INITIATIVE ON
Mixed Farming Systems

Context assessment for mixed farming systems in Malawi

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The Sustainable Intensification of Mixed Farming Systems Initiative aims to provide equitable, transformative pathways for improved livelihoods of actors in mixed farming systems through sustainable intensification within target agroecologies and socio-economic settings.

Through action research and development partnerships, the Initiative will improve smallholder farmers' resilience to weather-induced shocks, provide a more stable income and significant benefits in welfare, and enhance social justice and inclusion for 13 million people by 2030.

Activities will be implemented in six focus countries globally representing diverse mixed farming systems as follows: Ghana (cereal–root crop mixed), Ethiopia (highland mixed), Malawi: (maize mixed), Bangladesh (rice mixed), Nepal (highland mixed), and Lao People's Democratic Republic (upland intensive mixed/ highland extensive mixed).

Contents

Abbreviations and acronyms

ADMARC	Agriculture Development and Marketing Corporation
AEDO	Agricultural Development Extension Officer
AIP	Affordable Inputs Programme
CA	Conservation Agriculture
EAD	Environmental Affiars Department
EARS	East African Rift Valley System
ENSO	El Nino and Southern OScillation
EPAs	Extension Planning Areas
FAO	Food and Agriculture Organization of the United Nations
GDP	Dross Domestic Product
GoM	Government of Malawi
IOD	Indian Ocean Dipole
ITCZ	Inter Tropical Convergence Zone
JFM	January-February-March
NBSAP	National Biodiversity Strategies and Action Plans
OND	October-November-December
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SI	Sustainable Intensification
SIAF	Sustainable Intensification Assessment Framework
SI-MFS	Sustainable Intensification of Mixed Farming Systems Initiative
SMEs	Small and Medium Enterprises
UNDP	United Nations Development Programme
VNRMCs	Village Natural Resources Committees
ZAB	Zaire Air Boundary

Executive summary

In Malawi, the Sustainable Intensification of Mixed Farming Systems Initiative seeks to sustainably intensify crop-tree-livestock farming systems and develop reliable indicators to assess the systems to monitor the transition. But before strengthening these systems, the Initiative needed to understand and appreciate the current context of agriculture in terms of resource endowment, management, and agricultural intensity in the targeted districts and associated Extension Planning Areas (EPAs), namely: Balaka District, in EPAs of Phalula and Rivirivi, Dedza District, in EPAs of Lobi and Golomoti; Kasungu District, in EPAs of Lisasadzi and Chulu; and Champhira EPA in Mzimba District.

The purpose of the document was four fold: first, to provide a narrative description of key resources to characterize the food and farming systems in each of the selected EPAs; second, to use the SI Framework Assessment as a guide in identifying the intensity of agriculture within each EPA; third, to assess past and existing interventions on SI and associated indicators measured in each EPA; and four, to recommend mechanisms that would allow for sustainable intensification.

Agriculture accounts for over one-quarter of Malawi's gross domestic product (GDP). The sector provides direct and indirect employment, economic growth, export earnings, poverty reduction, food security, and nutrition in the targeted districts. Maize is the major food crop, but tobacco and soybean are dominant cash crops. Additional cash crops are sugar, tea, and cotton. Other legumes include common beans, pigeon peas, cowpea, and groundnuts. There is a higher concentration of livestock in the northern districts of Malawi and a low concentration in the south. Across the districts, the use of improved technologies such as inorganic fertilizer, hybrid seed, and mechanization remains low and inefficient. In addition, farmers have limited access to land and extension services. Besides Kasungu, which borders a national wildlife reserve, most districts have experienced significant land degradation, with high deforestation and soil erosion rates. Also, there are weak synergies across different farm components with very little integration of agroforestry within the farming landscapes.

The government acknowledges that agricultural intensification is needed to grow the economy and increase food security. Extension services have mainstreamed several technologies within the scope of sustainable intensification. This includes but is not limited to crop rotation, intercropping maize with multipurpose legumes, inorganic fertilizer, pest and diseases management and various water harvesting and soil conservation techniques. However, poor resources, including funding distribution, low levels of mechanization and literacy, etc., have impacted the sustainability of these interventions.

The key recommendations include conducting sensitization and awareness campaigns and enhancing knowledge dissemination to smallholder farmers about the importance and benefits of adopting SI technologies, particularly crop-tree-

livestock mixed farming systems. Train extension and farmers on farm system designing to enhance synergies across the different farm components.

Background

The desire for agriculture to produce more food without environmental harm, and make positive contributions to natural and social capital, has gained prominence over the years with several publications, including those by Conway (1997), "doubly green revolution"; NRC (1989), "alternative agriculture"; Swaminathan (2000), "evergreen revolution"; Snapp et al. (2010), "greener revolutions"; Garrity et al. (2010), "evergreen agriculture"; Milder et al. (2012), "agroecological intensification"; and DEFRA (2012), "green food systems". Agriculture is critical in achieving most of the United Nations Sustainable Development Goals (SDGs) targets. Sustainable Intensification (SI) of agriculture has found an important and special niche in contributing to increased global food production, environmental protection, and social capital. In a nutshell, SI is a concept that promotes the safeguarding of global food security while simultaneously protecting the environment and maintaining a good quality of life. This concept proposes three underlying principles: increasing agricultural productivity, improving resource-use efficiency, and reducing harmful inputs; and halting expansion in important biodiversity hot spots by confining food production to existing farmland.

One tenet of sustainable Intensification (SI) is the non-expansion of agriculture into unfarmed areas and "producing more output from the same area of land while reducing the negative environmental impacts", as expressed by Pretty et al. (2011). This concern for non-expansion is explained by the need to prioritize the protection of biodiversity and environmental resources. Land use intensification can be achieved through increased inputs, changing to more productive crops and converting to a more productive farming system, e.g., through irrigation (Martin et al., 2018).

Smallholder farmers in Malawi face a constant challenge: to choose between many, often competing, social, economic, and environmental objectives while also meeting expectations to intensify their farming practices sustainably and produce 'more with less'. Population growth, urbanization, water scarcity, soil degradation, climate change, evolving food consumption patterns and price volatility are pressures concerning these systems. In Malawi, the Sustainable Intensification of Mixed Farming Systems Initiative seeks to sustainably intensify crop-tree-livestock farming systems and develop reliable indicators to assess the systems to monitor the transition. But before strengthening these systems, the initiative needs to understand and appreciate the current context of agriculture in terms of resource endowment, management, and agricultural intensity. For this reason, a context assessment following the Sustainable Intensification assessment framework (SIAF) was undertaken.

Sustainable Intensification Assessment Framework (SIAF)

The SIAF provides a set of indicators organized into five domains considered critical for sustainability, namely productivity, economics, environment, the human condition, and social domains (Musumba et al., 2017).

Productivity

The productivity domain is critical in capturing productivity in cropping, tree, and livestock systems. Following the SI literature, this domain focuses on land as a critical input. Increasing productivity is the essential characteristic of intensification, intending to increase output per unit of input for a given period (season or year). In livestock systems, stocking rates or offtake may be used to measure intensification, while in cropping systems, intensification focuses on yields (Mahon et al., 2017). Across the different systems, resource management and use efficiency are also considered. For instance, irrigation and other agricultural water management practices, e.g., soil water conservation, rainwater harvesting, etc., are part of intensification as they increase water availability for production and de-risk it. This domain also captures post-harvest losses and cropping intensity (the number of crops per year from the same piece of land). It also contains indicators that may assess the land's production potential and variability due to biophysical aspects. Other inputs associated with intensification (such as labour, water quality, fertilizer, and capital) are captured in the economic domain.

Environment

This domain focuses on the natural resource base supporting agriculture (e.g., soil, water, air), the environmental services directly affected by agricultural practices (e.g., habitat, soil water holding capacity, biodiversity) and the level of pollution coming from agriculture (pesticides, eutrophication, greenhouse gases). Improved efficiency metrics are described under the economic domain but are also critical for tightening nutrient and energy cycles, a key principle for sustainable agriculture.

Economic

This domain focuses on issues directly related to the profitability of agricultural activities and returns to factors of production (land, labour, and capital). In addition to profitability, this domain includes indicators related to the productivity of inputs, apart from the land, and includes water, nutrients, labour, and capital. Furthermore, indicators likely to affect the probability of investment in enhancing productivity (market participation) are included in this domain. Farmers' decisions to choose which crop to grow or animals to keep and how to allocate resources to different activities are affected by the commodity's marketability and livelihood strategies chosen to improve well-being. This domain captures farmers' market orientation, income, diversification of income sources, extent, and movement towards the high value of their farm products and poverty, among others.

Social
This domain focuses on the social interactions of farming communities or society, including equitable relationships across gender, equitable relationships across social groups, the level of collective action, and the ability to resolve conflicts related to agriculture and natural resource management.

Human condition
This domain contains indicators related to the individual or household, including nutrition status, food security, and capacity to learn and adapt. While some of these concepts depend on social interactions (such as within the household or community), they are distinct from those in the social domain that directly focus on interpersonal relationships.

Objective of the study

The objective was to carry out a Context Assessment for four selected districts and associated EPAs in Malawi, namely: Balaka District, in EPAs of Phalula and Rivirivi; Dedza District, in EPAs of Lobi and Golomoti; Kasungu District, in EPAs of Lisasadzi and Chulu; and Champhira EPA in Mzimba District.

The purpose of this document is fourfold: first, to provide a narrative description of key resources that characterize the food and farming systems in each of the selected EPAs; second, to use the SI Framework Assessment as a guide in identifying the intensity of agriculture within each EPA; third, to assess past and existing interventions on SI and associated indicators measured in each EPA; and four, to recommend mechanisms that would allow for sustainable intensification.

Methodology

The context assessment relied heavily on a desk review of published and grey literature and stakeholder consultations (particularly key informant interviews). As such, the consultant adopted the two-pronged approach highlighted above in undertaking the four key activities of the assignment described in Sections 4.1 to 4.7.

Context assessment framework

This section provides a narrative description and key resources critical in characterizing the food and farming systems in the selected districts and associated EPAs. Below are some guiding questions and topics considered under each domain. As stated earlier, these questions were used as a guide to understand the current context.

Environmental context

- What is the climate/climatic zone of the EPA and district?
- What are the major climate change impacts projected or currently experienced?
- What are the main environmental challenges (land degradation, deforestation, weather-related risks, river systems etc.)?
- Is there information that describes the ecosystems?
- Describe any forests, nature reserves, or protected lands.
- Is there information on natural resources, land/soil, water, and biodiversity?
- A measure of the state of the natural biodiversity, the stressors, and the change over time.
- Wildlife, natural biodiversity on land, water, and wetlands, summarized at large scale (e.g., from the National NBSAP), and where possible, with more detail at the field and farm scales.
- Efforts by farmers to maintain natural biodiversity, e.g., intact riparian vegetation, forest patches, wind-break trees, hedge rows etc.
- Practices and policies adopted to maintain a high level of biodiversity.
- Existing practices enhance the quality and sequestration of soil organic matter versus practices that accelerate the loss of soil organic matter.
- This would include an estimate of fires, grazing, of compaction.
- Evaluation of the state of the soil and changes over time, including physical, chemical, and biological properties as affected by farming practices (if reports or data exist).
- Soil microbial diversity, including functional diversity.
- Occurrence of alien invasive species; and
- What is the water quality in the EPA, and how do these affect household use, livestock, and crop production?

Production context

People in different areas have different priorities and preferences regarding food, which impacts options available in farming situations across the EPAs. In this respect, the data required would include the following:

- Typology of producers and their practices related to agricultural inputs.
- Access to agricultural genetic material, improvements, modifications, and local practices
- Plant/crop diversity (including genetic diversity),
- Livestock and aquatic animal breeds (including genetic diversity), and
- Information on local food crops and livestock as well as wild harvest food preferences, including history and shifts over time and their seasonality.
- Information on local production of food, feed, and fodder commodities versus importing.
- Type of inputs used for production and how producers acquired such inputs (at a cost or not, in kind, in exchange for other goods and services or generated on a farm or not).
- The trend of input use, to make a difference between input reduction and absence of input use.
- Limitations and options available to farmers to reduce the dependence on synthetic fertilizers and pesticides (i.e., compost, manure, ash, fish meals, guano, biofertilizers, biopesticides, etc.).
- Farming practices that enhance and protect soil health, e.g., minimum tillage, mulching, conservation agriculture, resting land etc.
- Farming practices that enhance and protect animal health, e.g., shelter, vaccination, veterinary services, dip tanks.
- Water use for crop (and livestock) production in the case of irrigated production systems and an inventory of various techniques used for irrigation.
- Inventory of water retention techniques that enhance water availability in the crop and live production systems [for crops consider techniques that reduce the frequency of irrigation without significant impact on ecosystem services (e.g., zai technique, use of mulch, or use of furrows)]; and
- Synergies within the farm – what are the components, the interactions between the components, boundaries, inputs, and outputs?

Economic context

- What are the main value chains in the EPA?
- Do farmers/food producers have access to credit or savings and loan groups?
- Do farmers have land tenure? How is land inherited?
- What assets do farmers/food producers generally have access to?
- What are the main markets in the EPA? Both in terms of geographic location and nature of the market (basic food/agricultural inputs and output/livestock/clothes/appliances etc.).
- What is the distribution of markets across the EPA / what is the distance to markets across various reference points in the EPA?
- Available infrastructure for storing grain, refrigerating produce etc., on and off-farm.

- What is the road network like? How is the EPA connected to major cities, and how are villages within the EPA connected?
- Is migration important in the EPA? What is the percentage of men who emigrate? And for women? Is there immigration? What is the push/pull factors behind migration? Is it permanent or temporary?
- Employment opportunities within and outside agriculture.
- Diversity of clients for the on-farm products.
- Crops and livestock and aquatic animals that generate regular income within a year, one annual income or income after a couple of years following establishment.
- Income from activities beyond the farm level, including wild products such as NTFPs.
- On-farm processing, such as preparation (and local sale) of local dishes; and
- Other economic diversification includes wage labour, temporary or more permanent migration of some family members etc.

Social context

- What is the typical household structure? The family structure and size, including single-parent households etc.
- Describe the ethnicity of the EPA and fluxes over time.
- What are common educational levels? Are they similar for women/men across different ethnic groups?
- Describe asset ownership (Land, livestock, bicycles, radios etc).
- Who controls and manages assets, and how does gender aggregate this?
- What are the gender relations in the EPA? (see this link for guidelines on this. https://cgspace.cgiar.org/handle/10568/120076).
- How do farmers get information and make decisions?
- At what age do men/women typically get married?
- How are communities / public life in communities organized?
- What are the power relations in society, and how do they impact agriculture?
- Local community involvement level in natural resource management.
- Disaggregation of the above information by gender and youth and land ownership.
- Within the communities, is there access to services, extension service.
- What is the availability of schools (primary and secondary).
- What is the availability of mobile phone services/money, availability of cooperatives/farmer organizations etc.
- Can women be local leaders?
- Are social groups excluded from political decision-making (e.g., women or ethnic groups)?
- Who exerts "real" decision-making power in the territory, and what is the basis for such power; and
- Are there any other unique political factors at play?

Human condition context

- How are health levels, and do they impact the food chain?
- How do the national political scene and dynamics materialize at the EPA level?
- The diversity of diets and diet composition building on local food commodities.
- Knowledge of the nutritional facts of such food products.
- Level of dependence on food import (i.e., food produced out of the boundary of the EPAs); and
- Information on food preferences by the local communities and changes over time in consumption patterns.

Preliminary findings

Although the general discussion in this section is about Malawi as a country, the focus is on the four districts in which the MFS initiative is working, namely: Balaka, Dedza, Kasungu and Mzimba, with specific emphasis on the following seven EPAs: Rivirivi and Phalula, in Balaka district (Southern Region); Lobi and Golomoti, in Dedza district (Central Region); Lisasadzi and Chulu, in Kasungu district (Central Region); and Champhira in Mzimba district (Northern Region).

Context overview

Malawi is a landlocked country in sub-Saharan Africa (Figure 1). It lies at the southern end of the Great East African Rift Valley System (EARS) between latitudes 9° 22' and 17°03' south of the equator and longitudes 33° 40' and 35° 55' east of the Greenwich Meridian. Tanzania borders it to the north and northeast; Mozambique to the east, south and southwest; and Zambia to the west and northwest. The country's total surface area is approximately 118,484 km², of which 28,000 km2 (nearly 20%) is occupied by Lake Malawi/Nyasa/Niassa (Kululanga and Chavula, 1993). Malawi is 910 km long and varies in width from 60 to 161 km.

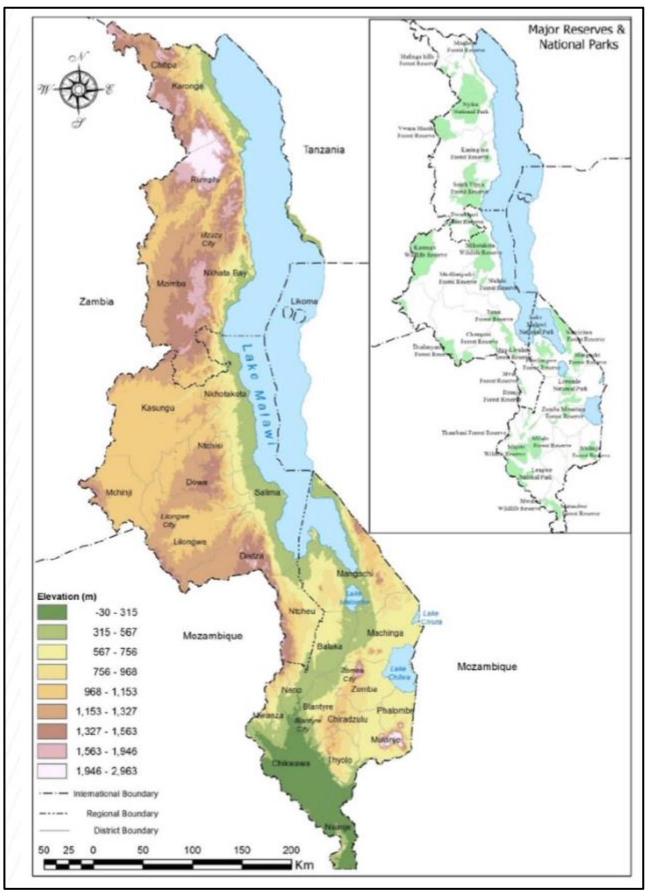


Figure 1. Map of Malawi (Source European Union 2021) Support evidence-based policy decisions by European Union in Malawi in the field of sustainable agriculture and food nutrition security RFS NO SIEA-2018-424 Report for Country Environmental Profile.

Environment context

Climate and climate change scenarios

Malawi experiences a tropical-continental climate with two distinct seasons: a wet season from November to April and a dry season from May to October. The dry season is characterized by strong southeasterly trade winds (Mwera), while during the wet season, the winds are generally northeasterly (Mpoto) and weaker. A cool, dry winter season prevails from May to August, with mean temperatures between 17 and 27 °C. A hot, dry season lasts from September to October, with average temperatures between 25 and 37 °C. Malawi's annual average rainfall varies from approximately 700 mm in low-altitude areas, such as the Lower Shire Valley in the Southern Region, to over 2000 mm in highlands and lakeshore areas (Figure 2) — variations in altitude and proximity to Lake Malawi. Rainfall patterns display wide inter and intra-seasonal variability.

Three major synoptic systems bring rainfall to Malawi, namely: the Inter Tropical Convergence Zone (ITCZ), the Zaire Air Boundary (ZAB)/Congo Airmass, and tropical cyclones (Kululanga and Chavula, 1993). The Inter Tropical Convergence Zone is broad in the equatorial low-pressure belt towards which the two hemispheres' northeasterly and southeasterly trade winds converge. The ITCZ oscillates randomly across the country during the rainy season, producing widespread rainfall. The rains start in the southern part of the country and progress northwards. The Zaire Air Boundary is a re-curved south Atlantic southeast trade winds system, which after collecting moisture over the Atlantic and Congo (Zaire) rain forest, arrives in Malawi via Zambia as a moist northwesterly wind, bringing widespread rainfall in the country. Tropical Cyclones are intense low-pressure cells that originate in the Indian Ocean and move from east to west and bring widespread heavy rainfall in Malawi, mainly in the southern part of the country, depending on their position in the Mozambique Channel. These rains usually result in flooding. Evidence suggests the existence of temperature variability and increased intensity of floods and droughts (EAD, 2008).

Analysis of trends in monthly rainfall across Malawi indicates that most regions have experienced decreasing but non-significant rainfall trends since 1960 (Tadeyo et al., 2020). Decreases are evident for annual and seasonal rainfall and from March to December (Muthoni et al., 2019). Muthoni et al. (2019) reported a significant decrease in December rainfall for a small extent around Mzuzu in northern Malawi, while slight increases are evident for the highest rainfall months of January and February. Again, this points to a tendency for the rain to fall more intensely, negatively impacting food production and water access. Decreases in annual runoff and increases in evaporation losses have also been found from 1979-2015 (Tadeyo et al., 2020), indicating that decreasing rainfall has practical significance in that Malawi has become more water-limited in recent decades. Ririvi and Phaula EPAs receive low rainfall (< 800 mm/annum) because they lie in the rain shadow area and are prone to dry spells. However, the remaining EPAs generally receive reasonably high rainfall annually.

Despite the changes in rainfall amount, significant changes in temporal distribution and extreme events have been reported in Malawi. Haghtalab et al., 2019 reported that at least one-third of Malawi experienced significant temporal shifts in the rainfall season. They reported very localized but significant shifts in (a) delayed onset ranging from 18 – 35 years; (b) a decrease in the number of dry days by about 21.6 days, (c) earlier cessation of rain seasons ranging from 21.6 days in the northeast and 36 days in the south, (d) decreased the number of extreme events by between 5 – 7 days, and (e) spatially isolated but robust trends in length of rainy seasons from 54 days shorter to 49 days longer. These changes are spatially heterogenous and not driven by broad-scale climatic forces.

Malawi is also vulnerable to droughts caused by the El Nino and Southern Oscillation (ENSO) phenomena and the Indian Ocean Dipole (IOD). Studies about the ENSO warm phase episode in southern Africa indicates two drought cells affecting Malawi, mainly the southern part of the country (Eastman et al., 1996). The first drought cell shows a path originating from Namibia but covering Botswana, Zimbabwe, southern Zambia, northwest Mozambique, and the southern part of Malawi. In contrast, the second drought cell is centered near southern Mozambique and southern Zambia and appears to expand outwards. Furthermore, it is envisaged that the intensity and frequency of these drought episodes will increase with climate change.

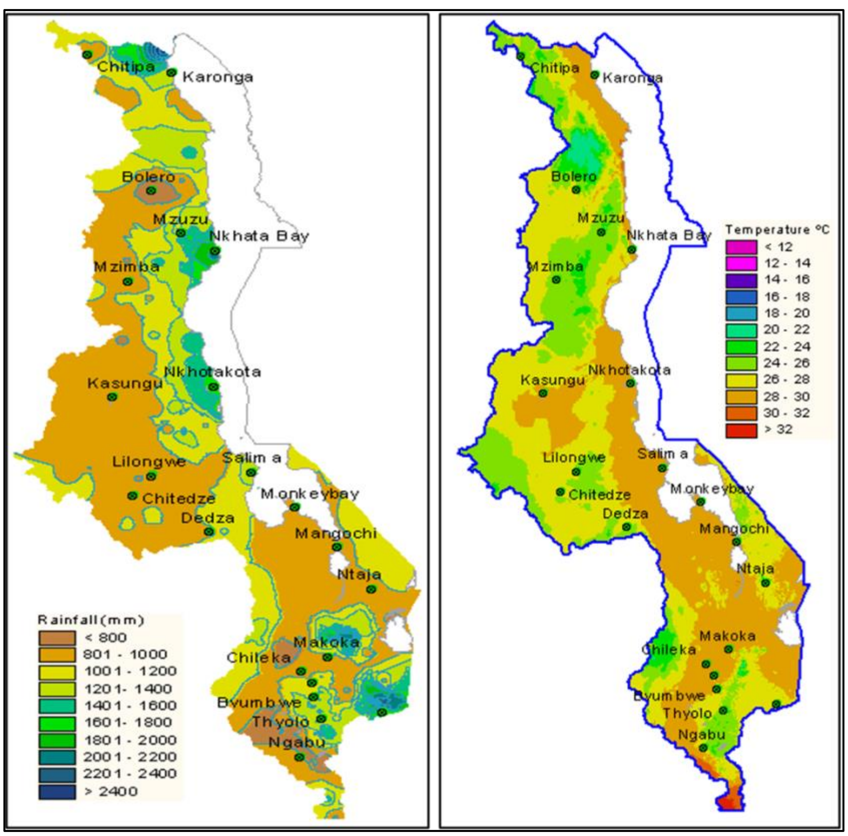


Figure 2. Rainfall and temperature distribution map (Source: Water Department/UNDP,1986).

Temperature data across Malawi indicates an increase in temperatures of 0.9°C since 1960 at an average rate of 0.21°C per decade. The increase in temperature has been most rapid in December-February (mid-summer) and slowest during September-November (early summer). Observations in Malawi are consistent with Sub-Saharan Africa and global trends. Regarding temperature-related extremes, hot days and nights have increased in all seasons. The average number of hot days has increased by 30.5 per year since 1960, particularly in summer, and the average hot nights increased by 41 days over the same period (World Bank, 2011).

Climate variability and change are already affecting Malawi, which has experienced more dry spells and extreme rainfall over the last two decades (Warnatzsch and Reay, 2019). Based on climate scenario analysis work across the country, the following conclusions may be drawn: (a) there is a positive trend in temperature rise, i.e., there will be an increase in temperature; (b) minimum temperatures exhibit a faster rise in temperature with climate change than maximum temperatures increasing evaporative loses; (c) generally, there is an insignificant decrease in rainfall during the OND period, and an increase during JFM resulting in a shift in the growing season; (d) future temperatures will rise by 1.3 °C to 2.6 °C; and (e) El Nino conditions will likely increase climate extremes, resulting in the increased severity, or magnitude/intensity, and frequency of floods, droughts, and strong winds (Mtilatila et al., 2022; Table 1).

What is clear from the description of climate change scenarios for Malawi presented above is the increased occurrence of floods, droughts, and strong winds. This has resulted in significant crop and animal losses in a country with low coping mechanisms to risk. Hence, the country needs to implement robust adaptation strategies in agriculture to ensure food and nutrition security.

Physiographic zones and soils

Malawi is divided into four major physiographic zones: the high land areas, plateau areas, rift valley escarpment and rift valley plains (Water Department/UNDP, 1986; Figure 3). The plateau areas occupy approximately 75% of the land surface and range in altitude from 750 - 1300 meters. The rift valley plains comprise the flat land along Lake Malawi's shores, ranging from 450 - 600 meters. The plateau areas are extensively peneplain-gently undulating surfaces with broad valleys and large level areas on the interfluves (Figure 3). They are ancient erosion surfaces (the African surface) of the late Cretaceous to Miocene age, which slope away from the escarpment zones due to uplift along the Rift Valley System. Still, the drainage systems have kept pace with these earth movements and largely drain towards the rift valley (Water Department/UNDP, 1986).

Consequently, the valleys become more incised towards the escarpment. The plateau areas are drained largely by dambos, i.e., broad, grass-covered swampy valleys liable to flooding and commonly have undefined drainage channels. The plateau areas are mostly covered by a thick mantle of saprolite derived by in-situ weathering of the underlying strata (Figure 3). The predominant soils covering the plateau and lakeshore areas are deep, calcimorphic alluvials and colluvial, which tend to be sandy. Hydromorphic soil deposits in isolated depressions have a high clay and silt fraction.

Table 1: A summary of projected temperature and rainfall changes in Malawi by physiographic zones or areas.

Location	New Century Period:2011 -2040	Mid-Centruy Period: 2041-2070	End Century Period: 2071–2100
Lower Shire Valley [Mzimba and Balaka district]	0.03°C-0.04°C: temperature increase.	1.4°C-2.8°C: temperature increase.	2.5°C-4.2°C: temperature increase.
	800 mm – 1000 mm.	January rainfall to increase by 8% while summer will be drier by 3% to 5%.	Rainfall to decrease by about 15%.
Shire Highlands	0.034°C: temperature increase (Jun-Dec).	1.0°C: temperature increase.	1.5°C-2.4°C: temperature increase.
	1000 mm – 1200 mm.	Winter rainfall to increase by 15%, and summer rainfall will decrease by 10%	Summer rainfall to decrease by 25%.
Central Areas	0.7°C-0.9°C: temperature increase.	1.3°C: temperature increase.	Temperature increase.
	800 mm -1100 mm:	October to December rainfall to decrease by 10% to 22%.	October to December rainfall to decrease by 20% to 56%.
Lakeshore Areas [Dedza District]	0.8°C-0.9°C: temperature increase.	1.5°C-2.0°C: temperature increase.	2.5°C-3.0°C: temperature increase.
	March to April rainfall will increase by 5% to 25%.	Winter rainfall will decrease by 65%.	There will be a general decrease in rainfall by 60%.
Northern Areas [Kasungu District]	0.2°C-0.9°C: temperature increase.	1.4°C-1.9°C: temperature increase.	1.7°C-2.3°C: temperature increase.
	Increase in rainfall by 3% to 8% from January to April.	October to December rainfall to decrease by 10% to 36%.	Rainfall to decrease by 56%.

The Lower Shire Valley is a wide rift valley system in the extreme southern part of the country, lying at an altitude 35 to 105 meters above sea level, and is mostly covered by calcimorphic alluvials, with extensive areas dominated by hydromorphic soils and vertisols. Riviri, Phalula and Golomoti EPAs in the Dedza and Balaka districts lie in the low-lying Lake Malawi/Shire Valley area, whereas Lobi, Lisasadzi, Chulu and Champhira in Mzimba and Kasungu districts are located in the plateau area.

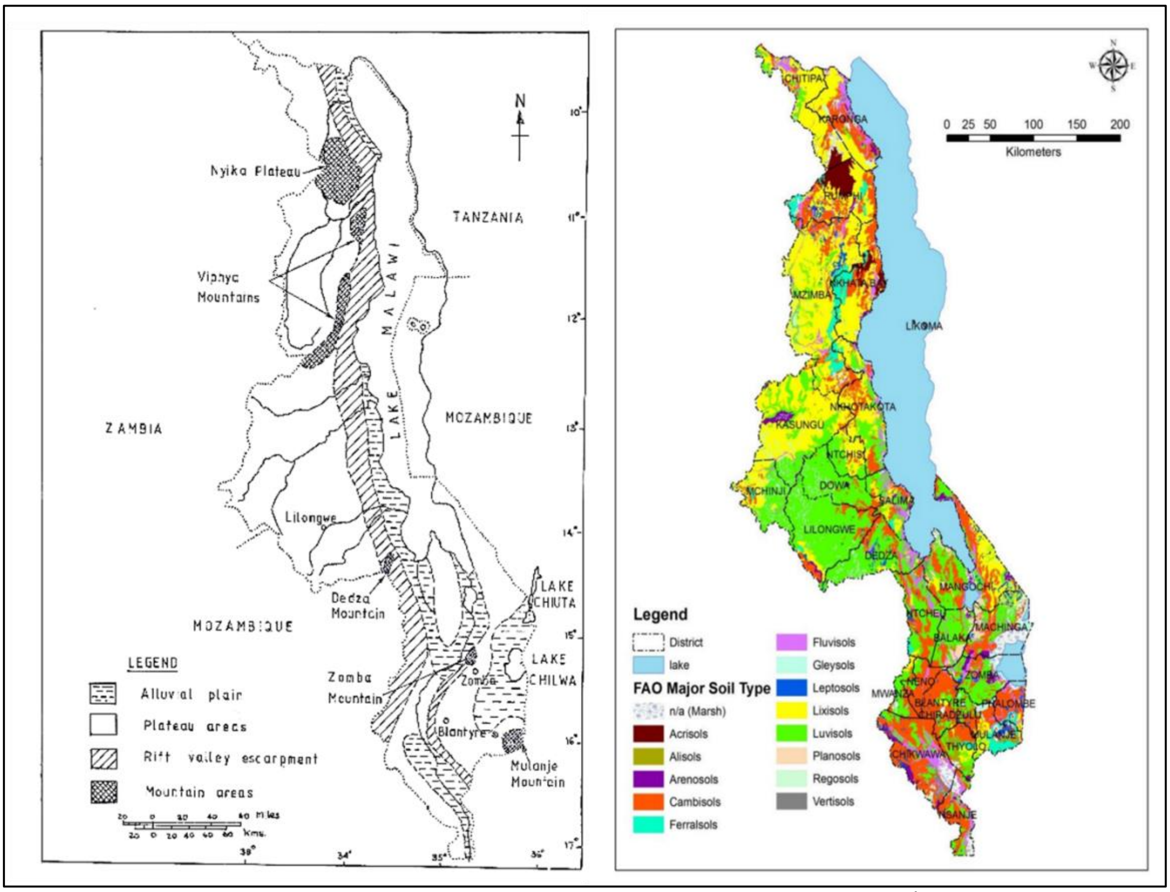


Figure 3: Physiographic Features (Source: Water Department/UNDP, 1986) and Soil Types (Source: AD, 2008) for Malawi.

Malawi's dominant soil texture is well-drained loamy clay sands with adequate to low nutrient levels (Snapp et al., 1998). Overall, sandy clay loam is found across 78% of the country, with the remaining soils; 10% sandy loam, 8.4% sandy clay, and 4% blend of clay loam soils (Li et al., 2017)Kasungu, Balaka and Dedza are characterized by medium-textured sandy loamy soils prone to erosion and fertility loss (Figure 4) Patches of clay loam soils can be found throughout the target sites, which tend to be used for crop production. Soil loss for Kasungu and Mzimba was projected at 30t ha^{-1} yr^{-1} in 2010 compared to 20 t ha^{-1} yr^{-1} in 1991 (DLRC, 2009). In Balaka, soil loss has been projected at 32 t ha^{-1} yr^{-1} compared to about 29 t ha^{-1} yr^{-1} (DLRC, 2009). Two main factors behind Malawi's high soil loss rates: are fragile soils on steep slopes and erosive rainfall. Engaging in agricultural activities in fragile soils or steep slopes plays a large role in increasing the rate of soil loss. Degraded soil properties were also reported in a 2014 pedology survey that revisited many 1990 FAO sites, with the highest depression in soil carbon being associated with intensively cultivated fields (Mpeketula, 2016; Omuto and Vargas, 2018).

The expansion of Malawi's agricultural land at the cost of natural forest cover has reduced vegetation cover and exposed more soil to the country's erosive rainfall. In addition, sustainable land management policies have not been adequately implemented to protect vegetation cover and ensure the sustainable use of non-renewable natural resources (Omuto and Vargas, 2018). Other human activities, such brick making, have also exacerbated these factors.

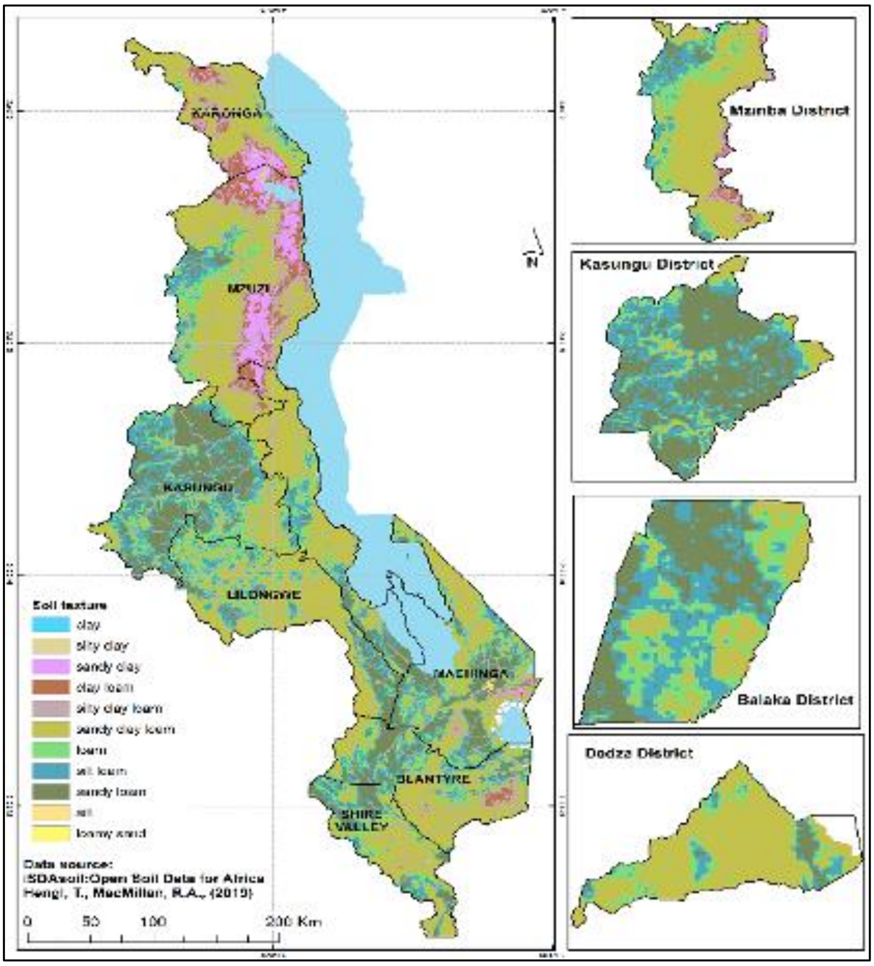


Figure 4: Map of soil texture in Malawi and for the four districts targeted by Sustainable Intensification of Mixed Farming Systems Initiative.

Biodiversity

Biodiversity in Malawi is important for economic, socio-cultural, and ecological purposes. Biodiversity contributes significantly to Malawi's economy and poverty alleviation (GoM, 2002 and 2015). For example, agro biodiversity was estimated to contribute about 40% of the Gross Domestic Product (GDP) and more than 90% of employment and merchandise export earnings in 2010. Fisheries, forestry, and wildlife sectors contributed 12.8% towards the GDP in 2010 (Yaron et al., 2011). Furthermore, communities have integrated biodiversity conservation and rural development through Community Based Natural Resources Management, especially in National Parks and Forest Reserves, to alleviate rural poverty. Communities practice sustainable fish and wildlife harvesting techniques, promote eco-tourism, and carry out income-generating activities like mushroom production and beekeeping, thereby taking away pressures on natural resources.

Aquatic ecosystem

Aquatic ecosystems cover about 20% of the total surface area of Malawi and are habitats to a diversity of fish and other aquatic fauna and flora (GoM, 2015). Major aquatic ecosystems in Malawi include lakes (Malawi, Malombe, Chilwa, Kazuni and Chiuta), rivers (Songwe, South Rukuru, North Rukuru, Dwangwa, Linthipe, Shire and Bua River), wetlands and other small water bodies (GoM, 2015). Aquatic ecosystems are important in Malawi as they provide goods and services such as fisheries, agriculture, livestock grazing, eco-tourism, water supply, water purification, carbon sequestration and transport (GoM, 2015).

Fauna ecosystems

Malawi has a rich plant diversity, comprising flowering and non-flowering plants (GoM, 2015). A great diversity of species is found in national parks, wildlife reserves, forest reserves and protected hill slopes (GoM, 2015). The wide variation in physiography, climate and edaphic factors has given rise to many vegetation types in Malawi (EAD, 1994; Figure 5). The following are the major biotic communities in Malawi:

- Montane evergreen forest.
- Montane grassland.
- Semi-evergreen forest.
- Closed canopy woodland of wetter uplands (tall Brachystegia spp); Open canopy woodland of plateaux (Brachystegia/Julbernadia/Isoberlinia); Open canopy woodland of hills and scarps (Brachystegia spp); Open canopy woodland fertile areas (Piliostigma/Acacia/Combretum).
- Mixed thicket/woodland of drier upland; Mopane woodland; Woodlands of fertile areas (Adansonia/Cordyla/Faldebia albida); Thicket/savanna of poorer areas (Combretun/Acacia); Woodland savanna of poorer areas (mixed species).
- Sand dune vegetation.
- Lakes (freshwater); Somewhat saline lakes (without outlet).
- Grasslands (seasonally wet), Grasslands (perennially wet/swamp); and
- Islands.

Globally biodiversity loss has been accelerated by human-induced changes to ecosystems and their functions. In Malawi, biodiversity plays a crucial role in the socio-economic success especially considering its role in forestry, fisheries, and wildlife sectors. Unfortunately, mass deforestation and demand for timber products have resulted in severe biodiversity losses in these ecosystems.

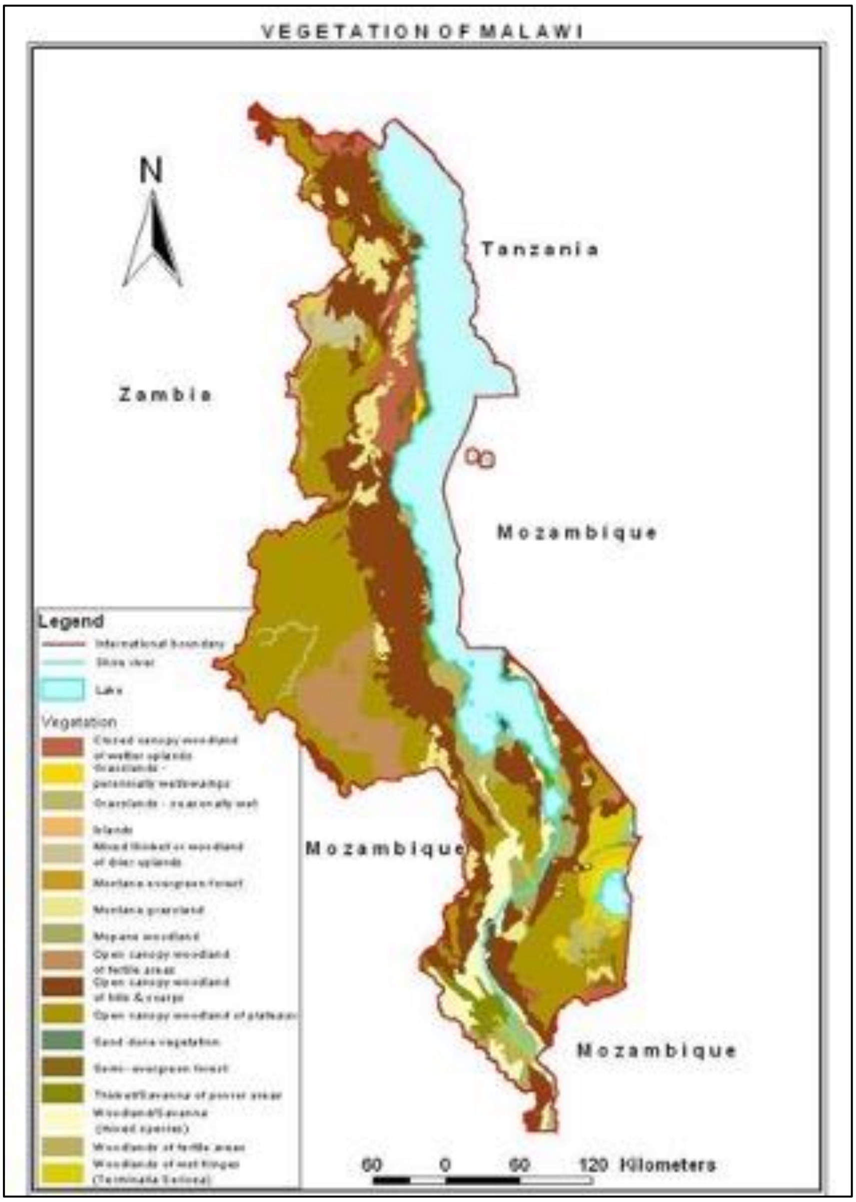


Figure 5: Vegetation cover of Malawi (Source: EAD, 2008).

To understand the state of Malawi's forests, one must account for energy issues in the country. More than 96% of the 18 million people in Malawi use firewood or charcoal for household cooking and heating. Between 2011 and 2017, Malawian's dependent on wood fuel increased by 2.5 million due to fixed hydroelectric power generation, limited grid coverage, and population growth. This growing demand for household energy is driving forest cover loss in Malawi, which, in turn, is undermining agricultural productivity and food security, water security and hydroelectric generating capacity. These trends leave Malawi especially vulnerable to climate shocks, such as droughts and floods, which have increased in frequency and severity over the last 20 years. Apart from Golomoti, Rivirivi and Phalula, which lie in the Upper Shire Valley, the rest of the EPAs are in the plateau area. The selected EPAs experience common environmental problems besetting the country: soil erosion, deforestation, depletion and degradation of water resources, a threat to fish resources, biodiversity, human habitat degradation, high population growth, air pollution, and climate change.

In Kasungu National Park, an area located in Kasungu district, the park's spatial and temporal patterns of land cover categories for the three-time points (Kpienbaareh et al., 2022; Figure 6). There was a noticeable reduction in the amount of forest cover in 1997 compared to 2008 and 2018, while at the same time, the distribution of shrubs increased over the three-time points. Figures 6a and b also show the emergence of more bare lands in the northern tip of the park and the eastern part of the map, indicating areas of intense deforestation (Kpienbaareh et al., 2022).

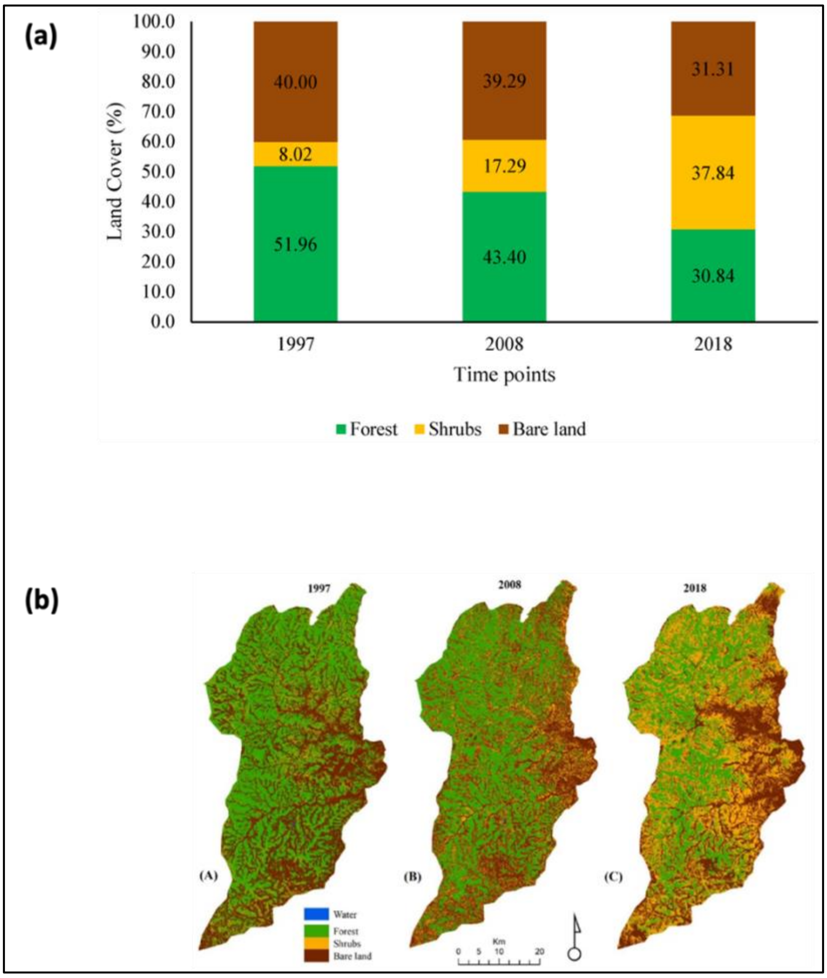


Figure 6: Percentage of land cover and distribution categories in the Kasungu National Park for 1997,2008 and 2018. The water class is not shown on the graph because of its small area size (Source: Kpienbaareh et al., 2022).

Beyond forest cover loss depicted in Kasungu National Park, the composition and configuration of most forest landscapes in Malawi affect wildlife in habitats. The compositional and configurational changes of landscapes in the park suggest that in tropical landscapes where animals are an integral part of the forest ecology, the changes that occur could negatively affect animals and result in extinction due to perturbations in their natural habitats and biorhythms. Overall, mammal species have undergone a severe decline in numbers, especially in recent years, mainly due to poaching and habitat loss. The government is, however, taking several initiatives to increase the mammal populations in protected areas.

The Biodiversity Finance Accelerator project (https://biofa.info/) in Malawi found that investing in enterprises that are biodiversity-positive improves the status of biodiversity by (a) providing biodiversity-based products that improve the abundance of important insects (i.e. bees), indigenous species, and trees for reforestation; (b) providing sustainable alternative resources that reduce communities' demands for forest or other natural products; and (c) ensuring sustainable management of aquaculture and fisheries. Strikingly, 86.2% of the enterprises reported growth in 2021, with an average 90% increase in sales compared to 2020 (https://biofa.info/). In addition, 92.8% of the enterprises provided their employees with several quality job indices, including equal pay, work benefits, and skills training. However, these enterprises remain highly vulnerable to climate change as their supply chains and customers face impacts that hamper business performance.

A significant amount of Malawian's biodiversity is found in production landscapes. At the same time, the rural population heavily depends on natural resources; it is not surprising that changes in agricultural practices in these landscapes have negatively affected biodiversity. Managing multifunctional landscapes requires combining context-specific land-sharing and land-sparing measures within spatially well-connected landscape mosaics, resulting in land-sharing/-sparing connectivity landscapes. In this light, SI within production systems can encourage land-sparing.

Production context

The economy of Malawi is predominantly agriculture-based. With population growth, the arable land per person has declined from 0.35 ha per person in 1961 to 0.2 ha per person in 2016 (World Bank, 2021). Therefore, people have resorted to farming in increasingly unsuitable areas and land systems, particularly on steep hillsides. Crop rotation through shifting agriculture is no longer possible, resulting in declining soil fertility and crop yields. Maize (*Zea Mays*) is the staple crop and a major source of carbohydrates for over 90% of the Malawian population. Approximately 70% of the land is under maize production yearly (Ngwira et al., 2013; Figure 7). Legumes are also grown long maize as intercrops or in adjacent lands. Common beans (dry beans) (*Phaseolus vulgaris*) (Figure 9) and cowpea (*Vigna unguiculata*) (Figure 10) were mostly grown in the cooler climate of the Dedza district (Figure 7), and pigeon peas (*Cajanus cajan*) is often found in the hotter climate of Balaka. Farmers in Kasungu also grow soybean (*Glycine max*). Other important crops include tobacco (*Nicotiana tabacum*), tea (*Camellia sinensis*), coffee (*Coffea arabica*), sugarcane (*Saccharum officinarum*), cotton (*Gossypium herbaceum*) and potatoes (*Solanum tuberosum*).

At a national level, Malawi produces enough maize to feed its population. Despite this, food insecurity continues to linger. In 2018, the country produced 3.4 million tons of maize, 3.3 million tons in 2019 and 3.8 million tons expected in 2020. Malawi's annual maize requirement is 3.1 million tons, indicating subsequent levels of surplus production over the years. Similar trends have also been observed for other crops like rice, pulses, and roots/tuber crops. However, this has not translated into household food security; the opposite has been the case. Due to dependence on erratic rainfall, small farm size, limited use of modern inputs, and poor access to markets, many farmers cannot meet their subsistence requirements. About 80% of smallholder farmers are net buyers of maize. Their purchase of maize is hindered by high import prices, largely reflecting Malawi's landlocked geography and poor road network. One in three households fails to meet its daily per capita caloric requirement

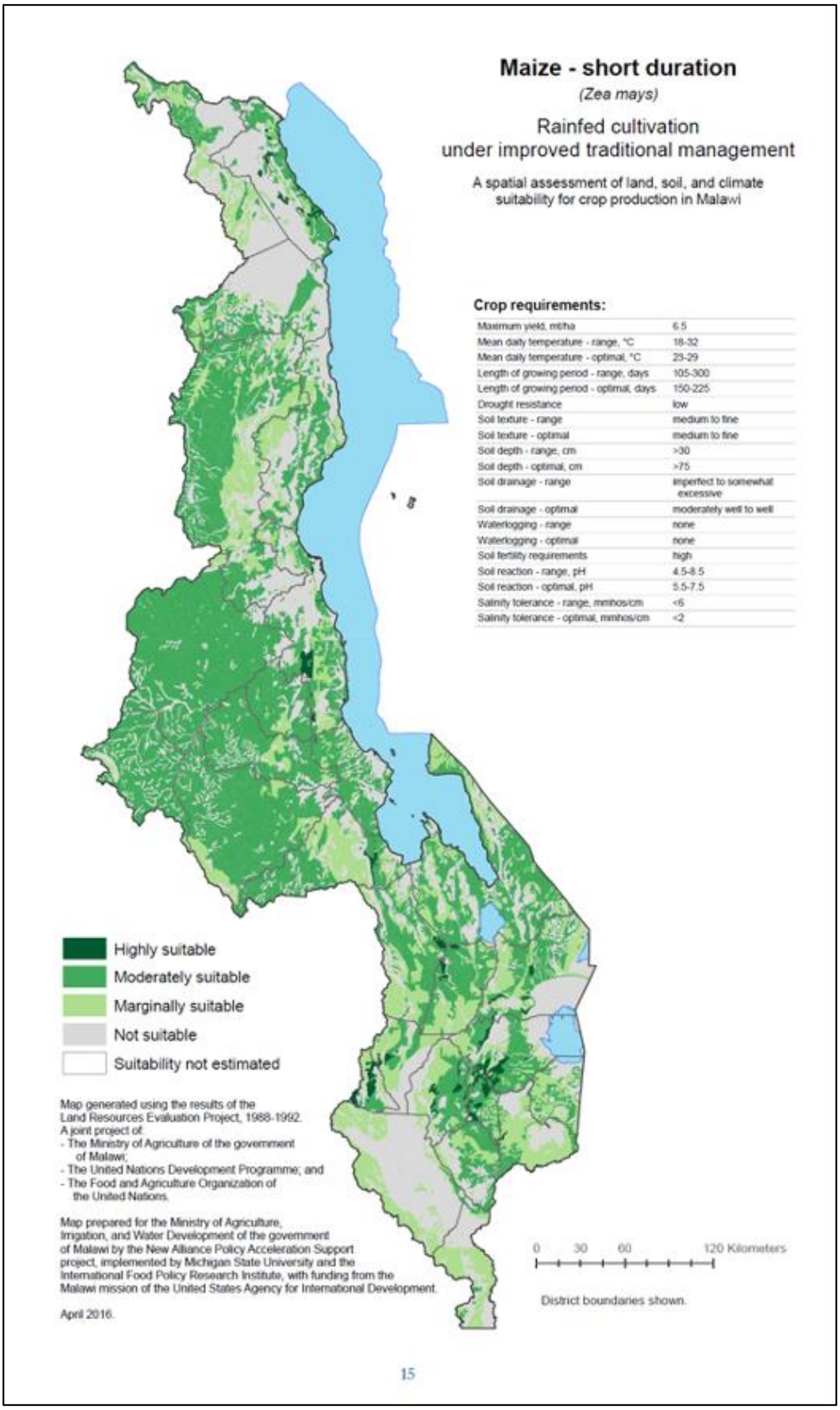


Figure 7: Suitability map for Malawi for short-duration maize (Zea mays L) under rainfed and traditional management practices

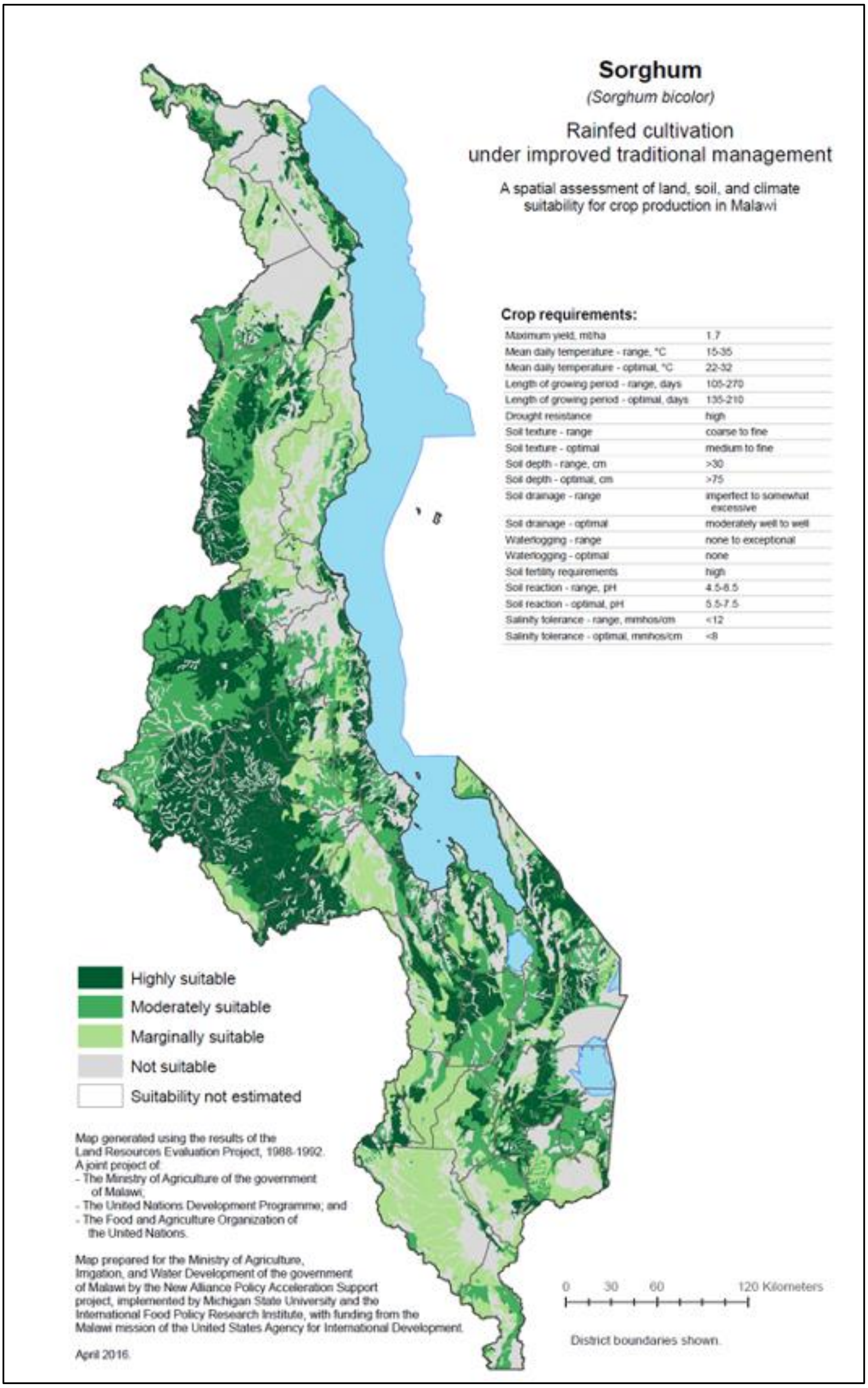


Figure 8: Suitability map for Malawi for sorghum (Sorghum bicolor) under rainfed and traditional management practices.

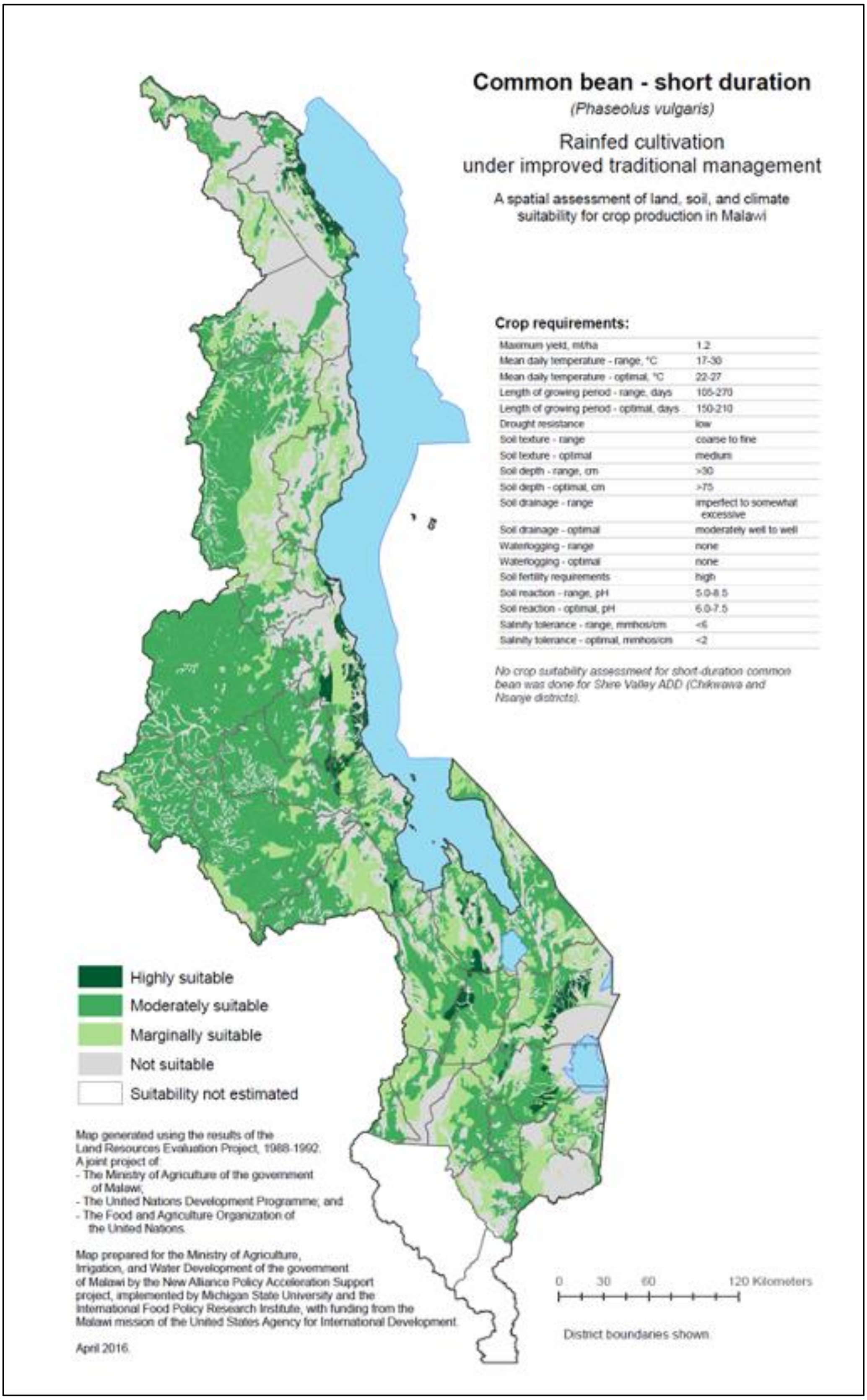


Figure 9. Suitability map for Malawi for short duration bean (Phaseolus vulgaris) under rainfed and traditional management practices.

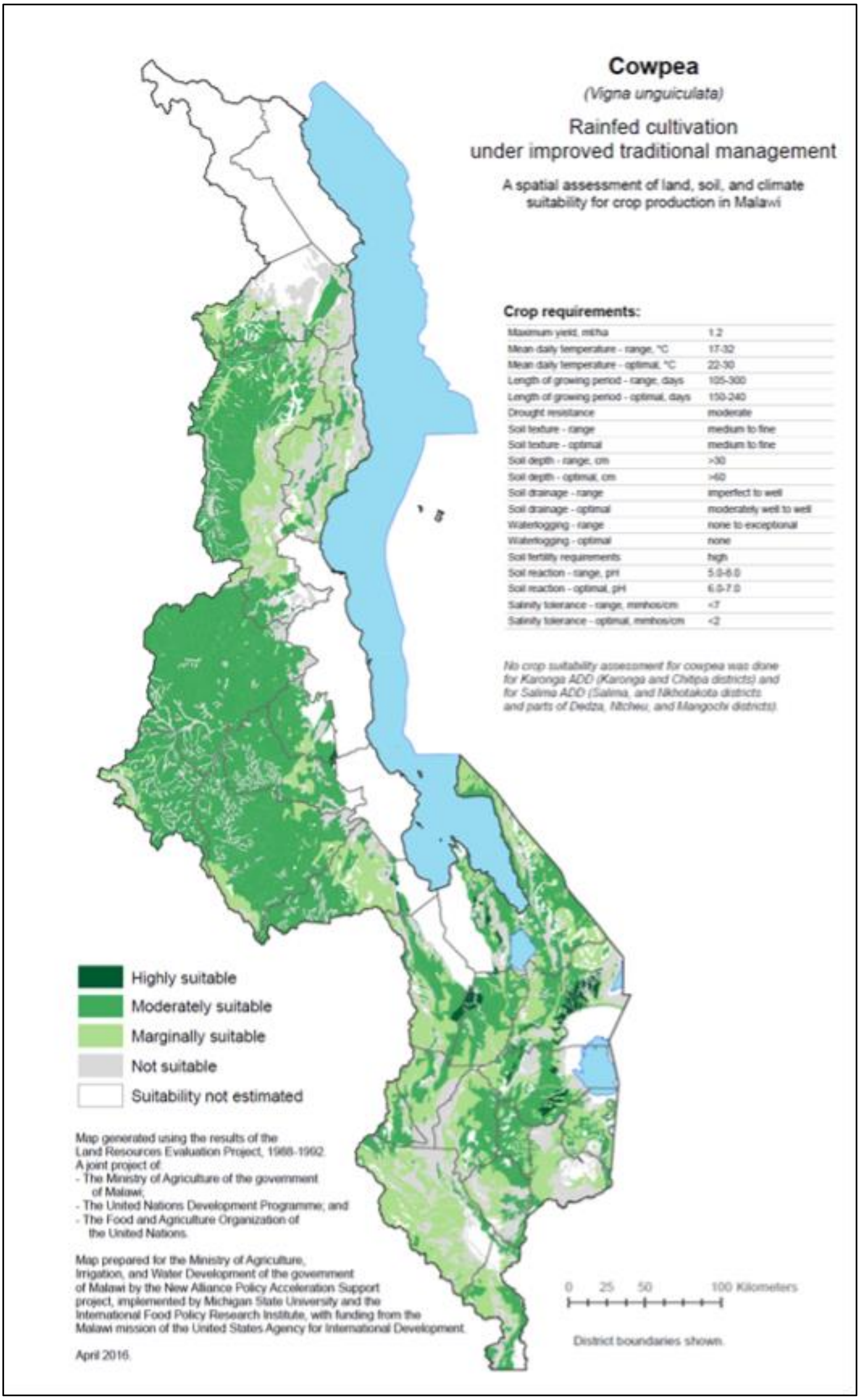


Figure 10: Suitability map for Malawi for cowpea *(Vigna inguiculata)* under rainfed and traditional management practices.

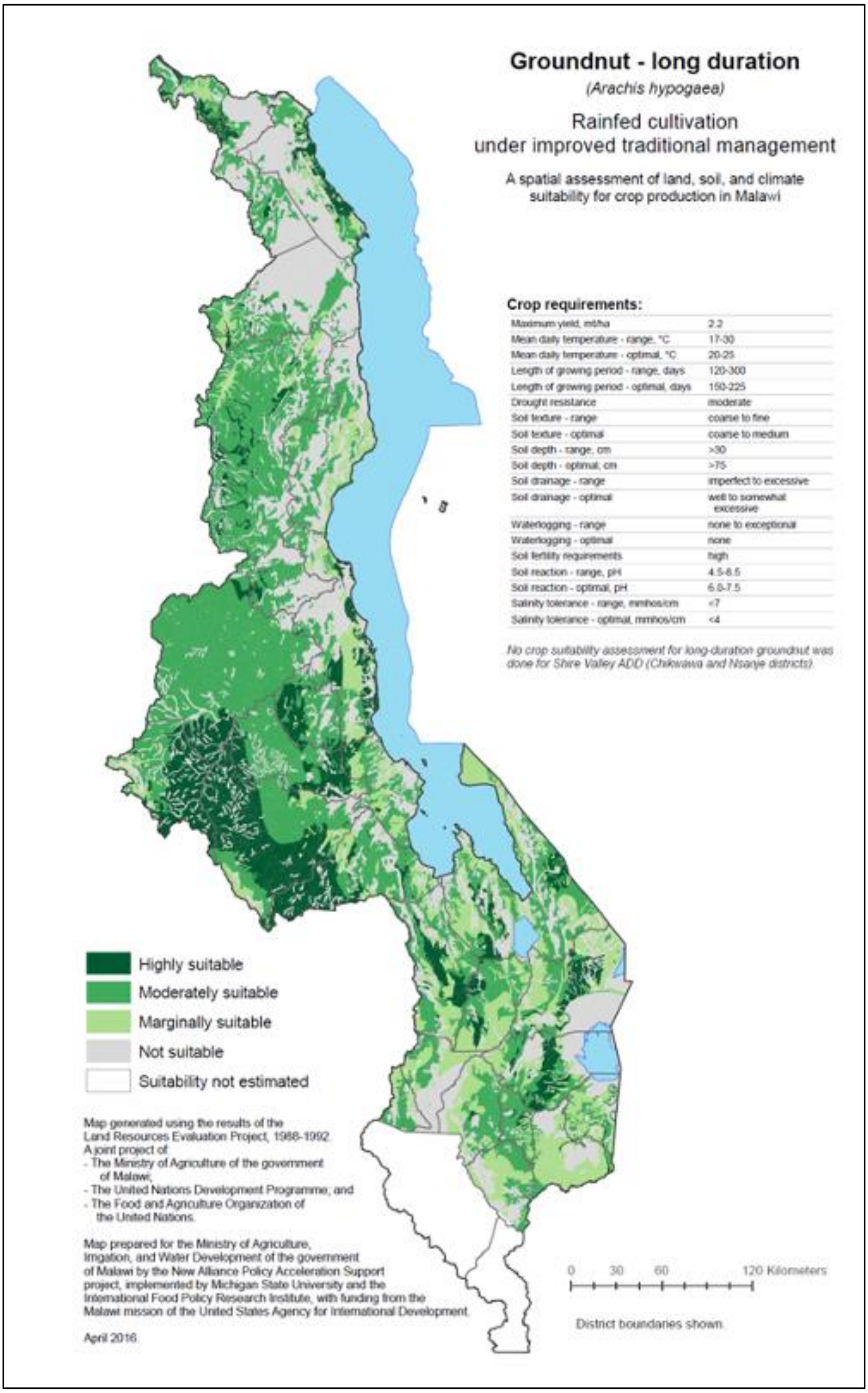


Figure 11: Suitability map for Malawi for groundnut *(Arachis hypogaea)* under rainfed and traditional management practices.

Although practiced on a small scale, livestock production entails keeping cattle, goats, pigs, sheep, rabbits, and poultry (mainly chickens, ducks, doves, and guinea fowls). Livestock production has more than doubled from 2006 to 2016, registering a livestock index of 244 in 2016 (considering a baseline index of 100 over 2004-2006) (World Bank, 2021). For example, in 2006/07, the country had 884,132 cattle and 2,623,017 goats (European Union, 2021). In 2014 there were just over 1.3 million cattle in the country and slightly over 6.3 million goats (European Union, 2021). Figure 12 shows the cattle density in Malawi in the four study districts of Balaka, Dedza, Kasungu, and Mzimba. Cattle are densely populated in Mzimba, an EPA that is further north of the other EPA. Livestock contributes greatly to sales revenue from meat, milk, hides, and employment (dipping tanks, veterinary services, slaughterhouses, etc.). Additional benefits to horticulture have been realized through the use of livestock manures.

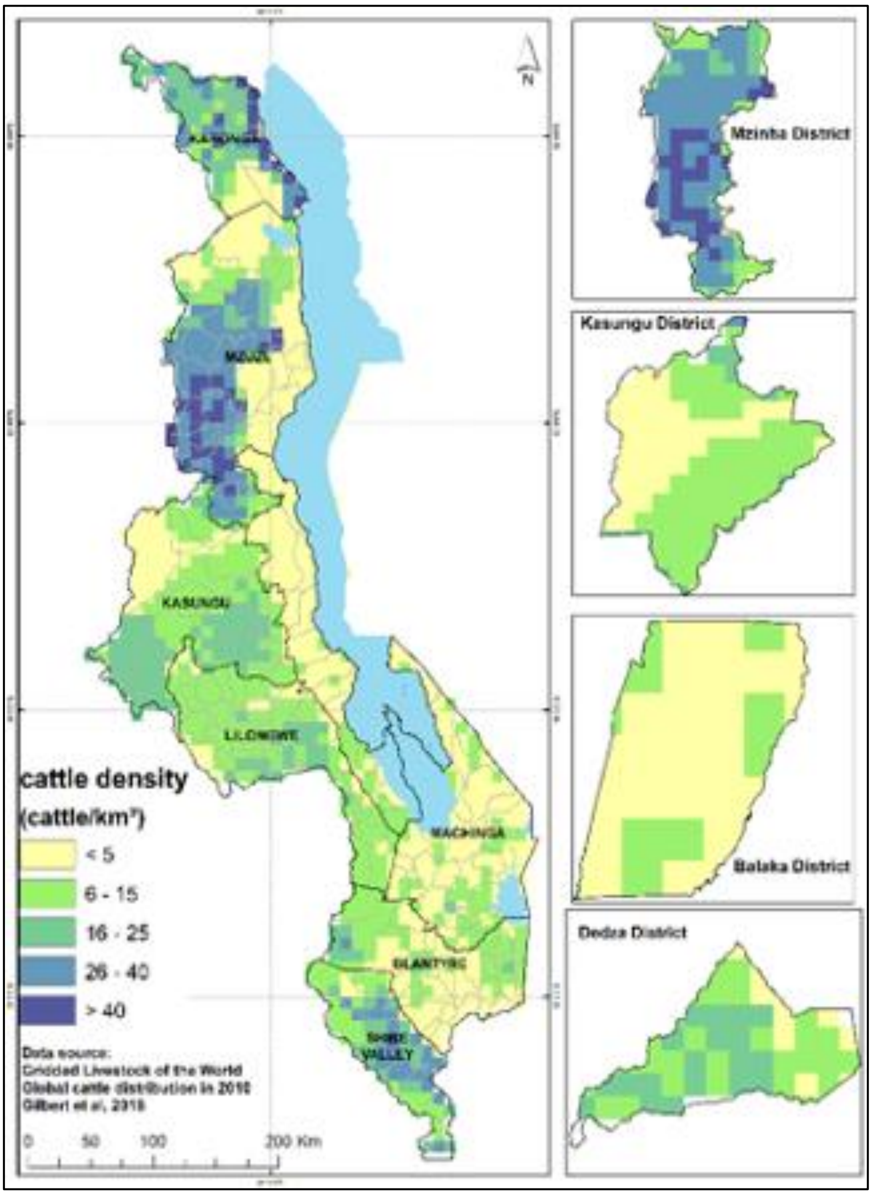


Figure 12: Cattle density across Malawi and for the four districts targeted by the Sustainable Intensification of Mixed Farming Systems Initiative.

Although there is potential for better production and productivity, the agriculture sector operates below its capacity. Agriculture relies mainly on rain-fed crop production, whereas production and consumption of animal products are very low. Irrigation is also done on a small scale. As a result, the country continuously faces food shortages at the national and household levels. The biophysical potential (Figure 13) is assessed by examining an area's rainfall, slope, and soil texture. Generally, Malawi has moderate to low biophysical potential for productivity, consistent with Burke et al. (2022) findings that showed the spatial organization of agricultural productivity that is moderate to low across the country. Large swaths of the terrain showed marginal to moderate decreasing productivity and notable decreasing slopes and the area to the southern/southwestern edge of Lake Malawi, including the Mzimba, Kasungu and Dedza District areas (a densely cultivated region; Figure 8). Although not explicitly mentioned, agricultural potential is also affected by poor soil health.

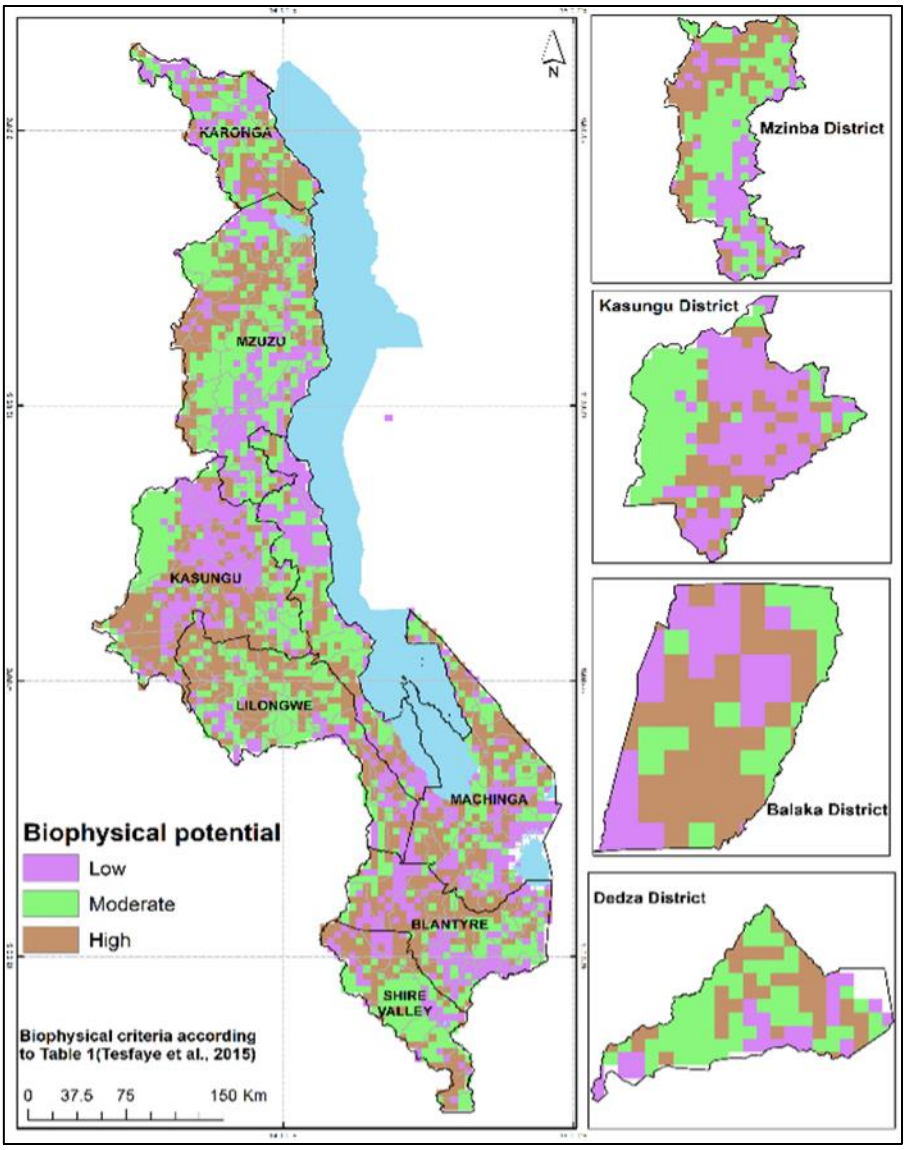


Figure 13: Map of the biophysical potential for Malawi and the four districts targeted by the Sustainable Intensification of Mixed Farming Systems Initiative.

Mungai et al. (2020) further explained the spatial agricultural productivity trends using distribution maps of pixel-by-pixel combinations of NDVI, rainfall, temperature, and soil suitability, and their percentage pixels in each category (Figure 14). Results showed that the northern region had more high productivity pixels as indicated by NDVI, while others are scattered across Malawi, in high plateau areas of Dedza mountains, and the southernmost tip of Malawi (lower Shire valley, which constitutes Balaka). Overall, 21% of agricultural lands are associated with an increasing agricultural productivity trend. The increased productivity could be largely attributed to higher levels of precipitation (900 mm to 1200 mm) in these high-elevation areas, in contrast to the lower precipitation (725 mm to 800 mm) and higher evapotranspiration in the lowlands. About 35% of agricultural lands are associated with no changes in productivity. These areas are found primarily in the central and southern regions. About 43% of all agricultural lands present decreasing productivity trends. These lands are predominantly in the southern region. Less than 1% of pixel combinations show increasing productivity trends associated with suitable soil pixels, with either decreasing rainfall and temperature trends or vice versa.

Factors affecting production

Major constraints and challenges to agriculture production in the four districts are exorbitant prices of farm inputs (i.e., fertilizer, herbicides and improved seed varieties); disease attacks and pest infestation; poor markets and transport networks; and stock theft for livestock, such that most of the farmers are forced to keep their goats in their houses where they also sleep, thereby avoiding to use the recommended standard livestock shelters where animals are vulnerable to theft. Some of the challenges the sector faces include vulnerability to weather shocks; poor management of land, water, and soils; low adoption of agricultural technologies; low access to finance facilities and farm inputs; low mechanization and technical labour skills; a limited irrigation system and weak linkages to market.

Low soil carbon

Soil carbon provides a source of nutrients through mineralization, helps aggregate soil particles (structure) to provide resilience to physical degradation, increases microbial activity, increases water storage and availability to plants, and protects soil from erosion. Soil carbon and phosphorus status in Malawi are low in most smallholder fields, as reported in FAO data and a country-wide survey of 2000 smallholder farms conducted in the early 1990s (Snapp, 1998). Degraded soil properties were also reported in a 2014 pedology survey that revisited many 1990 FAO sites, with the highest depression in soil carbon being associated with intensively cultivated fields (Mpeketula, 2016; Omuto and Vargas, 2018).

Low input use efficiency

Malawi's fertilizer consumption varies substantially across the country and is heavily subsidies by the government. According to Burke et al. (2020), most farm families sampled in the Dedza district had access to fertilizer throughout the FISP period. Household surveys conducted in Golomoti and nearby sites in Central Malawi report usage of 76 to 98 kg N ha^{-1} on maize plots over 2015–2018 (Burke et al., 2020). Although the amount of fertilizer mentioned is much higher than SADC, Middle-income countries average 40 kg N $ha^{-1.}$ Burke et al. (2022) observed a decline in productivity with increased fertilizer use. Several studies have shown that response rates range from nil to 11.5 kg kg^{-1} (Chirwa and Dorward, 2013; Snapp et al., 2013; Ricker-Gilbert and Jayne, 2017). Snapp et al. (2014) disaggregated their response estimates between monocropped maize (5.3 kg kg^{-1}) and intercropped maize (8.8 kg kg^{-1}). The authors demonstrated that increased fertilizer use alone is not sufficient to achieve sustainable agricultural intensification and that fertilizers contribute less to agricultural output than commonly believed. Furthermore, the price of farm inputs is very high and prohibitive, which has exacerbated the devaluation of the Malawi Kwacha, the country's currency. Also, according to Burke et al. (2022), soil nitrogen (Figure 10), soil carbon (Figure 11) and phosphorus status are low in most smallholder fields, as reported in FAO data and a country-wide survey of 2000 smallholder farms conducted in the early 1990s (Snapp, 1998).

Vulnerability to climate shocks
Water is a critical input to the sustenance of crop and livestock production. Crop production is mainly rainfed in nature, with about 118,843 ha under irrigation by the end of the 2019/2020 Financial Year, according to GoM's Ministry of Finance Annual Economic Report of 2020 (GoM, 2020a). This renders agriculture production vulnerable to both floods and droughts. However, the agriculture sector is very critical to Malawi's economy as it employs about 64.1 per cent of the workforce (NSO Labour Force Survey, 2013), contributes over 80 per cent of foreign exchange earnings and accounts for 27.1 per cent of the Gross Domestic Product (GDP) in 2019 (GoM, 2020a). Thus, the availability of water resources in adequate amounts and of acceptable quality is a prerequisite for the successful performance and sustenance of the agriculture sector in Malawi.

Livestock challenges
Livestock production faces several challenges, including limited pasture due to population pressure, inadequate production and storage technologies in feed and breeding programmes; insufficient animal health support infrastructure and services, such as dip tanks (GoM, 2016); and high prices of factory made-livestock feed leading to overgrazing as observed by some stakeholders (EU, 2021). Cattle farmers are restricted to the low-lying wetland and marginal forest areas until field crops are harvested. When cropland becomes seasonally available, there is very little grass for cattle to eat (NSO, 2010). Meanwhile, wetlands and forested areas are unsuitable for grazing because hillslopes begin to erode along animal paths, creating severe gulley erosion, further impacting soil moisture regimes and accelerating land degradation.

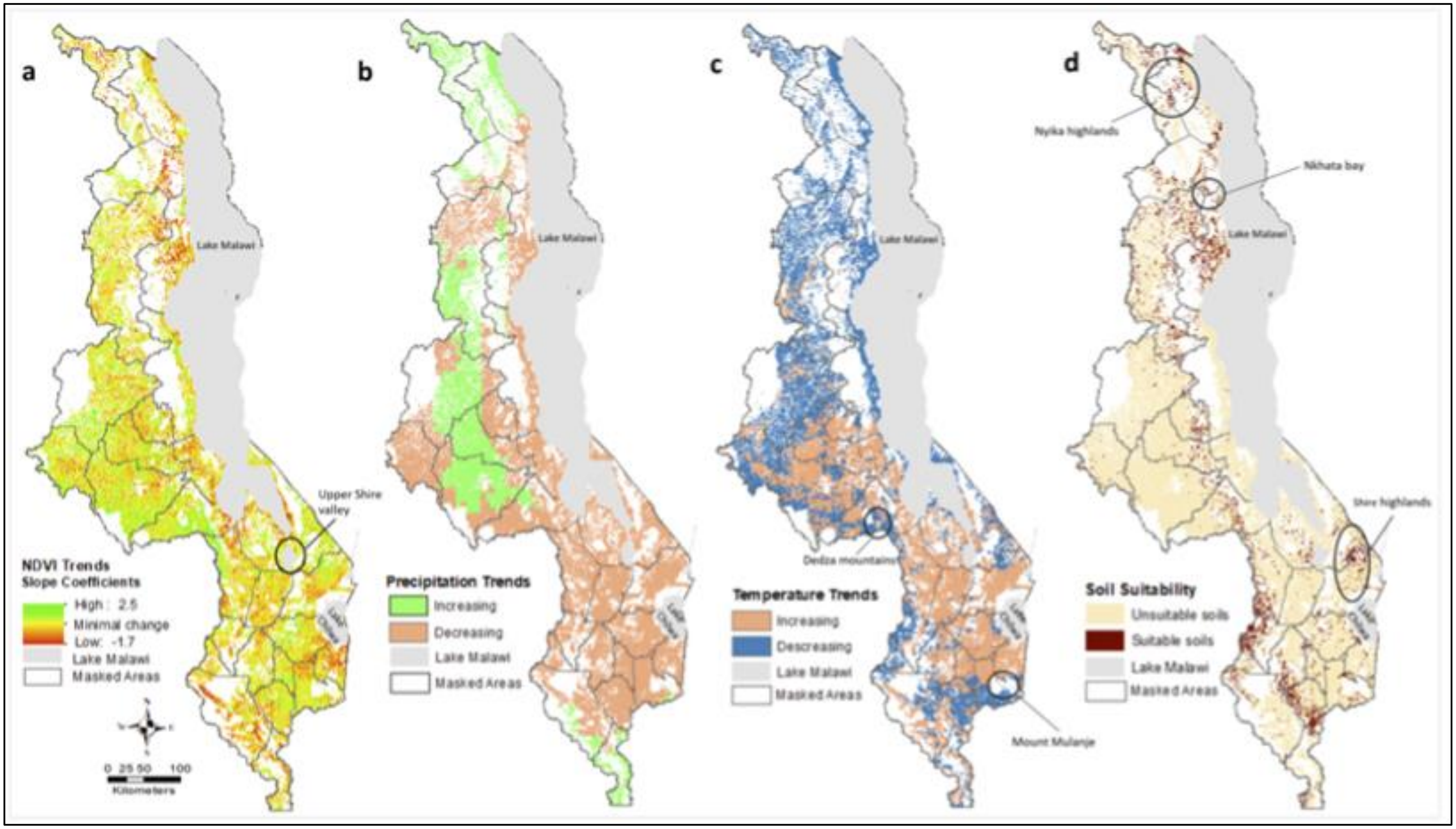


Figure 14: (a) Malawi's NDVI slope coefficients, few high pixels are seen scattered, while most pixels dominate the landscape. (b) Precipitation trend displaying the latitudinal north–south gradient), with increasing pixels shown in green, while decreasing pixels are in orange. (c) Land surface temperature trend displaying a latitudinal north-south) increasing pixels (orange) and decreasing (blue). (d) Spatial distribution of soil suitability data. In all the figures above, agriculture land cover is shown, while all other land cover types are masked in white. (Source, Mungai et al., 2020).

Opportunities

Mungai et al. (2020) and Burke et al. (2022) showed that in some areas, there was increasing productivity with suboptimal climate and soils. Their results showed evidence of pocks of intensification of agriculture across Malawi. A multi-locational survey by Africa RISING (Research In Sustainable Intensification for the Next Generation) indicated that farmers in many of the marginal environments are intercropping with legumes, growing a significant number of trees for green manure, or adopting other climate and soil-resilient strategies (Ortega et al., 2016, Mungai et al., 2016, Burke et al., 2022), Previous studies for Malawi show that mixed cropping systems with tree species are widespread, especially in the northern and central regions, nitrogen-fixing trees such as *Gliricidia sepium*, *Sesbania sesban*, *Tephrosia vogeii*, and *Faidherbia albida* that improve soil fertility are common (Coulibaly et al., 2017). Additionally, increasing productivity close to or within forested areas may suggest converting forest cover to agriculture. In such areas, few farmers practice shifting cultivation—letting the soil rest in natural forest regenerations or some cases; slash and burn practices are carried out (Mungai et al., 2020).

Of the four target areas of interest, Mzimba has the greatest potential for irrigation, which is not yet fully exploited. If well utilized, irrigation can be a cushion during prolonged dry spells and droughts. According to various assessment reports, Balaka and Mzimba have a potential irrigable area of about 5,872 and 10 739 ha, respectively. Currently, the area under irrigation is estimated at 656ha, representing only 11% of the irrigable area. Common crops grown under irrigation include vegetables, onions, tomatoes, and maize.

While all staff interviewed at the district level are very conversant and are fully aware of the benefits that accrue from adopting the "crop-tree-livestock" concept in agriculture production and convey the same message to local farmers at the EPA level, the focus by smallholder farmers is mostly on crop production, with a narrow focus on livestock production (particularly the keeping of cattle, goats, pig, rabbits, chickens, ducks, guinea fowl) and little adoption of agroforestry for the restoration of soil fertility for enhancing animal feed, provision of woodfuel for household use, and poles for construction. Several farmers are now adopting manure-making as an alternative to chemical fertilizers for crop production.

The use of chemical fertilizers, herbicides and improved seed varieties varies significantly across Malawi, and for the selected EPAs, Farmers in rural areas mostly depend on chemical fertilizer supplied by the government under the Affordable Inputs Programme (AIP). Besides, few farmers use chemical fertilizers and herbicides because of the exorbitant and prohibitive costs, with some farmers relying on manure making. General principles of Conservation Agriculture (CA)/Smart Agriculture were noted to be implemented in all the EPAs. Farmers know that CA is critical in enhancing soil fertility and crop yield and promoting water conservation at the field level in light of climate change, particularly in a country where rainfall patterns have become very erratic and unpredictable.

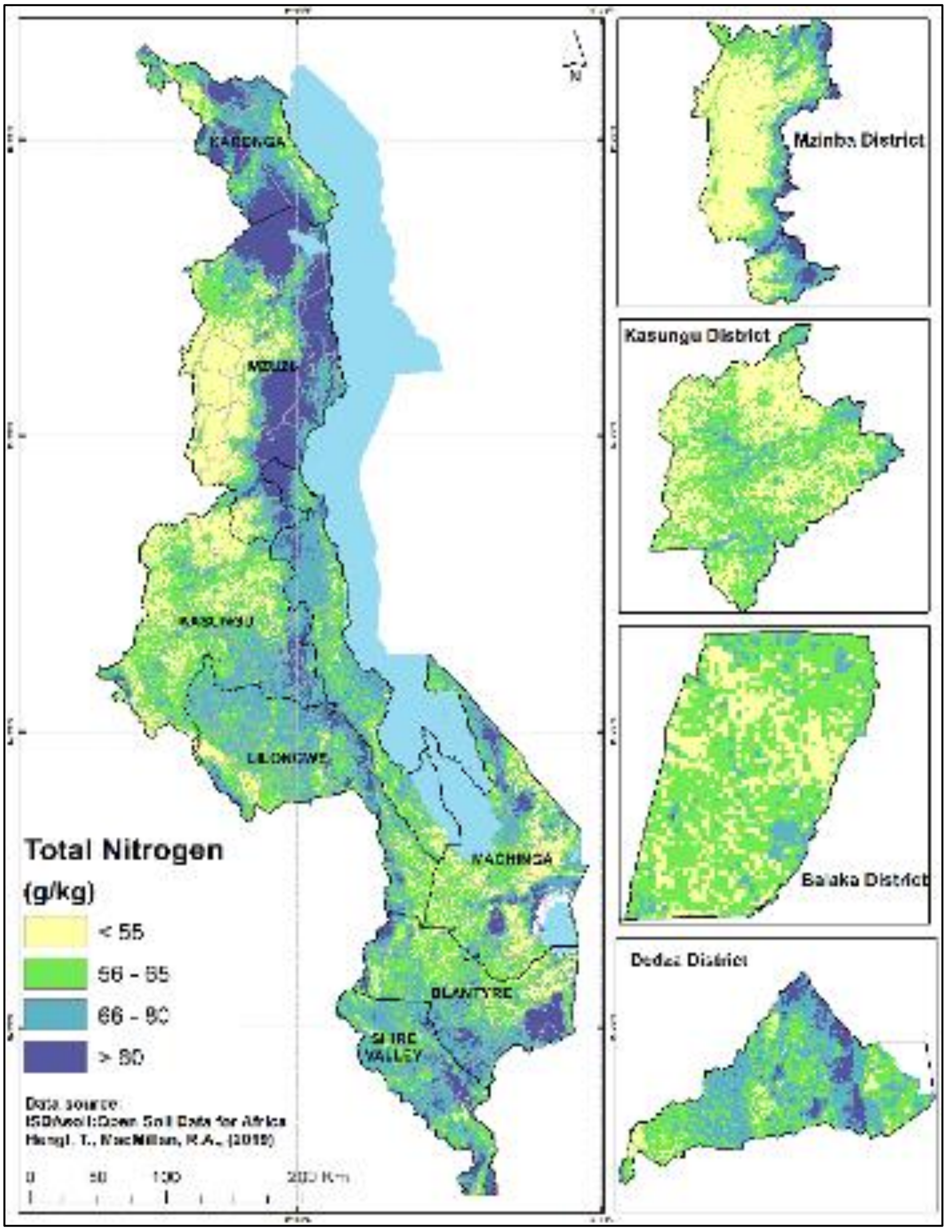


Figure 15: Total Nitrogen across Malawi and for the four districts targeted by the Sustainable Intensification of Mixed Farming Systems Initiative.

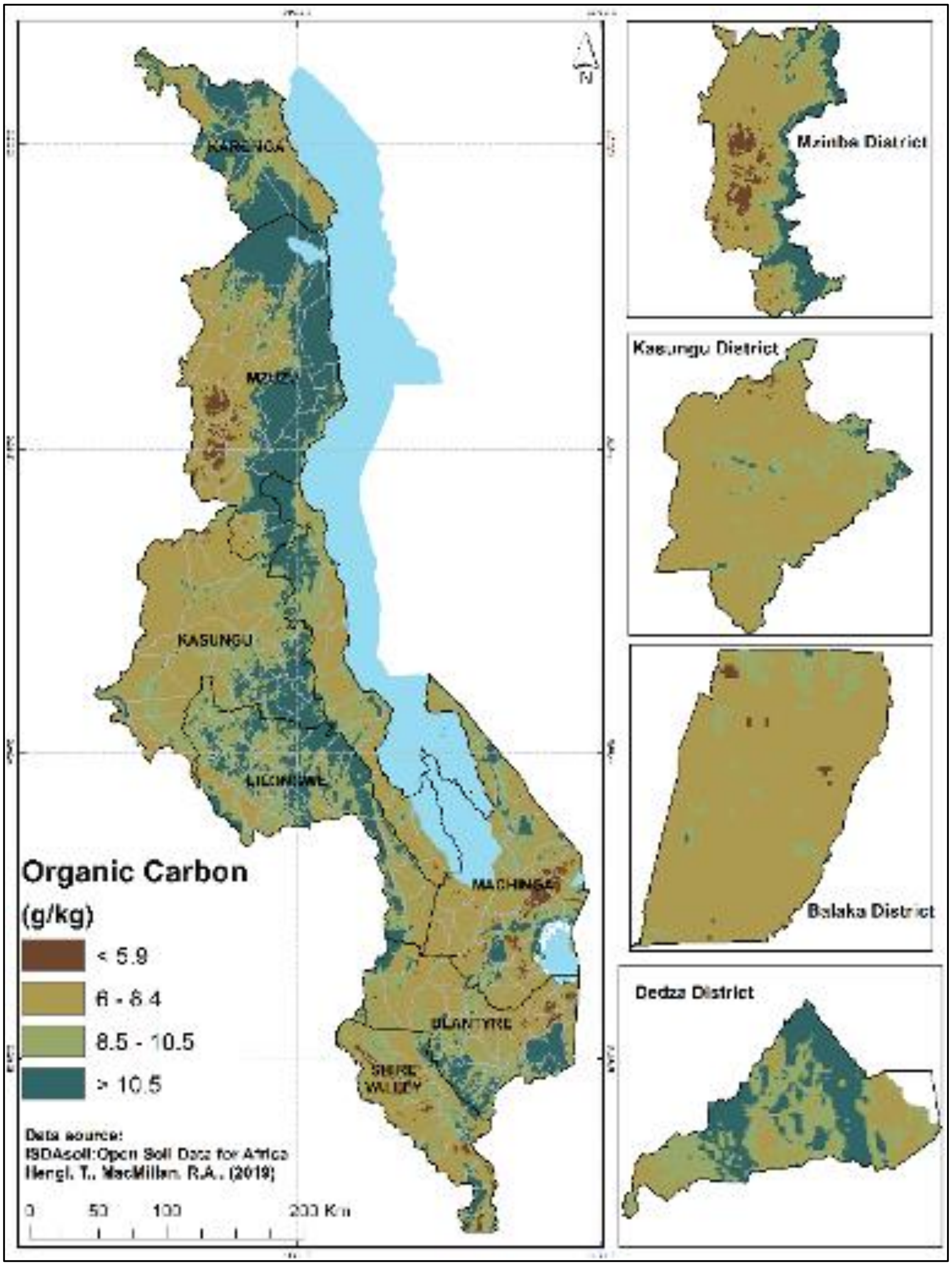


Figure 16: Organic Carbon across Malawi and for the four districts targeted by the Sustainable Intensification of Mixed Farming Systems Initiative.

Economic context

With nearly 90% of the population living in rural areas, Malawi's economy is predominately agro-based. The agriculture sector employs about 64.1% of the workforce (NSO Labour Force Survey, 2013), contributes over 80% of foreign exchange earnings and accounts for 27.1% of the Gross Domestic Product (GDP) in 2019 (GoM, 2020b).

Across the targeted districts and EPAs, rural communities' main activity is crop production, supplemented with livestock keeping and agroforestry, though on a very small scale. Most farmers do not have access to credit or savings, and very few belong to loan groups. Additionally, many smallholder farmers have adequate land; land tenure issues remain contentious in all the selected EPAs. Farmers mainly depend on vendors to sell their farm produce, more so now that the Government's Agriculture Development and Marketing Corporation (ADMARC) is not functional as an organization tasked with buying produce from smallholder farmers. "Ganyu" (short-term labour) contributed 18% to 37% of household income (The World Bank, 2022).

In the same way, income from household businesses is also important and can contribute up to 11%. There is a diversification of the household sources of livelihood. Other economic activities and sources of livelihood strategies include small and medium enterprises (SMEs), arts and crafts, quarrying, and fishing (especially in the lake shore regions). In some cases, people have adopted income-generating strategies, including felling live trees to make charcoal for sale.

Data from the household survey conducted by The World Bank (2022) showed that the probability of a household being poor could increase by 14% points after experiencing a climate shock and that household income from agriculture often decreases by 17 and 14% after a flood and drought, respectively (Figure 17).

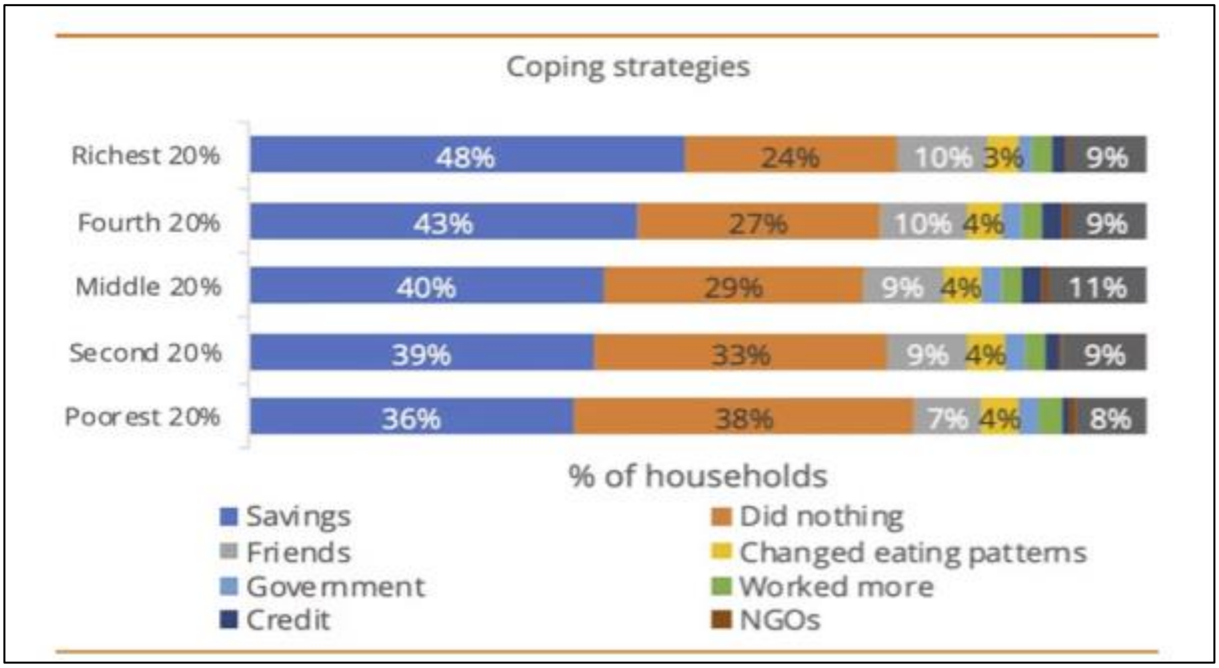


Figure 17: Household's source of support after suffering a climate shock (Source: https://www.worldbank.org/en/news/feature/2022/11/17/escaping-poverty-in-malawi-requires-improved-agricultural-productivity-climate-resilience-and-structural-transformation).

Markets can play an important role for farm households, who act as sellers and buyers of food and other agricultural commodities. Across Malawi, local markets are relevant for sales and purchases of smaller quantities to satisfy immediate needs. However, local markets are not always available in every village in Malawi. Figure 18 shows the ease farmers' access to markets in the country and the targeted districts. Dedza and Balaka have better market access than Kasungu and Mzimba. According to Figure 18 and Figure 19, Balaka is situated on the lake shore, Upper Shire Valley and Dedza are in the mid-altitude plateau region, and both sites have easy access to larger markets. Farm households use these district markets to sell farm produce and to buy food and non-food items. Reaching district markets usually involves walking a longer distance; hence most households do this only occasionally. Senganimalunje et al. (2022) added that though the Dedza and probably Balaka had access to good roads to transport goods to viable markets, high transportation costs would be a major limiting factor.

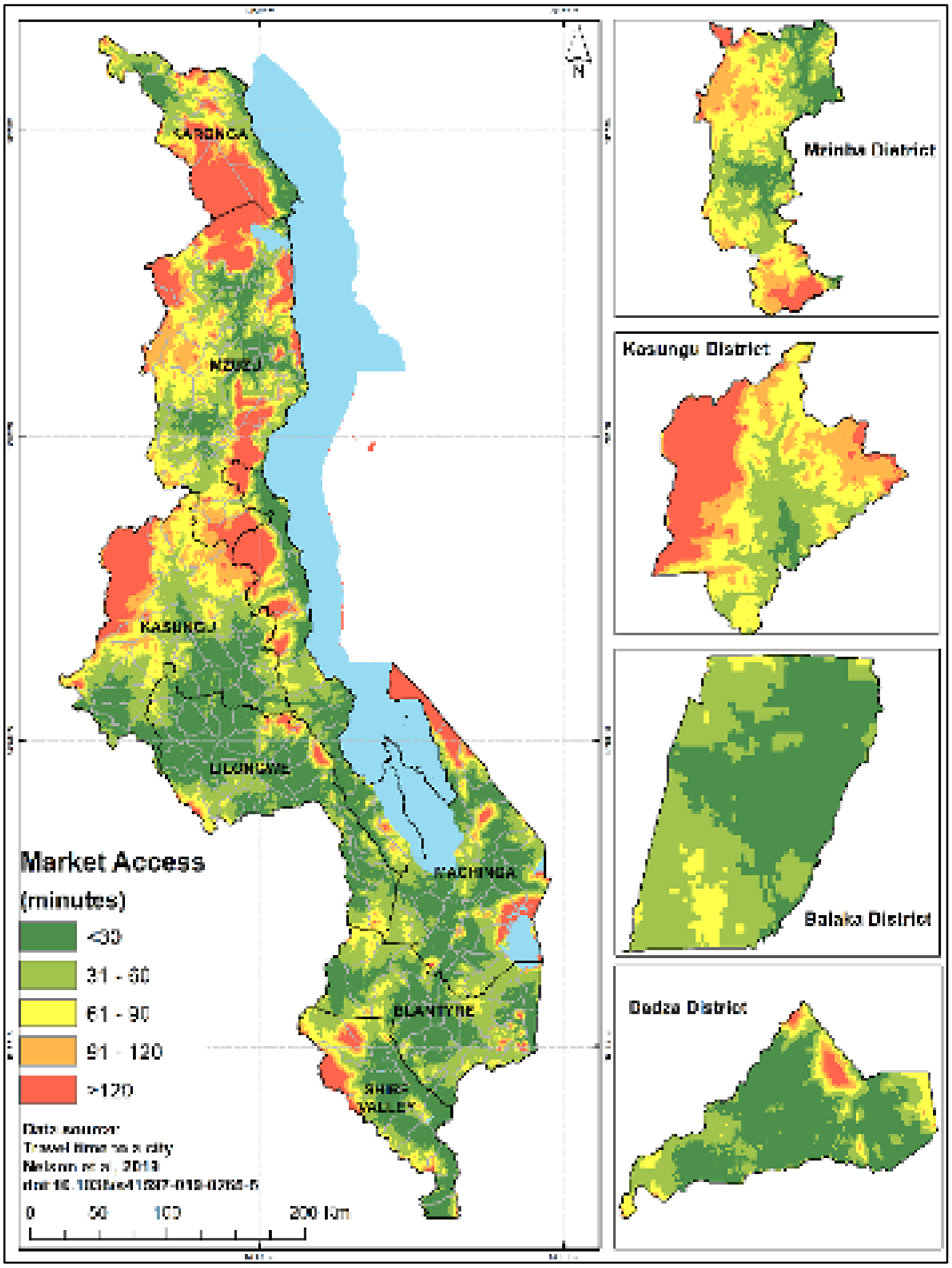
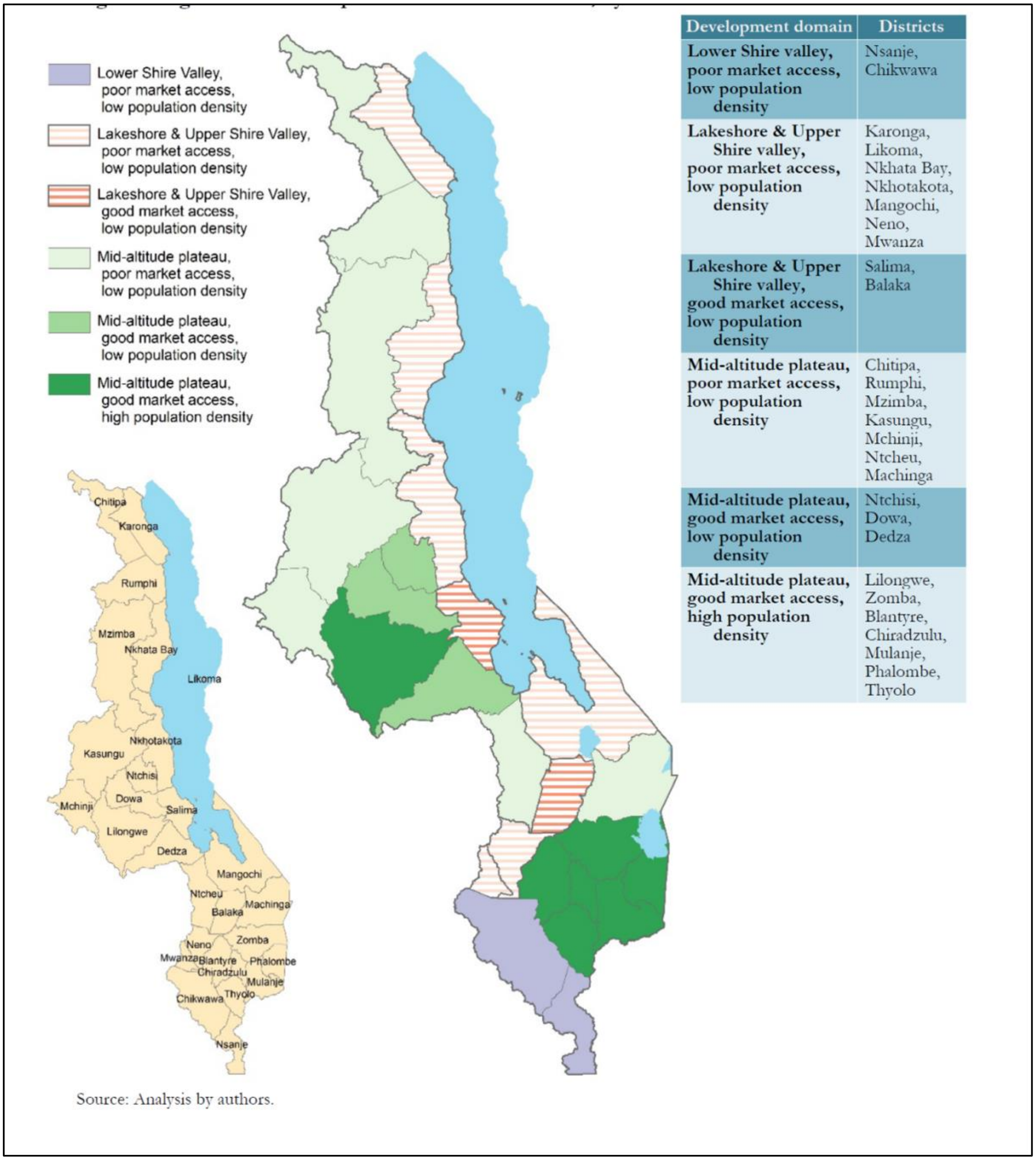


Figure 18: Ease of Market Access across Malawi and for the four districts targeted by the Sustainable Intensification of Mixed Farming Systems Initiative.



Development domain	Districts
Lower Shire valley, poor market access, low population density	Nsanje, Chikwawa
Lakeshore & Upper Shire valley, poor market access, low population density	Karonga, Likoma, Nkhata Bay, Nkhotakota, Mangochi, Neno, Mwanza
Lakeshore & Upper Shire valley, good market access, low population density	Salima, Balaka
Mid-altitude plateau, poor market access, low population density	Chitipa, Rumphi, Mzimba, Kasungu, Mchinji, Ntcheu, Machinga
Mid-altitude plateau, good market access, low population density	Ntchisi, Dowa, Dedza
Mid-altitude plateau, good market access, high population density	Lilongwe, Zomba, Blantyre, Chiradzulu, Mulanje, Phalombe, Thyolo

Figure 19: Development domains defined by topography, market access and population for Malawi (Source: Benson et al., 2016).

The World Bank (2022) observed constraints in districts lacking market access in establishing and growing businesses. Low levels of education and lack of training and skills also affect the survival of businesses. Half of all new businesses are not observed in operation in a given month during the first year, especially if the owner doesn't have an education certificate or is a woman (The World Bank, 2022).

Social context

As stated in Section 4.2.3, Malawi's population density is the highest in the SADC region. Currently, the figure stands at 203 people km^2 (Figure 20). A typical family unit in Malawi comprises a man and a woman with an average of five children. In the Balaka district, most people are Yaos or Chewas, while in Dedza and Kasungu districts, Chewas are the dominant tribe. In Champhira, Tumbuka is the dominant tribe. Men control ownership of assets at the household level, except in single-family units, although the general population of women in Malawi stands at 51.38% [Ref]. Local communities manage natural resources in the village through Village Natural Resources Committees (VNRMCs). In Kasungu, about 51.4% of farm families own land less than 1.0 ha, and only 2.1% have land over 3 ha. The distribution is typical of land holding in Malawi. Most of the land in rural Malawi is under the customary tenure system. Customary land is all land belonging to the people and held in trust and administered by traditional leaders. For instance, it covers 89%, 56% and 64% of the total land in Balaka, Kasungu and Mzimba under customary holding. In Balaka, land-holding rights follow a maternal system whereby land is transferred through inheritance from mother to daughter; the right to resolve disputes is left in the hands of a son who is married off to other areas.

Catchment management practices include the construction of check dams, planting trees, and many other methodologies. Local communities access extension services through extension workers, normally based in the local communities. Primary schools are generally within easy reach compared to secondary schools, although this may not be the case in some instances. No particular group of people are excluded from decision-making, although men still dominate these roles.

The main economic base of the country is agriculture, with subsistence and smallholder farming as the main activities for the rural population. The literacy levels of most of the rural farmers in Malawi are generally very low. Ownership of assets at the household level lies with the husband. Farmers receive most of their information about agriculture production from extension workers and Lead Farmers who live in the respective EPAs. Each of the EPAs has at least a primary and a secondary school, whether public or private. To avoid being ripped by vendors, most of the farmers in the EPAs have formed cooperatives or associations, which they use as outlets to sell their farm products at fair prices. Women play a key role in managing these village-level structures and often hold leadership positions, although generally, men have more power than women.

Within the agricultural sector, men in Malawi and across the targeted sites have typically been prioritized over women, leading to gender inequality. In the country, women comprise 52% of the population and 80% of the labour force. According to the 2015/16 Malawi Demographic Health Survey, 59% of employed women and 44% of employed men work in agriculture, the largest employment sector in Malawi (Botha, 2022). However, large gender productivity gaps in the agriculture sector remain wide. Ethical tea partnerships place the gender gap in agricultural productivity (https://ethicalteapartnership.org/gender-in-malawi-factsheet/). According to Botha (2022), farm plots managed by men produce an average of 25%

higher yields than plots managed by women. Women farmers have less access to inputs, credit, and extension than men. Women are significantly less likely to have bank accounts than men. Male farmers are more likely to receive and use fertilizer subsidy coupons than women.

Gender inequality is mostly underpinned by different levels of education, access to resources (such as land) and economic dependence. Gender roles are defined within society, intersect with other social identifiers, such as age, religion, and ethnicity, and reflect the appropriate behavior for men and women. Gender relations stem from the interplay between women's and men's roles in society. Roles and relations are social constructs and thus can and do change. Given that patriarchy predominates, women have typically held a less privileged position relative to men, and thus attempts at gender equality typically involve concerted efforts in favor of women's empowerment. Particularly in rural areas, gender inequality is reinforced by social norms. Acceptance of male authority over women is taught implicitly and explicitly through various institutions, including homes, schools, churches, and community gatherings.

Human condition context

Malawi is among a few sub-Saharan African countries that achieved Millennium Development Goal (MDG) 4 for child survival by 2015. The GoM reduced maternal mortality by 53% between 1990 and 2013 and increased the contraceptive prevalence rate from 7.4 in 1992 to 42% in 2010 (GoM, 2020c). With U.S. support, Malawi has reduced the number of HIV/AIDS deaths by 73% and the number of new HIV infections by 41% since 2003. These broad gains, however, mask important realities and structural dynamics in Malawi's health system that must be addressed if the advances of the past two decades are to continue. With a total fertility rate of 4.4 contributing to explosive population growth, Malawi's population will likely double by 2050. Such growth has the potential to derail many development gains achieved to date.

Malawi has a high unmet need for family planning services (26%), with acute needs among young people. Close to one million people live with HIV, with approximately 34,000 new infections yearly. Despite the gains in child health, 37% of Malawian children suffer from chronic malnutrition. Malawi is a high-burden malaria country with an incidence rate of 332 cases annually per every 1,000 people and approximately 4.8 million malaria episodes annually. Over a third of established positions in the health sector are vacant, and there is a perpetual shortage of qualified health workers in facilities across the country. Such tremendous health challenges constrained economic resources, and marginalized women and youth significantly burden the health system.

With a lull in Covid-19 cases, the seven targeted EPAs are not experiencing serious health issues. As such, smallholder farmers are not hampered by health problems to work in their gardens and raise their livestock. Similarly, the national political scene and dynamics have little impact at the EPA level. However, there is a general outcry by smallholder farmers throughout the country that the price of farm inputs is very high and prohibitive, particularly the price of fertilizer. This has exacerbated the devaluation of the Malawi Kwacha, the country's currency. Smallholder farmers are encouraged to diversify their diet composition based on local foods. This has been boosted by formulating the 2018 National Multi-Sector Nutrition Policy 2018-2022. It is worth noting that the 2016 National Agriculture Policy promotes nutrition-sensitive food and agriculture-based approaches, including the production of diversified foods and dietary diversification. It also promotes integrated homestead farming, production and consumption of high nutritive-value foods, more capital-intensive forms of agriculture (cash crops, livestock, and aquaculture), market access, and ensuring sustainable food and nutrition security for all Malawians.

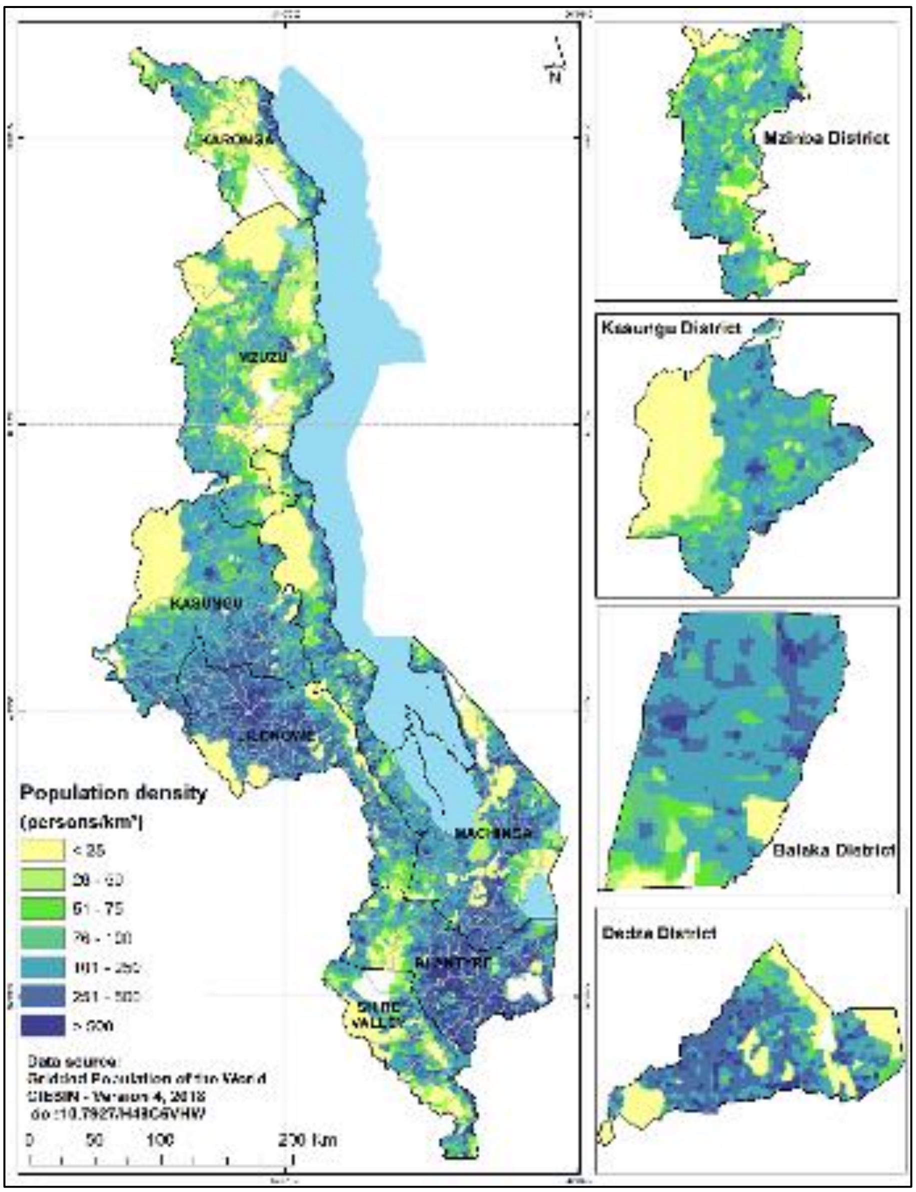


Figure 20: Population Density across Malawi and for the four districts targeted by the Sustainable Intensification of Mixed Farming Systems Initiative.

Like poverty, food insecurity is prevalent and a rural phenomenon in Malawi. Nationally, the caloric intake of over 50 per cent of the population falls short of the minimum daily caloric requirement of 2100 calories per day between 2004 and 2013 (World Bank, 2017). Child malnutrition is also high in Malawi. Food and Nutrition Security is Policy Priority Area 5 in the National Agriculture Policy, focusing on five key strategies, namely: (a) promote production and utilization of diverse nutritious foods in line with the National Nutrition Policy and Strategic Plan; (b) foster adequate market supply and access of diverse and nutritious foods; (c) ensure food safety for all; (d) promote private sector investments in production, processing and marketing of high-quality, nutritious foods, including complementary foods; (e) coordinate investments and sub-sectoral policies and strategies that help improve the nation's nutritional status and promote healthy diets; (f) promote bio-fortification and fortification of major food staples; and promote food and nutrition education for all. Since the neighboring EPAs produce similar foods, food imports do not arise, except for commodities such as fish which are dominant in areas along Lake Malawi, Lake Malombe, Lake Chilwa, Lake Chiuta and major rivers in the country.

Farming systems

Balaka District

The district comprises six (6) Extension Planning Areas (EPAs): Bazale, Ulongwe, Mpilisi, Phalula, Rivirivi and Utale. Each EPA has an Agricultural Development Extension Officer (AEDO). The district consists of 83 sections, among which 74 are filled with AEDOs, and 9 sections are vacant, one of the major challenges that the district is currently facing. The district extension staff mainly focuses on crop integration with livestock and agroforestry. However, the results generally show that crop farming comes first, followed by livestock farming and agroforestry. Since the district lies in the rain shadow area, it frequently experiences droughts, dry spells, and very high temperatures. But when the country receives heavy rains, the district experiences severe flooding.

Cropping system

The main crops grown include maize, pigeon peas, cowpea, groundnuts, horticulture crops (mainly vegetables), sorghum, tobacco, and cotton.

Challenges:

a) Climate Change (droughts, dry spells, floods),
b) Land tenure (not many people own land),
c) Pests' infestation and disease outbreaks,
d) Lack of proper markets as farmers rely on vendors to sell their products,
e) The exorbitant and prohibitive cost of farm inputs (seeds, fertilizer),
f) Reluctance by many smallholder farmers to embrace and accept new and improved variety breeds,
g) Inadequate access to extension staff by smallholder farmers for expert advice due to mobility challenges, since most of the motorbikes that were being by AEDOs and Assistant Veterinary Officers (AVOs) broke down a long time ago,
h) Inadequate staff, dilapidated houses, and offices for staff in the respective EPA and Sections

i) Farmers cannot identify the markets before growing a particular crop,
j) Many farmers prefer using indigenous knowledge in crop production to the technical knowledge provided by the AEDOs and Lead Farmers.

Livestock system

In Balaka District, livestock farming is mainly practiced on a small scale. Domesticated animals include goats, poultry (mainly local chicken), and pigs.

Challenges:

a) Pest infestation and disease outbreaks,
b) Poor housing standards by farmers for their livestock,
c) Lack of reliable markets,
d) Lack of access by smallholder farmers to hybrid and improved crop and livestock varieties,
e) Stock theft
f) Inadequate extension staff as some EPAs only have 2 AVOs.

Agroforestry

a) Agroforestry is practiced on a limited scale because of the shortage of land in the district,
b) Most farmers prefer crop and livestock farming for profits than practicing agroforestry,
c) Training is provided to farmers on the importance of agroforestry, but the uptake of the technology has been very slow,
d) In most cases, tree regeneration is promoted as a means of encouraging the adoption of agroforestry,
e) Inadequate seedlings are one of the contributory factors to the slow uptake of agroforestry technology in the district.

Projects/Organizations in the district working on SI

a) Agriculture Sector-wide Approach (ASWAP),
b) Sustainable Agriculture Production Program (SAPP), funded by IFAD,
c) Adaptation Fund Project (funded by the World Food Programme) focuses on agriculture insurance and marketing,
d) Malawi Watershed Service Improvement Project (MWASIP),
e) Promoting Sustainable Partnership for Empowered Resilience (PROSPER),
f) Climate Smart Public Works Programme

Challenges:

a) Poor mobility of staff,
b) Inadequate staff
c) Poor housing/offices for staff
d) Offices in the EPAs and Sections are in a dilapidated state,
e) There is a need for more funding to boost Farmer Field Schools (FFS).

Production synergies

a) People benefit from the provision of farm inputs from various projects that are being implemented in the district by various organizations,
b) Extension staff promote manure making as an alternative to chemical fertilizer,
c) Extension staff promote the growth of drought-tolerant crops because Balaka district is generally a drought-prone area,
d) Extension staff and Lead Farmers promote crop diversification,
e) Extension staff promote the implementation of land and water conservation.

Photo 1. Clockwise - Interview with AEDO of Rivirivi EPA; Rivirivi EPA Offices; Rivirivi EPA Offices; Interview with some of Rivirivi EPA smallholder farmers.

Dedza District

The district comprises 10 Extension Planning Areas (EPAs): Lobi, Golomoti, and Bembeke. Chafumbwa, Kabwazi, Lithipe, Kaphuka, Mayani, Mtakataka, and Kanyama. Each EPA has an Agricultural Development Extension Officer (AEDO). However, posts at some of the sections within the EPA are vacant, and this is one of the major challenges that the district is facing at the moment.

The district staff focuses on crops, livestock, and agroforestry; however, crop production is the most dominant type of farming among smallholder farmers, seconded by livestock farming and very little agroforestry. It should be noted that livestock farming benefits greatly from agroforestry by providing animal feed and poles for constructing kraals and facilitating the restoration of soil fertility.

Crop system

The main crops grown in the district are maize, beans, groundnuts, and soybeans. In Lobi, farmers also grow millet, sweet potatoes, tobacco, and cassava.

Challenges:

a) Climate Change (dry spells, droughts, floods).
b) Land tenure issues.
c) Pest infestation and disease outbreaks.
d) Poor markets, as farmers depend on vendors to sell their farm produce.
e) Lack of access to farm inputs (seeds, fertilizer);
f) Soil degradation.
g) Lack of access by farmers to agricultural experts, such as AEDOs, because of mobility/transport challenges; and
h) Inadequate extension staff, dilapidated houses, and offices for staff in the respective EPAs and Sections.
i) High cost of farm inputs.
j) Climate Change (dry spells, droughts); and
k) Land tenure/ownership issues

Livestock system

Livestock farming is done on a very small scale. Animals include cattle, goats, poultry (mainly local chicken), pigs, and rabbits.

Challenges:

a) Pest infestation and disease outbreaks.
b) Limited grazing area for the animals.
c) Poor housing for animals such that farmers keep their animals in houses where they live instead of using standards kraals.
d) Poor markets; and
e) Stock theft.

Agroforestry

a) Agroforestry is practiced on a very small scale, but the technology helps to provide feed for livestock, firewood for fuelwood, and the sustenance of soil fertility.
b) Common trees used in intercropping are Lukina and Msangu;
c) Training is provided to farmers by the extension staff on the importance of adopting agroforestry practices.
d) Tree regeneration is also promoted; and
e) Seedlings for trees used in intercropping are provided to farmers by extension staff; however, poor tree management increases the mortality rate.

Projects/Organizations working on SI

a) Agriculture SWAP (ASWAP).
b) Clinton Development Initiative (DCI), for the provision of small loans to smallholder farmers.
c) One Acre Fund.
d) Evangelical Association of Malawi (EAM).
e) Total Land Care.
f) Relief Eagles; and
g) Agriculture Sector Wide Approach (ASWAP

Challenges:

a) Poor mobility/transport.
b) Inadequate extension staff.
c) Poor housing for extension staff; and
d) Dilapidated office houses and office buildings in all EPAs and Sections.

Photo 2. Clockwise - Lobi EPA Office; Interview with AEDO for Golomoti EPA: Interview with AEDO for Golomoti EPA; Photo 13: A poster at Golomoti EPA Office

Production synergies

a) Extension staff teach smallholder farmers how to make manure.
b) Extension staff promote the growing of drought-tolerant crops
c) Promotion of crop diversification.
d) Smallholder farmers are being encouraged to adopt agroforestry to sustain soil fertility; and

e) Farmers are also encouraged to adopt soil and water conservation practices.

Kasungu District

The district has 6 Extension Plan Areas (EPA): Chulu, Kaluluma, Kasungu Chipala, Chamama, Lisasadzi, and Santhe.

Crop system

The main crops grown in the district are soybean, maize, ground nuts, tobacco, and sunflower. In Lisasadzi, sweet potato and cassava are also produced.

Challenges:

a) Climate change
b) Pest infestation and disease outbreaks
c) The varieties grown are not in line with the weather conditions experienced in the area.
d) Poor markets and road networks
e) High cost of farm inputs
f) In areas where crops are grown close to Kasungu National Park, wild animals often destroy them.
g) Climate Change (dry spells and floods)
h) Lack of crop varieties
i) Inadequate extension staff

Livestock system

Cattle, goats, pigs, rabbits, and pottery are some of the domestic animals in this area.

Challenges

a) Lack of veterinary Assistants
b) Lack of improved livestock varieties
c) Inadequate training provided to farmers by extension staff
d) Poor housing for animals

Agroforestry

a) Tree regeneration is done on a small scale.
b) Tree seedlings are usually provided to farmers, complemented by training.

Projects/Organizations

a) Food and agriculture organization (FOA)
b) Plan Malawi
c) World Vision
d) Kasungu Coordination Project.
e) Agriculture Sector Wide Approach Project (ASWAP)
f) Food and Agriculture Organization (FAO)
a) World Vision
b) Plan Malawi
c) Centre for integrated community development (CICOD)

d) Haifa Malawi
e) Evangelical Lutheran
f) Total land care

Mzimba District

The district consists of 13 Extension Planning Areas (EPA): Kazomba, Chikangawa, Hola, Bulala, Eswazini, Mamwamula, Muchinge, Mbawa, Vibangalala, Champhira, Luwerezi, Hemfeni, Khosolo. The district consists of 110 sections, of which 54 are not filled. The district-level staff focus on the three research areas, i.e., crop farming, livestock farming and agroforestry

Crop system

The main Crops grown are maize, soybean, cassava, sweet potatoes, sunflower, cabbages, tomatoes, and onions.

Challenges:

a) Climate Change (dry spells, floods).
b) Pest infestation and disease outbreaks.
c) Lack of proper markets as farmers depend on vendors to sell their products.
d) Poor accessibility to farm inputs (seeds, fertilizer).
e) Poor markets.

Livestock system

Livestock Farming is practiced on a reasonably large scale. Animals include goats, poultry (mainly local chicken), pigs, and chickens.

Challenges:

a) Diseases
b) Poor housing for animals
c) Lack of reliable markets
d) Lack of access to hybrid varieties.

Agroforestry

a) Agroforestry is not practiced on a large scale in the district.
b) Training is provided to the farmer on the importance of agroforestry
c) Tree regeneration is promoted
d) Seedlings are provided to farmers

Projects/Organizations working on SI

a) Agriculture Sector Wide Approach (ASWAP)
b) Community-Based Facilitator (CBF)
c) Sustainable Land Management
d) Coordination Project
e) Kulima and Afikepo
f) Climate resilience initiative Malawi
g) Plan International

h) NASFAM
i) Total Land Care
j) Ungwelu
k) Transform
l) Synod of Livingstonia

Challenges:

a) Poor mobility by extension staff
b) Low staffing levels
c) Poor housing for extension staff
d) Dilapidated offices
e) Water scarcity

Production synergies

a) Promotion of manure making
b) Promotion of drought-tolerant crop varieties
c) Promotion of crop diversification
d) Provision of farmer training
e) Promotion of soil and water conservation technologies
f) Promotion of Farmer Field Schools

Projects/Organizations

a) Catholic Development Commission in Malawi (Cadecom)
b) Total Land Care
c) Plan Malawi
d) Kulima Beta
e) Enhancing Agricultural Input and Output Market for Increased Resilience for Smallholder Farmers
f) Delivered at Place (DAP)
g) Agriculture Sector Wide Approach (ASWAP)

Conclusion and recommendations

It is clear from this report that the adoption of SI is an absolute necessity for Malawi, considering that the country's population density is the highest in the SADC region, currently standing at 203 people per square kilometer and that the country is grappling with nine environmental problems, namely: soil erosion, deforestation, depletion and degradation of water resources, the threat to fish resources, biodiversity, human habitat degradation, high population growth, air pollution, and climate change. In light of the above, adopting SI using a mixed farming system approach is the most likely panacea for the country's myriad social-economic problems. Furth more, the report has provided information on the types of crops grown in the selected EPAs and the types of livestock that smallholder farmers keep. Commonly grown crops in the four study districts include maize, groundnuts, beans, tobacco, cotton, cowpea, pigeon peas, sorghum, horticulture crops (vegetables, tomatoes, onions, etc.), millet, soybeans, sweet potatoes, potatoes, cassava, rice, and sunflower while livestock types comprise: chickens, goats, cattle, rabbits, pigs, guineafowl, ducks, and sheep.

The report has also highlighted some of the following challenges to agriculture production in the seven EPAs:

a) Climate Change (droughts, dry spells, floods).
b) Land tenure issues, e.g., not many people own land).
c) Pests' infestation and disease outbreaks.
d) Lack of proper markets as farmers rely on vendors to sell their products.
e) The exorbitant and prohibitive cost of farm inputs, especially seeds, fertilizer, and herbicides.
f) Reluctance by many smallholder farmers to embrace and accept new and improved variety breeds.
g) Inadequate access to extension staff by smallholder farmers for expert advice due to mobility challenges since most of the motorbikes that were being by AEDECs, AEDOs, and Assistant Veterinary Officers (AVOs) broke down a long time ago.
h) Inadequate staff, dilapidated houses, and offices for staff in the respective EPAs and Sections.
i) Farmers cannot identify the markets before growing a particular crop.
j) Many farmers prefer to use indigenous knowledge systems in crop production than the technical knowledge provided by the extension staff (e.g., AEDOs) and Lead Farmers.
k) Lack of access by smallholder farmers to hybrid and improved crop and livestock varieties,
l) Stock theft
m) Inadequate extension staff, as some EPAs and some sections do not have agricultural, veterinary officers (AVOs).
n) Poor mobility of staff,
o) Inadequate staff
p) Poor housing/offices for extension staff.

q) There is a need for more funding to the extension staff to boost Farmer Field Schools (FFS).
r) Lack of construction materials for kholas.
s) Inadequate feed,
t) Water scarcity,
u) Limited grazing area for the animals.
v) Poor housing for animals such that farmers keep their animals in houses where they live instead of using standards kraals.
w) Poor management of trees
x) Many farmers still use local seeds for maize production.
y) The varieties grown are not in line with the weather conditions that are experienced in the area.
z) Poor markets and road networks.
    - In areas where crops are grown close to Kasungu National Park, wild animals frequently destroy them.
    - Lack of skills for tree management, and
    - Inadequate seedlings.

The report has also listed several organizations/NGOs implementing various projects in the study districts intending to boost crop and livestock production. These include:

a) Agriculture Sector-wide Approach (ASWAP).
b) Sustainable Agriculture Production Program (SAPP) funded by IFAD.
c) Adaptation Fund Project (funded by WFP) focuses on agriculture insurance and marketing.
d) Malawi Watershed Service Improvement Project (MWASIP).
e) Promoting Sustainable Partnership for Empowered Resilience (PROSPER).
f) Climate Smart Public Works Programme.
a) Clinton Development Initiative (DCI), for the provision of small loans to smallholder farmers.
h) One Acre Fund.
i) Evangelical Association of Malawi (EAM).
j) Total Land Care.
k) Relief Eagles.
l) Food and agriculture organization (FOA).
m) Plan International.
n) World Vision International.
g) Kasungu Coordination Project.
m) Community Based Facilitator (CBF)
n) Sustainable Land Management.
o) Coordination Project.
p) Kulima and Afikepo funded by FAO.
q) Climate Resilience Initiative Malawi.
r) NASFAM.
s) Ungwelu;
t) Transform; and
u) Synod of Livingstonia

For the SI system employing the crop-tree-livestock mixed farming methodology to be successfully implemented in Malawi, listed below are some of the recommendations that CIMMYT will need to address:

a) Conduct sensitization, public awareness, and knowledge dissemination campaigns to smallholder farmers about the importance and benefits that accrue from adopting SI technologies, particularly to ***crop-tree-livestock*** mixed farming systems.
b) Conduct rigorous and extensive training of smallholder farmers about SI mixed farming system technologies involving ***crop-tree-livestock*** mixed farming system.
c) Establish demonstration plots ***crop-tree-livestock*** mixed farming system through Farmer Field Schools (FFS) and LEAD Farmers where smallholder farmers could learn from.
d) Explore ways in which smallholder farmers could have easy access to small loans for procuring farm inputs, especially fertilizer, herbicides, improved seeds and seedlings, and livestock (chickens, goats, cattle, rabbits, etc.).
e) Explore ways in which smallholder farmers could have easy access to support services, e.g., availability of shops within easy reach where smallholder farmers could buy farm inputs, availability of dipping tanks for livestock disease control, easy access to Chitopa (Livestock Diseases) Clubs; establishment of Cooperatives as facilities where smallholder farmers could easily access small loans, and use the facility to sell their farm produce to outside markets thereby avoiding the middlemen (vendors) who steal from smallholder farmers by offering them low and very poor prices; and
f) Ensure improved market access by smallholder farmers.

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