, or both together?
- Do you use irrigation? If yes, how has it influenced your cropping decisions? If no, how do you manage dry spells?
- Looking ahead, do you think climate change will make you increase or reduce soybean production?

Section 6. Practical understanding of sustainability

Q: ***Looking ahead, do you think soy-maize farming will continue to expand, or might farmers move away from it?***

Probes:

- What would make farmers stop growing soybean?
- What would make the system stronger and more stable in the future?
- Which actors or changes would be most important for long-term success?

Enumerator. *For non-adopters: Do you think soy–maize farming has a future in this area? What makes you say that?*

Section 7. Structured livelihood component

Enumerator instruction. *Switch from the audio-recorded conversation to the structured tool below. Read each item exactly as written. Record Yes or No for each item. Administration should take 2–3 minutes; keep a steady, neutral pace and do not react to answers.*

7.1 Food Insecurity Experience Scale (FIES)

Chichewa / English bilingual field instrument. Reference period: ***miyezi khumi ndi iwiri yapitayi*** *(the past 12 months).*

Read to the participant before starting:

Chichewa: *"Tsopano ndikufunsani mafunso okhudza zakudya. Taganizirani za miyezi khumi ndi iwiri yapitayi. Kodi panali nthawi imene, chifukwa chakusowa ndalama kapena njira zina zopezera chakudya …"*

English: *"Now I would like to ask you some questions about food. Think back over the last 12 months. Was there a time when, because of a lack of money or other resources …"*

Core FIES items (Q1–Q8)

#	Question (Chichewa / English)	Yes	No
Q1	**Munali ndi nkhawa kuti simukhala ndi chakudya chifukwa chakusowa ndalama kapena njira zina zopezera chakudya?** *Were you worried you would not have enough food to eat?*	☐	☐
Q2	**Munalephera kudya zakudya zopatsa thanzi / zakasinthasintha chifukwa chakusowa ndalama kapena njira zina zopezera chakudya?** *Were you unable to eat healthy and nutritious food?*	☐	☐
Q3	**Munadya mitundu yochepa ya zakudya chifukwa chakusowa ndalama kapena njira zina zopezera chakudya?** *Did you eat only a few kinds of foods?*	☐	☐
Q4	**Munalephera kudya chakudya chammawa, kapena chamasana kapena chamadzulo chifukwa chakuchepa kwa ndalama kapena njira zina zopezera chakudya?** *Did you have to skip a meal?*	☐	☐
Q5	**Munadya chakudya chochepa kusiyana ndi momwe munkafunira chifukwa chakusowa ndalama kapena njira zina zopezera chakudya?** *Did you eat less than you thought you should?*	☐	☐
Q6	**Chakudya chinatha pabanja / pakhomo lanu chifukwa chosowa ndalama kapena njira zina zopezera chakudya?**	☐	☐

#	Question (Chichewa / English)	Yes	No
	Did your household run out of food?		
Q7	**Munamva njala koma simunadye chakudya chifukwa chosowa kwa ndalama kapena njira zina zopezera chakudya?** *Were you hungry but did not eat?*	☐	☐
Q8	**Munakhala tsiku lonse osadya kanthu chifukwa chosowa ndalama kapena njira zina zopezera chakudya?** *Did you go without eating for a whole day?*	☐	☐

FIES raw score (total Yes responses, Q1–Q8): _____ / 8

Descriptive raw-score classification: 0 = food secure | 1–3 = mild | 4–6 = moderate | 7–8 = severe food insecurity.

Note. *This raw-score banding is used only for descriptive within-sample comparison; it is not the FAO Rasch-based prevalence method and is not intended to estimate population prevalence.*

7.2 Additional items for households with children under five

Filter question. *Ask first; administer the two child items below only if the answer is Yes.*

Chichewa: Kodi pakhomo pano pali ana ochepera zaka zisanu zakubadwa? (Inde / Ayi) **English:** Does this household have any children under five years of age? (Yes / No)

If Yes, read: *"Kodi pa miyezi khumi ndi iwiri yapitayi panali nthawi yomwe mwana wina ochepera zaka zisanu zakubadwa …" (Over the past 12 months, was there a time when any child under five …)*

#	Question (Chichewa / English)	Yes	No
C1	**Mwana wina aliyense osachepera zaka zisanu zakubadwa analephera kudya zakudya zopatsa thanzi chifukwa chakusowa ndalama kapena njira zina zopezera chakudya?** *Did any child under five not eat healthy and nutritious foods?*	☐	☐
C2	**Mwana wina osachepera zaka zisanu zakubadwa sanapatsidwe chakudya chokwanira chifukwa chakusowa ndalama kapena njira zina zopezera chakudya?** *Was any child under five not given enough food?*	☐	☐

Note. *Following FAO guidance (Ballard et al., 2013), the two child-referenced items are recorded to help interpret household food insecurity but are not included in the FIES raw score (Q1–Q8).*

Section 8. Closing

Enumerator instruction. *Resume audio recording for these closing questions.*

Q: ***What are the biggest opportunities and risks for soy-maize cropping in your area?***

Q: ***Is there anything else you would like to add that we have not discussed?***

Enumerator. *For non-adopters: ask the same closing questions, framed around whether soy–maize farming has a future in this area and what would have to change for them to consider it.*

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Source and citation

Chichewa FIES wording reproduced from: FAO (2013). *Voices of the Hungry Project. Piloting the Global Food Insecurity Experience Scale for the Gallup World Poll in Malawi: Linguistic adaptation in Chichewa and Chitumbuka* (prepared by C. Manyamba). Rome: FAO.

FIES instrument and scoring: FAO (2014). *The Food Insecurity Experience Scale Survey Module*. Voices of the Hungry. Rome: FAO.

Child-referenced items follow Ballard, T. and Kepple, A. (2013), *Voices of the Hungry: Linguistic Adaptation Guidelines and Moderator Guide*, Version 1.2. Rome: FAO.

Appendix 2: Interview Guide B

Field Interview Guide B - Stakeholders
For extension officers, NGO practitioners, private sector actors, government representatives, and researchers.
Drivers and Perceived Sustainability of Soy-Maize Cropping Innovation in Central Malawi · Mcleo Midzi · MSc Thesis, SLU · LEG4DEV Project / IITA
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Interviewer quick reference **Interview duration:** Maximum 60 minutes. **Language:** Conducted in English. **Before starting:** Introduce yourself and the study, explain voluntary participation and confidentiality, confirm informed consent, and request permission to audio-record. **Recording:** Audio-record all sections with consent. **Structure:** Six thematic sections followed by a short closing.

Stakeholder information

Participant ID	
Actor category	
Organisation / role	
District	
Date	
Interviewer	

Section 1. Role and experience
Main question: ***Can you describe your role in relation to soybean and maize farming in this region?***
Probes:

- How long have you worked in this area or on this topic?
- What specific activities does your organisation carry out related to soybean or soy-maize systems?
- How has your role, or your organisation's involvement, changed over time?

Section 2. Adoption dynamics
Main question: ***From your perspective, what is driving the transition towards soy-maize systems in Malawi?***
Probes:

- Role of market demand and value chains (buyers, processors, exporters).
- Influence of private sector actors and contract farming arrangements.

- Impact of government policies and development programmes (e.g. input subsidy programme, agricultural extension).
- Role of farmer networks and cooperatives (e.g. NASFAM).
- Availability of technologies and inputs (improved varieties, inoculants).
- How these different factors interact with and reinforce one another.

Regime resistance and lock-in

- What keeps the maize-dominated system in place despite promotion of soybean? Are there institutional, market, or cultural factors that resist change?
- Are there policies, subsidies, or market structures that inadvertently discourage soybean adoption?

Section 3. Actors, institutions, and power relations

Main question: ***How do different actors interact in shaping soy-maize systems in this region?***

Probes:

- Which actors have the most influence over how the system operates?
- How do farmers, buyers, NGOs, and government agencies work together, or fail to coordinate?
- Are there conflicts, tensions, or coordination problems among these actors?
- Whose interests are prioritised in current arrangements?
- Are there actors who are missing from the system but should be involved?

Section 4. Climate pressures and system response

Main question: ***How do soy-maize systems perform under climate challenges such as droughts and heavy rainfall?***

Probes:

- Are current systems resilient to increasing climate variability?
- Do climate shocks threaten the market, input, or credit systems that support soy-maize farming?
- What adaptations are being promoted by your organisation or others to maintain the system under climate stress?
- Have extension recommendations or programme designs changed in response to recent droughts or floods?
- Has climate variability changed the way contracts, credit arrangements, or insurance products work for soy-maize farmers?

Section 5. Livelihood and social impacts

Main question: ***What livelihood changes have you observed among farmers who have adopted soy-maize systems?***

Probes:

- Have you observed changes in household income, food security, or asset accumulation among adopting farmers?

- Are there differences in livelihood outcomes between men and women, or between wealthier and poorer households?
- Are there farmers or groups who have been left behind or disadvantaged by the shift towards soy-maize?
- Have you observed cases where farmers adopted and later abandoned soy-maize? What drove that decision?

Section 6. Sustainability as system viability

Main question: ***In practical terms, do you consider current soy-maize systems to be sustainable in Malawi?***

Probes:

- Economic viability: profitability for farmers and stability of markets.
- Environmental sustainability: long-term effects on soils and land, including soil fertility benefits from biological nitrogen fixation.
- Institutional sustainability: reliability of input supply, credit, extension, and policy support.
- Equity: who benefits and who may be left behind.
- Are there tensions or trade-offs between these dimensions of sustainability?

Overall, is the system becoming more or less stable over time?

Closing

Characterising the transition

Main question: ***How would you characterise the change you are witnessing in soy-maize farming?***

Probes:

- Is this a minor adjustment within the existing maize-based system, or something deeper and more structural?
- Do you think soy-maize is becoming permanently embedded in the farming system, or does it remain dependent on external support (NGOs, projects, subsidies)?
- If external support were withdrawn, would farmers continue growing soybean at current levels?

Closing questions

What are the biggest opportunities and risks for soy-maize cropping going forward?

Is there anything else you would like to add that we have not discussed?

Appendix 3: Informed Consent Form

Participant Information Sheet
Kalata Yofotokozera Wotenga Nawo Mbali

Study Title / *Mutu wa Kafukufuku*
Drivers and Sustainability of Soy-Maize Cropping Innovation in Malawi
Zomwe Zikupangitsa Kusintha kwa Ulimi wa Soya ndi Chimanga ku Malawi ndi Ngati Ulimi Umenewu Ukhoza Kupitirira
Researcher / *Wofufuza*
Mcleo Midzi, MSc student at the Swedish University of Agricultural Sciences (SLU), conducting research under the IITA LEG4DEV project.
Mcleo Midzi, wophunzira wa MSc ku Swedish University of Agricultural Sciences (SLU), akupanga kafukufuku pansi pa IITA LEG4DEV.
Purpose of the Study / *Cholinga cha Kafukufuku*
This study seeks to understand why farmers in Central Malawi are growing soybean alongside maize, what factors support or hinder this change, and whether these farming systems can be sustained under conditions of changing climate. We are speaking with farmers, extension officers, NGOs, private sector actors, and government representatives across Kasungu, Mchinji, and Lilongwe districts.
Kafukufuku ameneyu akufuna kumvetsetsa chifukwa chake alimi ku Central Malawi akulima soya pamodzi ndi chimanga, zomwe zimathandiza kapena kulepheretsa kusintha kumeneku, ndiponso ngati njira za ulimiyi zingathe kupitirira pamene nyengo ikusintha. Tikulankhula ndi alimi, alangizi a ulimi, mabungwe, anthu a bizinesi, ndi a boma ku Kasungu, Mchinji, ndi Lilongwe.
What Participation Involves / *Zomwe Kutenga Nawo Mbali Kumaphatikizapo*
If you agree to take part, I will ask you questions about your farming practices, your experience with soybean and maize, climate challenges, and your household's wellbeing. The interview will take approximately 60 minutes. With your permission, I will audio-record the conversation to ensure accuracy. If you prefer not to be recorded, we will take written notes instead.
Ngati muvomera kutenga nawo mbali, ndikufunsani mafunso okhudza ulimi wanu, chidziwitso chanu pa soya ndi chimanga, mavuto a nyengo, ndi za moyo wa pa banja lanu. Kufunsidwaku kutenga mphindi 60. Ndi chilolezo chanu, ndijambula mawu kuti tikhale otsimikiza. Ngati simufuna kujambulidwa, tilemba m'malo mwake.
Voluntary Participation / *Kutenga Nawo Mbali Mwaufulu*
Your participation is entirely voluntary. You may choose not to answer any question, and you may stop the interview at any time without giving a reason. Your decision will not affect your relationship with any organisation, project, or extension service.

Kutenga nawo mbali kwanu ndi kwaufulu. Mukhoza kusankha kusayankha funso lililonse, ndipo mukhoza kusiya nthawi ina iliyonse popanda kupereka chifukwa. Chisankho chanu sichikhudza ubale wanu ndi bungwe, pulojekiti, kapena ntchito ya alangizi.

Confidentiality / *Chinsinsi*

Everything you share will be kept strictly confidential. Your name will not appear in any report, thesis, or publication. We will use a code instead of your name. Audio recordings will be stored securely and accessed only by the research team. All data will be stored on password-protected devices.

Zonse zomwe mutiuze zikhala za chinsinsi. Dzina lanu silizaoneka mu lipoti, zolemba za sukulu, kapena zofalitsidwa. Tigwiritsa ntchito nambala m'malo mwa dzina lanu. Zojambulidwa zikhala m'malo otetezedwa ndipo anthu okhawo a kafukufuku ndiwo amatha kupeza. Zonse zisungidwa pa zida zotetezedwa ndi mawu achinsinsi.

Risks and Benefits / *Zoopsa ndi Ubwino*

There are no known risks to participating in this study. Some questions about food and livelihoods may be sensitive; you are free to skip them. This is an academic study and there are no direct benefits, payments, or material compensation for participating. The information you provide will help improve understanding of farming systems in Malawi.

Palibe zoopsa zodziwika potenga nawo mbali. Mafunso ena okhudza chakudya ndi moyo akhoza kukhala ovuta; mukhoza kuwadumpha. Uyu ndi kafukufuku wa sukulu ndipo palibe phindu, malipiro, kapena zinthu zomwe mupatsidwe potenga nawo mbali. Chidziwitso chanu chithandiza kumvetsetsa za ulimi ku Malawi.

Contact Information / *Momwe Mungapezere Ofufuza*

Researcher: Mcleo Midzi
Email: mczi00001@stud.uu.se
Phone: +265 985 455 312
Supervisors: Jennie Barron and Michael Jones, Swedish University of Agricultural Sciences (SLU)
Host institution: International Institute of Tropical Agriculture (IITA), LEG4DEV Project

Informed Consent Form
Kalata ya Chilolezo

Study: Drivers and Sustainability of Soy-Maize Cropping Innovation in Malawi
Researcher: Mcleo Midzi (SLU / IITA LEG4DEV) | mczi00001@stud.uu.se | +265 985 455 312
Interview ID: _____ **Date:** _____

By ticking the boxes below, I confirm that:
Podinda m'mabokosi ali m'munsimu, ndikutsimikiza kuti:

□	I have read or been read the Participant Information Sheet and understand the purpose of the study. *Ndawerenga kapena ndinawerengeredwa Kalata Yofotokozera ndipo ndamvetsetsa cholinga cha kafukufuku.*
□	I have had the opportunity to ask questions and my questions have been answered satisfactorily. *Ndapatsidwa mwayi wofunsa mafunso ndipo mafunso anga ayankhidwa bwino.*
□	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. *Ndamvetsetsa kuti kutenga nawo mbali kwanga ndi kwaufulu ndipo ndikhoza kusiya nthawi ina iliyonse popanda kupereka chifukwa.*
□	I understand that my identity will be kept confidential and that my name will not appear in any report or publication. *Ndamvetsetsa kuti dzina langa likhala la chinsinsi ndipo silizaonekera mu lipoti kapena zofalitsidwa.*
□	I understand that there are no direct benefits, payments, or material compensation for participating. *Ndamvetsetsa kuti palibe phindu, malipiro, kapena zinthu zomwe ndipatsidwe potenga nawo mbali.*
□	I agree to participate in this interview. *Ndavomera kutenga nawo mbali mu kafunsidwe ameneyu.*

Audio Recording Consent / Chilolezo cha Kujambula Mawu
□ I agree to the interview being audio-recorded.
Ndavomera kuti kafunsidweyu ajambulidwe mawu.
□ I do NOT agree to audio recording. Written notes may be taken instead.
Sindivomera kujambulidwa mawu. M'malo mwake mukhoza kulemba zolemba.

Participant / ***Wotenga Nawo Mbali***

Signature or mark / Kusainira kapena kudinda		Date / Tsiku

Printed name (optional) / Dzina (ngati mufuna)

Researcher / Enumerator / ***Wofufuza / Wofunsa***

Signature / Kusainira		Date / Tsiku

Printed name / Dzina

If oral consent is given instead of a written signature:
Ngati chilolezo chaperekedwa pakamwa m'malo mwa kusainira:
□ Oral consent was obtained and recorded on the audio device at the start of the interview.
Enumerator signature confirming oral consent: _____

One copy of this form is to be kept by the research team. If the participant requests a copy, provide one.
Kalata imodzi isungidwe ndi a kafukufuku. Ngati wotenga nawo mbali akufuna kalata, mupatseni.

Appendix 4: List of Interviewees

Farmer participants (n = 30: 22 adopters, 8 non-adopters)

ID	District	Adopter / non-adopter	Adoption trajectory	Gender	Age range	FIES band	Interview date
LIL-FA-01	Lilongwe	Adopter	Continuing adopters	Female	45+	Food secure	11 April 2026
LIL-FA-02	Lilongwe	Adopter	Continuing adopters	Male	45+	Mild	11 April 2026
LIL-FA-03	Lilongwe	Adopter	Continuing adopters	Female	45+	Moderate	11 April 2026
LIL-FA-04	Lilongwe	Adopter	Continuing adopters	Female	35-40	Mild	11 April 2026
LIL-FA-05	Lilongwe	Adopter	Continuing adopters	Female	45+	Food secure	11 April 2026
LIL-FA-06	Lilongwe	Adopter	Continuing adopters	Male	35-40	Moderate	16 April 2026
LIL-FA-07	Lilongwe	Adopter	Continuing adopters	Female	18-25	Moderate	16 April 2026
LIL-FA-08	Lilongwe	Adopter	Continuing adopters	Male	35-40	Food secure	16 April 2026
LIL-FA-09	Lilongwe	Adopter	Continuing adopters	Male	45+	Mild	16 April 2026
LIL-FA-10	Lilongwe	Adopter	Continuing adopters	Female	35-40	Food secure	16 April 2026
KA-NA-01	Kasungu	Non-Adopter	Reversers	Male	35-40	Mild	17 April 2026
KA-FA-02	Kasungu	Adopter	Continuing adopters	Female	45+	Mild	17 April 2026
KA-FA-03	Kasungu	Adopter	Continuing adopters	Female	45+	Mild	17 April 2026
KA-FA-04	Kasungu	Adopter	Reduced-scale adopters	Female	45+	Severe	17 April 2026
KA-NA-05	Kasungu	Non-Adopter	Reversers	Female	30-35	Moderate	17 April 2026
KA-FA-06	Kasungu	Adopter	Continuing adopters	Male	45+	Mild	18 April 2026
KA-NA-07	Kasungu	Non-Adopter	Constrained non-adopters	Male	30-35	Mild	18 April 2026
KA-FA-08	Kasungu	Adopter	Reduced-scale adopters	Female	45+	Food secure	18 April 2026
KA-FA-09	Kasungu	Adopter	Reduced-scale adopters	Male	30-35	Mild	18 April 2026
KA-NA-10	Kasungu	Non-Adopter	Reversers	Female	35-40	Mild	18 April 2026
MCH-FA-01	Mchinji	Adopter	Continuing adopters	Female	18-25	Mild	14 April 2026
MCH-FA-02	Mchinji	Adopter	Continuing adopters	Female	45+	Food secure	14 April 2026
MCH-NA-03	Mchinji	Non-Adopter	Reversers	Male	35-40	Mild	14 April 2026
MCH-FA-04	Mchinji	Adopter	Reduced-scale adopters	Female	30-35	Moderate	14 April 2026
MCH-NA-05	Mchinji	Non-Adopter	Reversers	Female	35-40	Mild	14 April 2026
MCH-FA-06	Mchinji	Adopter	Reduced-scale adopters	Female	35-40	Moderate	15 April 2026
MCH-FA-07	Mchinji	Adopter	Continuing adopters	Male	45+	Moderate	15 April 2026
MCH-NA-08	Mchinji	Non-Adopter	Constrained non-adopters	Female	30-35	Severe	15 April 2026

ID	District	Adopter / non-adopter	Adoption trajectory	Gender	Age range	FIES band	Interview date
MCH-FA-09	Mchinji	Adopter	Continuing adopters	Male	45+	Mild	15 April 2026
MCH-NA-10	Mchinji	Non-Adopter	Constrained non-adopters	Female	45+	Severe	15 April 2026

Stakeholders (n = 14)

ID	Actor category	Sector / role (described generically)	District	Interview date	Language
EXT-01	Agricultural extension officer	District / EPA extension, Ministry of Agriculture (DAES)	Lilongwe	11 April 2026	English
EXT-02	Agricultural extension officer	District / EPA extension, Ministry of Agriculture (DAES)	Lilongwe	16 April 2026	English
EXT-03	Agricultural extension officer	District / EPA extension, Ministry of Agriculture (DAES)	Mchinji	14 April 2026	English
EXT-04	Agricultural extension officer	District / EPA extension, Ministry of Agriculture (DAES)	Mchinji	14 April 2026	English
EXT-05	Agricultural extension officer	District / EPA extension, Ministry of Agriculture (DAES)	Kasungu	15 April 2026	English
EXT-06	Agricultural extension officer	District / EPA extension, Ministry of Agriculture (DAES)	Kasungu	15 April 2026	English
EXT-07	Agricultural extension officer	District / EPA extension, Ministry of Agriculture (DAES)	Kasungu	15 April 2026	English
NGO-01	NGO practitioner	Soybean promotion / programme staff	Lilongwe	27 March 2026	English
NGO-02	NGO practitioner	Soybean promotion / programme staff	Lilongwe	31 March 2026	English
PRIV-01	Private sector actor	Input supply / seed	Lilongwe	27 March 2026	English
PRIV-02	Private sector actor	Aggregation / trading	Lilongwe	5 April 2026	English
PRIV-03	Private sector actor	Contract / market intermediary	Lilongwe	5 April 2026	English
RES-01	Researcher	Agricultural research	Lilongwe	8 April 2026	English
RES-02	Researcher	Agricultural research	Lilongwe	8 April 2026	English

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