Norwegian University of Life Sciences

Master's Thesis 2022 30 ECTS
Faculty of Landscape and Society

Diversification and its impacts on smallholder's livelihood in Malawi – the economic benefits of a whole farm approach

Anjali Saru
Masters in Global Development Studies

Diversification and its impacts on smallholder's livelihood in Malawi – the economic benefits of a whole farm approach

M.Sc.

Global Development Studies Thesis

Anjali Saru

Abstract

Malawi is the sixth poorest country in the world, and its citizens are especially vulnerable to climate change since they are concentrated in rural areas and rely on agriculture that is highly dependent on rain. Farmers' inability to enhance their standard of living and the depletion of nutrients for ordinary calorie consumption is exacerbated by the fact that they consume the majority of their production—maize being the staple crop. It seems that smallholders in Malawi would benefit from a "whole farm approach," which seeks to build a profitable base to bear fluctuating market conditions and to transition traditional crops into high valued cash crops. The integrated crop and livestock system in Malawi is still uncharted, despite the fact that sweet potato, cassava, soybean, and other crops are being adapted. Furthermore, the populace is also engaged in occupations apart than farming. Therefore, it becomes difficult for smallholders to choose between potentially high-profit but low-risk ventures. This study explores to understand the impact of whole farm approach and economic benefits based on different crops and livestock combination. Around 470 individuals were selected from the pool of 1100 farmers based on their primary and second importance source of income namely crops, labor and livestock from Dowa district, Malawi. The semi-structured questionnaire were asked by qualified field research assistants to extract demography, quantity related to growing crops and livestock and income surrounding them. The study's findings suggested that the biggest returns might be expected from the sale of Irish potatoes and vegetables, while crop cultivation alongside livestock served as a secondary source of income for practically every item. Cattle stood highest yielder from livestock farming. The whole farm approach (diversification) has the potential to increase economic resilience in smallholders.

Acknowledgments

I would like to acknowledge and give my warmest thanks to my supervisor Prof. Lars Olav Eik and co-supervisor Muhammad Azher Bhatti who made this work possible. Their guidance, patient and advice carried me through all the stages of writing my thesis and helped to obtain the data from TRANSFORM program.

I would also like to give special thanks to my parents, husband, and family as a whole for their continuous support and understanding while writing my thesis. It would not have been possible without their encouraging words and love.

Finally, I'd like to thank myself for enduring difficult times and never losing faith in myself.

This thesis is dedicated to my late maternal uncle Mr. Bharat Thapa. May his soul rest in peace

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Contextual information

Between 1960 and 2010, the population doubled in Malawi, raising concerns about food security, particularly for small farmers and people with poor incomes (Sekaran et al., 2021). Similarly, the population is projected to reach 9.7 billion by 2050 and 10.9 billion by 2100 (United Nations, 2019). By the year 2019, there were 650 million undernourished people in the world, according to the United Nations (2022); since the pandemic, that figure has risen to approximately 800 million. In the same manner, around 120 million people have been driven into extreme poverty in 2020, thus the first increase in extreme poverty since 1998 while setting back around three years of poverty reduction progress (United Nations, 2022).

Agriculture is the mainstream for almost every sector. Around 37% of the land area is used for agriculture in the world meanwhile contributing 4.3% to the gross domestic product (GDP) alongside forestry and fishery (The World Bank, 2019). According to Feliciano (2019), with more than 80% of the poor residing in rural areas, agriculture is considered to be a more reliable sector than other industries to generate income and treat food insecurity. Moreover, smallholder agriculture, which involves farms with less than 2 hectares of land and low asset bases, can also be a good starting point for reducing poverty (Feliciano, 2019). Similarly, smallholder farms are estimated to contribute more than 70% of the food supply for Asia and sub-Saharan Africa (SSA) (Bhatti et al., 2021). On the other side, smallholders frequently store their crops for their use and rely on raising animals as a backup food source, making them vulnerable to unforeseen occurrences like climate change and generating a gap in the nourishment supplement (Bhatti et al., 2021; Sekaran et al., 2021).

Although sub-Saharan Africa is entitled as an upper-middle-income region with around $3000 per capita GDP, many countries are found to be immersed in poverty in rural areas (Carter & May, 1999). In the contribution to Africa's GDP, agriculture holds an average 15% share which counts for around 57 %of employment (Heumesser & Kray, 2019). Holding those facts, the rural areas are dominated by smallholders with scarce or no land/ resources to compete for the uncertainties for a sustainable livelihood. With the prevalence of steady 4.5 %growth in GDP annually for almost two decades, the development is registered for the mineral and hydrocarbon resources only which fail to support inclusive growth or produce employment (Heumesser & Kray, 2019).

Following that, Heumesser and Kray (2019) also quote Goyal's and Nash's report that the recent steadiness in the growth of agriculture output of 3.3 % between 2001 and 2014 was the result of the expansion of the cultivation, not the productivity growth.

Withstanding the expended horizon, the term diversification is introduced in the agriculture sector of SSA which is mostly driven by the opportunities and constraints encountered in such an environment (Tittonell et al., 2010). The 'diversification' holding the spotlight in the SSA refers to a sectoral shift from farm to non-farm activities in the case of the rural economy whereas 'increase in the income strategies by increasing the number of activities for the individual livelihood (Alobo Loison, 2015). The diversification is highly driven by the individual objective, socio-economic factors, and the social class of the smallholders. At a time the diversification in SSA has shifted the focus from farm activities to non-farm activities thus decreasing the activities in agriculture and the lesser utilization of fertile land which has arose much of the debate on the diversification (Alobo Loison, 2015). Nevertheless, diversification can also regulate the impactful changes in the livelihood of the smallholders which can result in various benefits thus upgrading the quality of life. Noting that the supply of global food has changed from grains to animal protein in the last 50 years (Sekaran et al., 2021), integrated crop and livestock production can be explored with the diversification concept. According to author Davis, the rainfall-dependent agriculture of SSA did receive extension services that were intended to give farmers research-based knowledge, but they failed as a result of a lack of appropriate technology, a disconnect between extension and farming practitioners, and the exclusion of clients in problem definition and problem-solving (Bhatti et al., 2021). The prospects of maintaining the sustainable livelihood of the smallholders with integrated crop and livestock production need plenty of attention from the researcher and experts.

Diversification in agriculture has been through different phases of definition over the years and region, despite that, the prime definition remains intact on the shift of traditional crops into high-valued cash crops that can meet the demand of the market as well as provide the employment opportunity (Deogharia, 2018). Following that, the diversification would always aim to channel the profitable base for the smallholder that can depend on the volatile market and bear the price risk on the organized system which will ensure to make a sustainable income and increase the quality of life. The diversification of agriculture can be categorized into horizontal and vertical

shifts where the horizontal diversification can be done by adding new crops into the existing cropping system to increase agriculture productivity or shifting to high-ending cash crops whereas vertical diversification is achieved by adding value to the existing cropping system through the processing, packaging, and branding (Deogharia, 2018). Similarly, Maggio and Sitko (2021) have demonstrated two favorable diversification ways; first, the sampling effect, whereby higher diversity enhances the likelihood of cultivating the best-adapted species for a specific location, and second, the complementary effect, in which different species use resources in ways that are distinct from one another, allowing more diversified systems to maximize the utilization of the available resources. Deogharia (2018) also detailed the stages of diversification into four stages of change from monoculture to multiple cropping, adapting crop and animal husbandry collaboration, initiating mixed farming, and also focusing on the processing, packaging, and branding campaign of the product which would ensure to involve the available human and environmental resources in its full potential to mitigate the price risks and market volatility. Overall, agriculture diversification can be a potential way to attain a diversified source of income for smallholders in the globalized market.

Meanwhile, within the diversification of agriculture, integrated crop and livestock system can be further explored alongside crop diversification. The diversification in agriculture stands for the wholesome shift in the system of agriculture practices where both crop and livestock are taken into consideration for the change into high-return alternatives. Whereas, crop diversification withstands the replacement or addition of high-value commodities in the existing crop system likely, cash crops (vegetables and fruits for export market) (Clements et al., 2011), in addition, the integration of livestock to the crop system named as mixed farming can be also applied for poverty alleviation (Bacon et al., 2014). Furthermore, the integration of trees and crops named agroforestry also falls under diversification (Altieri et al., 2015). In SSA, crop diversification is frequently seen as a way to increase productivity while lowering risk and volatility in smallholder agricultural systems (Maggio & Sitko, 2021).

1.2 Different diversification in agriculture

As discussed above, diversification within agriculture can be medium for poverty alleviation and sustainable livelihood (Birthal et al., 2013). Besides, mixed farming, agroforestry, or crop

diversification, other different approaches are applied under agriculture diversification which is listed in the table below:

Table 1 Diversification in the agriculture system Source: Feliciano (2019)

Diversification types	Description of diversification
Increased structural diversity	Crops that are more architecturally diverse within a field, such as strip intercropping, involve growing more than one crop in strips that are both wide enough to allow for autonomous cultivation and narrow enough to allow for crop interaction.
Genetic diversity in monoculture	Growing mixed varieties of a species in a monoculture.
High-value crops	A shift from a less profitable and sustainable crop or cropping system to a more profitable and sustainable crop or cropping system.
Crop rotations	Temporal diversity through crop rotations.
Polyculture	Growing two or more crop species and wild varieties within the field. Spatial and temporal diversity of crops.
Diversify the field with non-crop vegetation	Growing weed strips or vegetation banks in and alongside crops.
Mixed farming	Crops and livestock.
Agroforestry	Growing crops and trees together.
Mixed landscapes	Development of larger-scale diversified landscapes with multiple ecosystems.

The above-listed different diversification covers almost every diversification practice under the agriculture system and except the mixed landscapes, every other diversification can be obtained at the farm level with the variety of either using the same land unit or different spaces at the same time or different time (Lin, 2011). Feliciano (2019) citing different authors has listed down the benefits in association with the 'no poverty' goal as an increase in income and employment, climate change mitigation and adaption, crop productivity, low risk to market fluctuations, and upper hand on controlling pest and diseases and so on. Overall, the diversification cannot be ignored to attain the economic benefits for the smallholders' livelihood as almost every options can be applied on the small level of farm.

1.3 Malawi background

Malawi is a landlocked country situated in the Southeastern part of Africa covering 118.5 thousand square kilometres (The World Bank, 2019), and holds a population of around 19 million till the year 2019 (Bhatti et al., 2021). Out of total land, 23.8 %of land falls under forest, followed by 22.9% under terrestrial and marine protected areas (The World Bank, 2019) and has the third-largest freshwater lake in Africa namely lake Malawi (Bhatti et al., 2021). Moreover, around 74% of people in Malawi live in absolute poverty (with daily incomes of less than $1.90) and is ranked as the sixth poorest country with a per capita income of $1.57, and 17 %of the population is undernourished (Bhatti et al., 2021; The World Bank, 2019). In addition to that, more than 80 %of the population is from rural areas that are dependent on the agriculture sector (Esser et al., 2005). Smallholder farmers predominate in the agriculture sector as a result of the high population density in rural areas. Furthermore, Malawi's GDP is US $12.17 billion, with the agricultural sector contributing 23% of the country's GDP (The World Bank, 2019).

The economy as a whole is significantly impacted by the agricultural industry (Esser et al., 2005). Meanwhile, just 28,000 hectares of land are legally or semi-formally irrigated in Malawi, where crop output is determined by rainfall, making them susceptible to drought and irregular rainfall (Bhatti et al., 2021; Esser et al., 2005). In comparison to Zambia (0.86 hectares per person) and the rest of sub-Saharan Africa (0.40 hectares per person), Malawi (0.23 hectares per person) has one of the highest population densities in the region, but when compared to other countries in the continent with similar densities, Malawi is only able to produce one major harvest with a single rainy season (except for irrigation) rather than two rainy seasons like others (Esser et al., 2005). For Malawi, the harvesting season runs from November through March (roughly 4-5 months) and is followed by the dry season, which runs from April through October (Ellis et al., 2003). Additionally, according to Ellis et al. (2003), some farmers can use the remaining moisture in valley bottoms (dambos) to continue farming after the rainy season has ended (in what are called dimba fields). Climate change's effects can be seen in the increasingly frequent and severe weather-related shocks and stress that have occurred recently, such as irregular rainfall, flooding, and protracted dry spells (Morton, 2007). High levels of climate vulnerability have been observed in Malawi (droughts and floods), especially in 2015, 2016, and 2019, which harmed the economy overall as well as important socioeconomic sectors (Bhatti et al., 2021).

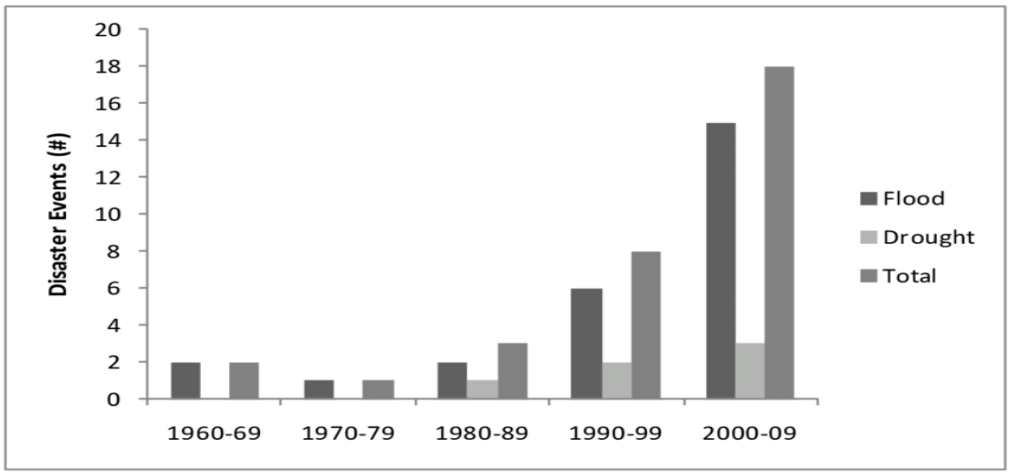


Figure 1 Trend of floods and drought in Malawi. Source: Lewin (2011)

Eighty percent of the cultivated land in the smallholder subsector is used to grow maize (the dominant crop and staple food), whereas tobacco is the primary agricultural crop exported, followed by tea, sugar, and coffee (Ministry of Economic Planning and Development 2004). The popularity of maize is also widespread among small farmers in Southern Malawi; on about 90% of their land, maize is grown, and it accounts for almost 80% of their daily food calories (Esser et al., 2005).

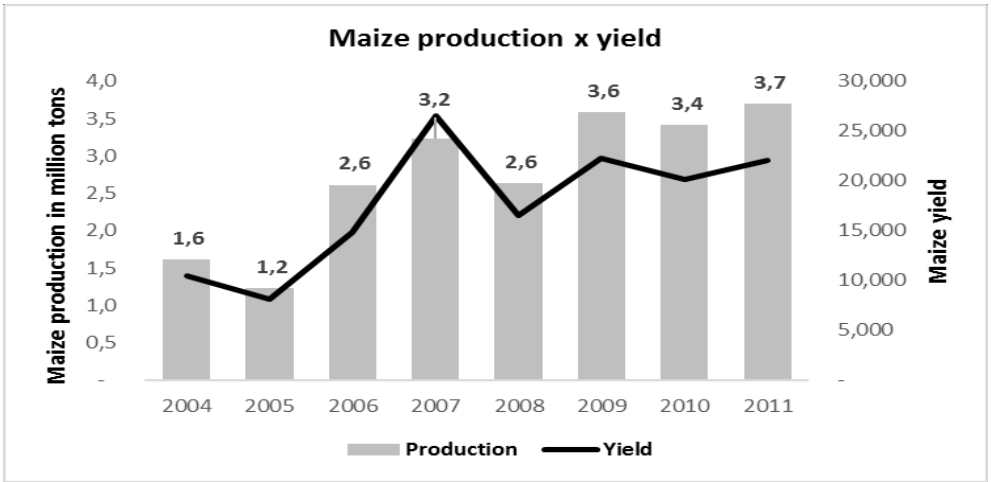


Figure 2 Maize production and yield in Malawi from 2004 to 2011. Source: Schiesari et al. (2016)

Even if they raise crops primarily for self-consumption, about 60% of rural households cannot satisfy their yearly needs with the existing supply, contributing to the rising poverty rate (Esser et al., 2005). The other popular crops in agriculture include groundnuts, sunflowers, beans, cowpeas,

rice, soybeans, and other root crops, which are sporadically incorporated into or loosely rotated with the production of maize (Banda, 2008; Esser et al., 2005).

Smallholders also rear livestock, especially cattle, goats, sheep, pigs, and poultry, though their yield is still insufficient in Malawi (Esser et al., 2005). Malawi's livestock industry, which accounts for 7% of the GDP, is primarily used as a form of financial protection against floods, droughts, and unpredictable rains (Esser et al., 2005; Menon, 2007). Bhatti et al. (2021) reported the importance of farm diversification including livestock for improved livelihoods of smallholder Malawians; it affects the production of livestock-based products, and as a result, Malawi imports almost half of its dairy products (Esser et al., 2005). In addition, Malawi is also experimenting with agroforestry fertilizer trees (especially Faidherbia albida & Gliricidia sepium) and maize to combat the drought, soil infertility, and other climatic obstacles (Amadu et al., 2020; Thangata & Alavalapati, 2003).

1.3.1 Structure of Malawi agriculture

In Malawi, the customary (smallholder) and estate (large scale) sectors regulate the agricultural land where the smallholder covers 6.5 million hectares and the large scale owns 1.2 million hectares on leasehold or freehold (Esser et al., 2005). The customary sector can be categorized as subsistence, smallholder, and pastoralist. Under subsistence agriculture, farming and related operations' primary output is consumed directly, having few or no purchased inputs, and only a small fraction of the output is marketed (Barnett et al., 1997). Whereas smallholder agriculture is a term used more broadly to refer to rural farmers, primarily in developing countries, who rely mostly on family labour for farming and whose farms are their main source of income (Cornish, 1998). Additionally, pastoralists almost entirely rely on the sale of cattle and animal products to buy essential foods and other requirements or on artisanal fisheries and aquaculture enterprises (Allison & Ellis, 2001; McPeak & Little, 2006). Most of the available agricultural land—roughly 70%—is rain-fed for cultivation (Esser et al., 2005). Maize is the prime crop for the smallholder whereas tobacco leads the estate sector (Morton, 2007). Having said that, the productivity of the maize is closely monitored by the government of Malawi as well as other donors since Maize is the staple food in Malawi. The farming system in SSA has multiple accounts for extended services that were focused on the research-based knowledge to uplift smallholder livelihood but failed in

the inclusion of smallholders for the strategy, thus, ignoring the importance of community practices (Bhatti et al., 2021).

Moreover, the yield of the production was also determined in terms of Lead Farmer (LF) and Follow Farmer (FF); the former farmer usually encourages others to the adaption of new technology while the latter will evaluate the others and decide on selective policies based on their preference (Bhatti et al., 2021). Also, over the last decade, Malawi has introduced crop diversification, and integrated crop-livestock and agroforestry systems in the agriculture structure. The varieties of maize, the production of mushrooms under fertilizer trees, and the production of cassava, and sweet potato instead of maize are some examples of diversification in agriculture in Malawi (Morton, 2007).

1.3.2 Diversification and Malawi

As discussed in the above section, Malawi is not new to the term of diversification in agriculture. With the population outnumbered in rural areas more than in urban and rainfall-dependent farming, the low productivity and food insecurity are not surprising. The continuous climate change and now the pandemic have made the livelihood of smallholders in Malawi vulnerable and at risk. Rural Malawians who live in poverty have several serious challenges that can only be overcome by increasing agricultural productivity, diversifying farm output to lower risk and move toward better value products, and diversifying livelihoods toward nonfarm companies (Ellis et al., 2003). Snapp and Fisher (2015) also reported the positive relation of diversification between crop and dietary, livestock and dietary, and agriculture input subsidies and crop.

Since the majority are sub-subsistent smallholders in Malawi, diversification might be favored for the options that can situate their needs and supplement priority rather than profit maximization (Key et al., 2000; Maggio & Sitko, 2021). Similarly, their crop choices are determined based on their available resources, risk of climate change, and market accessibility (Maggio & Sitko, 2021).

Chapter 2: Objectives of the study

The general objective of the study is to understand the impact of diversification on the livelihood of smallholders as well as analyze the economic benefits based on different crops and livestock. Malawi is in dire need of a revolutionary step in agriculture and livestock production that can retain a profitable yield alongside a sustainable biosphere and adhere to the vulnerabilities and uncertainties.

The sub-objective of the study are

- To understand the impact of diversification in agriculture and the economic benefits surrounding it
- To compare and contrast the various combination of integrated crop and livestock systems and their yields
- Analyze the livelihood of the smallholders based on their adaption to the different agricultural diversifications

Chapter 3: Literature review

3.1 Diversification in the developing countries

Agriculture still has a long way to go to catch up with secondary and tertiary industries in terms of diversification, which is a crucial component of structurally changing an economy, especially in developing countries (Vyas, 1996). The diversification in agriculture or rural livelihood diversification might converse different strategies but both aim to serve the rural population (43% of the total population, The World Bank (2019)) who are dependent on agriculture for their source of income. According to Ellis (2000b, p. 15), "Rural livelihood diversification is defined as the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and to improve their standard of living." Moreover, diversification is a continuous strategy of securing multiple sources of income or adapting the best alternative options for a better livelihood (Niehof, 2004). Thus, it has been observed that developing countries with a high rural population density employ a variety of diversification strategies.

Diversification in developing nations is not a recent phenomenon as the rural population already has numerous sources of income for their subsistence from trading, remittance, and non-farm activities (Ellis, 2000a). Diversification is frequently mistaken for concern with sources of income, but there is no simpleton relationship between them; there are several factors, options, groups, and contexts, such as gender roles, that must all be taken into account (Niehof, 2004). Moreover, the different determinants of diversification are seasonality, risk, labour markets, credit market, asset strategies, coping behaviour, change in consumer demand or change in government policies, and most recently, response to climate change (Ellis, 2000a; Gajigo, 2013). The determinants mentioned state the intensity of the diversification in rural lives, for example, asset ownership would differ among the rural poor and rural well-off or the gender; similarly, the smallholders tend to adapt the non-farm activities during the off-season (Ellis, 2000a). According to asset strategies, relatively wealthy smallholders who successfully diversify their sources of income, particularly by utilizing opportunities and synergies between agricultural and non-farm activities, are likely to benefit from diversification more than poorer smallholders (Alobo Loison, 2015). The research in rural southern Laos supports this result, showing that household-level livelihood diversification is connected with better wealth status and ownership of a variety of assets as part of a progressive, accumulation livelihood plan for individuals with fewer limitations (Martin & Lorenzen, 2016).

While the green revolution altered Asia's agriculture by developing high-yielding grain varieties, the productivity of agriculture has increased with structural change supported by industrialization and urbanization in Europe and North America (Djurfeldt et al., 2005; Timmer, 2009). The same cannot be projected for SSA, however, as, in contrast to consolidated farms in Europe and North America, the size of farms is generally decreasing due to rising population density in rural SSA which is further complicated by the absence of modern input (fertilizer or irrigation) use and advance technological tools (Alobo Loison, 2015). Additionally, the lack of industrialization in SSA limits non-farming prospects, making smallholder farming the only viable option for the region's expanding young labour force (Alobo Loison, 2015; Losch et al., 2012). These studies highlight the value of smallholder agriculture and the requirement for SSA to upgrade to modern inputs.

Diversification is also derived as a necessity or choice that is influenced by pull or push factors (Alobo Loison, 2015; Ellis, 2000a). The necessity for diversification might lead to settling on low-standard activities as they are driven by push factors (negative factors) such as drought and flood. Whereas the choice is voluntary action where the decision is done to achieve a more profitable outcome, thus, pull factors (positive factors). Rehima et al. (2013) studied the instance of Ethiopia and concluded that agriculture there is highly diversified to meet domestic requirements, and market demands, withstand price fluctuation, and manage income risks. Additionally, Utpal and Manabendu (2010) perceived the practice of crop diversification in India as a necessity for farmers, particularly small and marginal farmers, to survive. Due to contextual factors like gender-based in developing nations, the impact of diversity varies for each country.

For instance, a case study on Kenya by International Food Policy Research Institute (IFPRI) stated that the average household income is lower when a woman is in charge (Kennedy, 1991). However, another study conducted in rural KwaZulu-Natal by Mtshali (2002) demonstrates against the generalization of such gender roles and reports that households headed by women typically have more opportunities to diversify their sources of income in poor, patrilineal, and patriarchal societies where spouses have limited mobility. Additionally, the former result is supported by the female-headed households in rural Botswana with slightly more disposable income than male-headed ones (Niehof, 2004). Similarly, only 46% of homes headed by women reported an improvement in economic situations, compared to 77% of households headed by men, in the study

on the effects of market liberalization on poor smallholder households in Malawi (Orr & Mwale, 2001). In addition to gender, the temporal perspective, or seasonality, obstructs generalizing the effects of diversification in emerging nations (Niehof, 2004). Observations among rural West Nepalese people revealed that attempts to diversify livelihoods while using the same amount of inputs did not produce the same level of results for each demographic (Gautam & Andersen, 2016). The caste/ethnicity and associated socioeconomic features of households were thought to have an impact on the results for west Nepal, resulting in an income difference in the community. Thapa et al. (2017) also project similar variables like female-headed households, Brahmin ethnic group, literate mother's households, remittance-receiving households, etc. for their correlated relation to increase high value crops' (HVC) productivity.

However, at some point, even among developing nations, similar effects can be drawn. For example, according to the study done by Asfaw et al. (2019), in Malawi, Zambia, and Niger, exposure to extreme rainfall events is positively correlated with either crop or livelihood diversification, indicating that climatic shocks are important driving forces behind diversification. Furthermore, an analysis of changes in livelihood strategies of Malawi by Orr and Mwale (2001) reported that the majority (56 percent) indicated an improvement in their economic situation, despite evidence from rapid rural appraisal (RRA) suggesting that the poor are getting worse. Higher revenue from crops (burley tobacco, vegetables, and grain legumes) and microenterprises was associated with market liberalization. Moreover, market liberalization because of structural adjustment appears to have promoted livelihood diversification and boosted rural trade and services in rural areas of Malawi. It promoted migration as well, increasing money through transfers made by migrant workers in cities (Niehof, 2004; Orr & Mwale, 2001).

Likewise, according to empirical research, diversifying a farm's operations by incorporating horticulture, supplemental businesses, and other High Environmental Value (HVE) commodities like mushrooms, etc., will boost farm income (Sen et al., 2017). Similar to this, Nepal's agriculture has also seen a change from mono-cropping to multi-cropping, livestock farms, and agroforestry farms as a result of technological advancements (irrigation), inputs (fertilizers), and educational professional training programs (Dhakal et al., 2012). While Nepal's diversification strategy appears to be motivated by choice, the marginalized minority is nonetheless driven by necessity since they are concerned about the effects of climate change. In a similar instance, the coping mechanisms

identified in Sri Lanka included using government-issued food stamps, taking part in food-for-work programs, exchanging food with neighbours, buying food on credit from merchants, finding part-time employment, reducing the variety and quality of food consumed, skipping meals, temporary labour migration, and selling productive assets in rural populations (Niehof, 2004). Meanwhile, in Eastern Norway, diversification has a positive relationship with farm size (Culas & Mahendrarajah, 2005). While in the research on Malawi, farm diversity is more closely associated with access to markets for buying and selling agricultural produce from the region and the use of botanical fertilizers for total nutritional diversification (Koppmair et al., 2017).

Diversification is both enduring and pervasive, enduring in the sense that it is not just a passing trend that will quickly disappear with further economic development, and pervasive in the sense that it is not only a localized or scattered phenomenon tied to specific agricultural families in specific places (Ellis, 2000a). Experts' use of diversity in various sectors manifests its success. Likewise, agriculture diversification is a widespread adaptation to reach different output levels. As discussed in previous sections by the different authors, Figure 2 describes more factors affecting agriculture diversification and its impact.

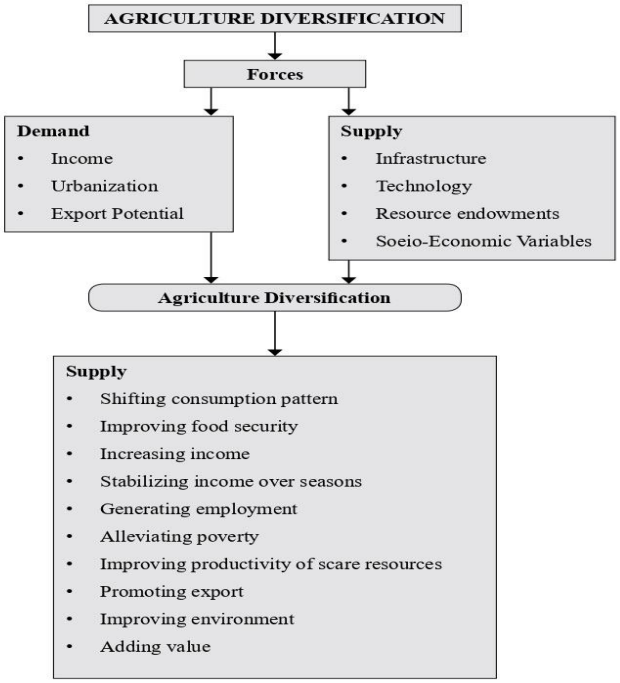


Figure 3 Factors affecting agriculture diversification and its impact Source: Deogharia (2018)

Nearly all the outputs experienced in the various nations are covered by the impacts shown in the figure, while other contextual considerations affect how coherently the same result is obtained. The diversification of agriculture has also been further developed over the years of research into crop diversification, integrated livestock and crop system, fishery and livestock integration, and agroforestry. Based on different studies, crop diversification and integrated livestock and crop system seem to be more practiced in developing nations followed by agroforestry and the rest. The crop diversification and integrated livestock and crop system tend to agree more on population preference while opting for diversification albeit non-farm activities which are further discussed below.

3.1.1 Crop diversification

Crop diversification in agriculture is a universally followed phenomenon that has been approached from different perspectives over the period. The multi-crops system, crop rotation, and genetic diversification in crops are some examples of the form of crop diversification (Feliciano, 2019). Crop diversification is often viewed as the best way to boost revenue while also providing dietary variety for the rural population to combat growing food insecurity, and poverty in developing nations (Bezner Kerr et al., 2019). Crop diversification gives farmers access to other crops that they are unable to acquire due to cost or poor infrastructural constraints in rural, isolated places where family access to food relies heavily on its production (physical access) (Adjimoti et al., 2017). Similarly, a two-year study of households data in Malawi revealed a positive relationship between crop diversification and diet (Bezner Kerr et al., 2019). It was shown that adding manure and compost affected intercropping and the diversification of legumes in addition to maintaining the agroecological environment. Care for the environment is also taken alongside while promoting crop diversification in rural areas. As per Bai et al. (2022), the findings from Rupa Lake in Nepal suggest that a strategy that incorporates both awareness-raising and on-farm conservation measures can generate increased crop diversity and better serve the climate-resilient livelihoods of people in mountainous areas because these crops are crucial to the everyday lives of the locals.

Aside from the concern for the environment while crop diversification, policies, and programs are also valued because the sole decision of adapting the different crops is made by the farmer, who is influenced by a variety of factors. For instance, Karki et al. (2020), according to her research on Nepal's rural population's adaptation to climate change, there is an opportunity for local farmers,

community-based organizations, and local and general government organizations to play a role in inspiring the modernization of traditional agricultural techniques. Furthermore, Kankwamba et al. (2018) reported that in Malawi, based on household data from 2004/5 and 2010/11, the adaptation of diversification tends to increase with the introduction of the government's Farm Impact of Input Subsidy Program (FISP), despite the reduction in diversification over the period (Figure 4). The program set up irrigation infrastructure, technology, high-yield fertilizer, and other things as an aid to diversification.

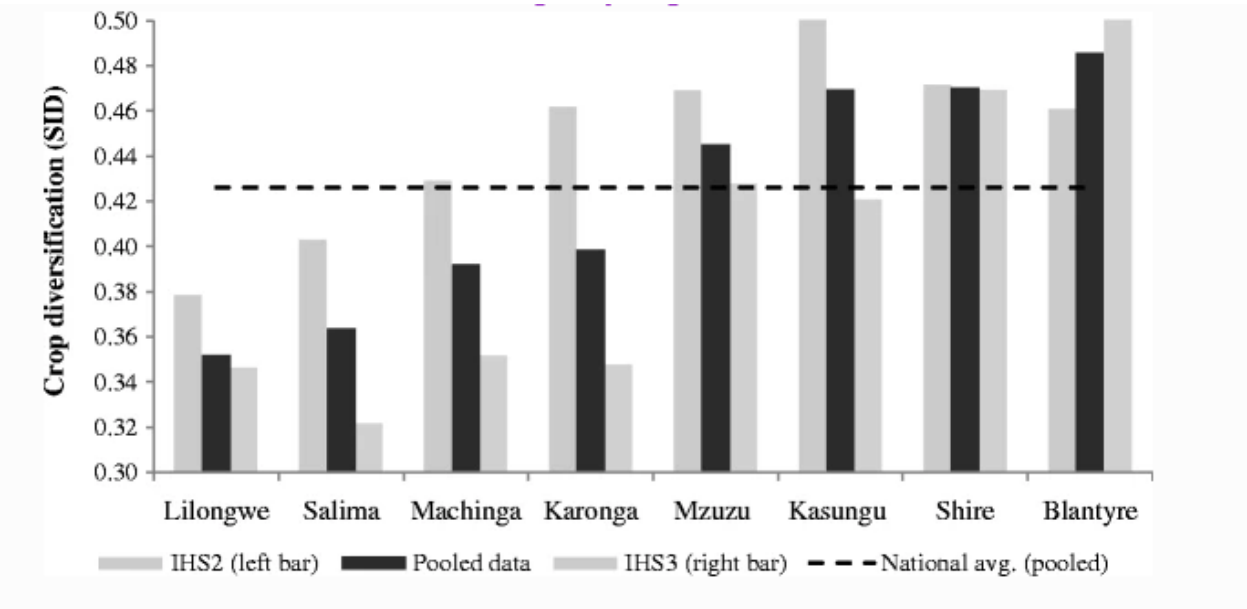


Figure 4 Crop diversification at the farm level in different districts of Malawi Source: Kankwamba et al. (2018)

The IHS2 and IHS3 in figure 4 indicate Second Integrated Household Survey and Third Integrated Household Survey respectively, while based on Simpson's Index of Diversification (SID).

Moreover, Maggio and Sitko (2021) claimed that the seven widely used cropping systems in Malawi and Zambia were appropriate for the agricultural systems in both countries. Maize (a primary staple crop), legumes (beans, pigeon peas), staple crops (alternative staples like rice, and millet), and cash crops are the four key elements of a cropping system (cotton, tobacco). Maize-monocropping (MM), Maize-Legume (ML), Maize and Staple Crop (MS), Maize and Cash Crop (MC), Maize-Legume-Staple Crop (MLS), Maize-Legume-Cash Crop (MLC), and Maize-Legume-Staple-Cash Crops (MLSC) are the seven cropping systems based on these crops. All the dimensions mentioned above alternate the production of a single maize crop with a variety of

options, where maize can either be produced equally or not at all. Table 2 listed below podcast the commercialization index under seven dimensions of the cropping system where Zambia tends to have the upper hand over Malawi (Maggio & Sitko, 2021).

Table 2 Commercialization Index for integration of maize, legumes, staples, and cash crops Source: Maggio and Sitko (2021)

percentile value out of total production (%)							
	MM	ML	MS	MC	MLS	MLC	MLSC
Malawi	7	11	19	36	13	38	19
Zambia	24	35	19	52	33	51	48

These results project how the population of Malawi are subsistence farmers (consumed the production themselves rather than selling) in comparison to commercialized farmers of Zambia. Following the agro-ecological techniques of legume residue management in Malawian families, one-third of farming households who incorporated legume residue soon after harvest were nearly three times more likely to be food secure than farming households that had not included crop residue (Madsen et al., 2021). Additionally, Mhango et al. (2013) also detailed the chances for small-scale farmers in Malawi to increase their output of legumes (preferable for pigeon peas) with the help of fertilizer availability, advanced legume seed subsidies, and informational sessions. The study revealed farmers' positive interest regarding the cultivation of legumes (apart from soybeans) in deficient soil and the production of grain for consumption and supply.

As with maize for Malawi, the dominance of staple foods in agriculture is nothing new in emerging countries. However, this dependence has put people in a "maize poverty trap," so crop diversification helps with dietary variety, improved income, and soil nutrient security (Mango et al., 2018). Government officials' interest in diversification has risen as a result, leading to the creation of numerous initiatives for low-cost inputs and educational radio programs for smallholders (Ragasa et al., 2021). Although the outcome has been impressive, there is still room for improvement in these initiatives. Following that, Okori et al. (2022) conducted two studies over 7 years divided into the learning phase and scaling-out phase to measure the efficacy of farmer-to-farmer extension and community seed banks. By offering numerous one-on-one training sessions to selective farmers who were more likely to be Lead Farmers from the community and by establishing seed banks with enhanced and qualified seeds, the farmer-to-farmer extension

relationship was saturated. The end outcome was impressive, with a 35-fold increase in farmers' access to improved seeds and a 1.8-fold increase in the production of groundnuts with less aflatoxin contamination, and three training sessions being more than enough for the farmers. Moreover, the output market participation in crop diversification also reinforced the food security and nutrient dietary diversity which presumably depended on demographics, farm size, and radio ownership (Asfaw et al., 2012; Mulenga et al., 2021).

3.1.2 The integrated crop and livestock system

The integrated crop and livestock system is another phenomenon in agriculture diversification. It incorporates a whole-farm approach, allowing farmers to delight in both crops and cattle concurrently (Bhatti et al., 2021). The livestock in developing nations is usually valued as liquid assets which can be easily sold off in the market (Banda & Tanganyika, 2021). Livestock production has multiple outputs, like, meat, milk, eggs, and so on. The output of livestock can be even further turned into value-added products, manure, yogurt, and leather for other products. Despite the multiple facilities, livestock production is underrated in agriculture. Now, the incorporation of crops and livestock together is not a widely adopted system in developing nations. Some nations might be ahead in ICLS like the hilly region of Nepal but Malawi is still behind on it (Rege et al., 2022; Thorne & Tanner, 2002).

There are multiple beneficiaries for the livestock and crop integration that can compensate for any shortfalls in sole crop diversification or other factors. The integrated crop and livestock would increase the food security and nutrient diet (milk, meat) for the subsistence smallholder as well as provide the opportunity to participate in the output market, thus, ensuring multiple sources of income (Sekaran et al., 2021). He further elaborates on the diversification of livestock in cattle, poultry, swine, sheep/goat, etc.; cattle production holds the prime attention followed by poultry in developing nations. In contrast to Malawi, where goat and cow husbandry are prioritized, smallholders in hilly areas of South Asia, particularly Nepal, invest in raising cattle, poultry, and goats (Banda & Tanganyika, 2021; Das & Shivakoti, 2006). Livestock production, crop choices, soil fertility, socio-economic factors, and climate change are the factors that can manipulate the results of integrated crops and livestock. Figure 5 summarizes the principal aspects of the integrated crop-livestock system.

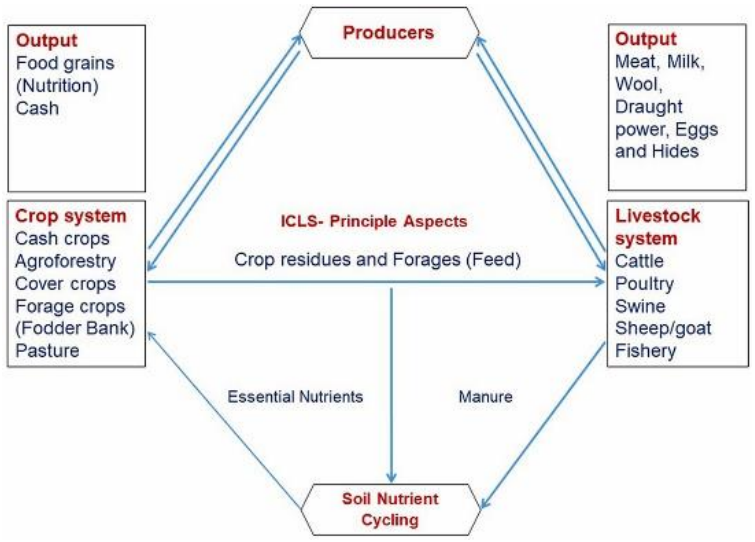


Figure 5 Principal aspects of the integrated crop-livestock system (ICLS) Source: Sekaran et al. (2021)

The livestock is deemed as nutrient recycling and a source of rural energy that depends on forest grazing and agricultural land for feed (Das & Shivakoti, 2006). For an instance, the use of duck in rice production to control weeds, the use of cows/ox in traditional agriculture tools (plowing), and rice and fish cultivated on the same land are some examples depicting integration among crops and livestock (Banda & Tanganyika, 2021). The limited farm size in Malawi stands as a constraint for the integration as the same land should be divided for crop production as well as livestock rearing (Rege et al., 2022). Moreover, the Holistic Agriculture Diversity Index (HADI) projected 28.22% (low) diversity in the agriculture of Malawi; with maize, mango tree, and chicken being prime production (Fatch et al., 2021).

Chapter 4: Methodology

A structured way of formulating and implementing the plans and interpreting the results is very important for any research as it weights direction for any study. This chapter would explore the methods which would be fitting to the study and also evaluate the advantages and disadvantages of the applied methods. The methodology process ensures to provides the path for future exploration for other research as well as tends to guide systematically, for example, the process of literature review, concept and theories, sampling cases, data collection, data analysis, and writing up (Bryman, 2016).

4.1 Research design

Research design is the conceptual framework that specifies how to transform research questions into a particle and logical framework of tactics and procedures to assure successful and methodical responses to these research questions (Bryman, 2016; Kothari, 2004). The process of choosing the research design is mostly driven by the objective of the study and the research question surrounding it. The design has to fulfill the purpose of neutrality, reliability, validity, and generalization for the study (Bryman, 2016). A descriptive research design was used for this study because this design describes facts and characteristics in-depth of the given population systematically and accurately. Fireman Kramer (1985) explained in a descriptive research design, the researcher observes, describes, investigates, and analyzes the feature to build new information in an area where prior work is deficient or insufficient. He further stated about two levels of descriptive research design where the first level is focused on the research problem and no prior knowledge is available which contradicts to form any concept whereas under the second level the prior knowledge exists and concepts can be formulated but the relationship between variables cannot be predicted. The later one is more relatable to our research.

This study was based on a quantitative approach which entailed the creation of data in a quantitative format that can be submitted to a strict and formal quantitative examination (Kothari, 2004). This approach tends to explore the relationship between variables and answer the research problems of the study.

4.2 Study area

The study area of the research was based in the Dowa district, Malawi.

4.3 Sampling method

The purposive sampling method was used for this study. Under purposive sampling, the research problem guides which category of the population should be sampled for the study(Bryman, 2016). Concerning the research problem, farmers from the five districts of Malawi are used for sampling.

The sampled farmers were selected based on their source of livelihood from the data pool of 1100 farmers. The farmers having crops, labor, or livestock as a source of income were taken for the data collection. Crops 1st, labor 1st, crop 2nd, labor 2nd, and livestock 2nd were the five groups categorized based on the crop as first, labor as first, crop as second, labor as second, and livestock as the second source of livelihood respectively. A total of 470 farmers were selected.

Table 3 Sample size of groups based on different source of livelihood

Group based on source of livelihood	**Sample size**
Crops 1st	251
Labor 1st	20
Crop 2nd	34
Labor 2nd	90
Livestock 2nd	75
Total	**470**

4.4 Data collection

For the study, primary data were collected to get in-depth information on the economic benefit of the whole farm approach. This study used the cross-sectional design to collect the data by administering semi-structured questionnaires.

4.4.1 Questionnaire

The semi-structured questionnaire was prepared to answer the research problem and was asked to sample farmers under the administration of a qualified field researcher. The questionnaire was based on closed-ended questions and was mostly administrated to extract the demography, quantity related to growing crops and livestock, and income surrounding them.

4.5 Reliability and validity

Reliability stands for the consistency of a measure whereas validity refers to the accuracy of measurement (Heale & Twycross, 2015). Reliability and validity are very important for quality research. Under this study to maintain reliability, the farmers were interviewed with the same set of questions under the same circumstances. The questionnaire designed also stood for homogeneity, stability, and equivalence attributes of reliability.

Similarly, to ensure validity, the farmers were selected from a different area of the district to represent the population that is disused in the study. The questionnaire used was reliable and intended to produce results that are valid for the study. The internal validity might be questioned as the selected data for this study was sampled from the huge primary data collected from the field. To overcome such, excel tools were used to segregate the data so to maintain accuracy in the data.

4.6 Data analysis

The collected quantitative data were analyzed using different descriptive quantitative tools. To summarize and look for patterns, the descriptive tool helps to discover the absolute number (Bryman, 2016). The data from the questionnaire were evaluated and checked for accuracy throughout then they were coded and transformed into tabular form to get a better understanding. Different excel tools were used to analyze the data and extract the pattern in them. The economic analysis was done after sorting the smallholders based on their preferences for the sources of livelihood. The whole population was segmented based on important sources of livelihood.

Chapter 5: Results

5.1 Profile of the farmers

For attaining the objectives of the study, the sample's profile also plays a vital role to shape the result and their relation to other variables. Their education and land ownership alongside their preference to hire labour and to grow or not to grow the crops were discussed to understand the profile of the sampled farmers.

5.1.1 Education level of the sampled population

The educational level of the farmers was categorized into five levels for this study namely primary, secondary, adult literacy, not literate, and tertiary. Table 1 shows the education level of sampled farmers.

Table 4 The educational level of the study sample population (%) with respect to their importance for the sources of livelihoods in Dowa district, Malawi

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Primary School	66.1	65	70.6	71.1	68.0
Secondary School	25.9	20	20.6	18.9	22.7
Adult Literacy	1.2	5	2.9	1.1	1.3
Not literate	6.0	10	5.9	6.7	8
Tertiary	0.8	0	0.0	2.2	0

The above table indicates that primary education was most prevalent among farmers than other levels of education. Farmers who rely on labor 2nd as their major source of income were in the lead, with a primary education rate of 71.1%, followed by farmers who depended on crops 2nd (70.6%). Farmers who specialize in crops 1st and livestock 2nd respectively make up the majority of those with a secondary education, which is the second highest degree of education among farmers. However, only farmers from the labor 2nd (2.2%) and crops 1st (0.8%) groups have a tertiary level of education. While the prevalence of illiteracy among farmers is greater than that of adult literacy across all categories, it is higher among farmers from labor 1st (10%) and livestock 2nd (8%).

5.1.2 Land ownership

The size of land held by farmers among different sources of livelihood is also collected to determine the characteristics of farmers and sorted with a minimum, maximum and average size of land.

Table 5 The land holding size of the study sample population (in ha) with respect to their importance for the sources of livelihoods

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Average	1.1	0.8	1.1	0.9	1.1
Min	0.5	1	1	0.5	0.5
Max	13	9	10	8	10

Farmers from all categories averagely own land measuring at least one hector, although crops 1st group farmers own up to 13 hectors maximum.

5.1.3 Labor hiring and growing crops

Other determinants of farmers are measured in terms of hiring farm labor and growing the crops for the year 2020/21 season. The data are collected in the form of positive or negative affirmative and tabulated below.

Table 6 The percent of surveyed farmers hiring farm labour and grown crops in the last season with respect to their importance for the livelihood sources

		Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
HH[1] hire labour	Yes	42.6	15.0	29.4	42.3	40.0
	No	57.4	85.0	70.6	57.7	60.0
Grew crops in the	Yes	42.6	90.0	94.1	100.0	100.0
2020/2021 season	No	57.4	10.0	5.9	0.0	0.0

[1] Household

The data shows that, although practically all farmers, except for the crop 1st group, grew crops throughout the seasons of 2020–2021, the majority of farmers from different groups choose not to recruit farm workers. In comparison to farmers in the labor 1st (15%) and crop 2nd groups (29.4%), those in the crops 1st (42.6%), labor 2nd (42.3%), and livestock 2nd (40%) groups tend to hire agricultural workers more frequently. Furthermore, the crop 1st group's farmers only account for more than half of those who don't plant crops for the season.

5.2 Farm commodities and their variables

The people under study are surveyed on how many different agricultural products they grow on their property. Ground nuts, soy beans, beans, maize, Irish potatoes, sweet potatoes, and vegetables were the agricultural products that the farmers were asked about in the study. Later on, the economic aspects of commodities would be explored where data were collected in huge numbers and the average value are sorted for a better understanding of each group concerning their importance of livelihood sources. The area used for plantation, quantity harvested, quantity sold, estimated unit price, and total value would depict various dynamics of commodities in relation to the groups.

5.2.1 Commodities' Preference

Table 7 The percent (%) of surveyed farmers growing various farm commodities with respect to their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Ground nuts	49	15	41	36	49
Soybean	63	40	50	63	56
Beans	25	10	24	20	28
Maize	100	80	88	100	100
Irish potato	5	0	10	0	4
Sweet potato	18	10	15	20	15
Vegetables	31	10	15	27	40

The table shows that, except for the farmers of labor 1st (80%) and crop 2nd (88%), all farmers of crop 1st, labor 2nd, and livestock 2nd plant maize. In addition, of all the commodities, maize has the

largest affirmative for planting. Farmers' second favorite product is soya beans, followed by ground nuts and vegetables. Irish potato is the least preferred agricultural product among farmers, rating poorly for each category and not even being grown by labor 1st and labor 2nd group.

5.2.2 Tobacco

Another popular farm commodity among the sampled population is tobacco. The data represents in-depth information about variables related to tobacco like area planted, quantity harvested and sold, estimated unit price, and total value.

Table 8 Tobacco growing smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Growing	51	3	5	17	13
Not growing	200	17	29	73	62
Total (n)	251	20	34	90	75
Area planted in acres	1	1	1	1	2
Quantity harvested in kg	568	117	330	296	973
Quantity sold in kg	583	117	330	307	1,029
Estimated Unit Price	4,005	800	1,840	9,692	1,116
Total Value (MK)	716,728	88,333	469,000	554,068	1,192,000

The above table represents that majority of the sampled population didn't plant tobacco. The number of the population who planted tobacco was highest for crop 1st (20.31%) group. Despite the more people growing tobacco by crop 1st group, the planted areas are largest for livestock 2nd group (2 acres) followed with the highest amount of quantity harvested also (973 kg). The total value of growing tobacco was based on the estimated unit price for each category where livestock 2nd group (1 million) takes the lead followed by the crops 1st (0.7 million) and labor 1st (0.088 million) had the least value among all.

5.2.3 Groundnuts

The data below represents the economic analysis of the groundnut commodity in five sampled groups.

Table 9 Groundnuts growing smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Growing	122	3	14	32	37
Not growing	129	17	20	58	38
Total (n)	251	20	34	90	75
Area planted in acres	0.93	1.17	0.96	0.59	1.23
Quantity harvested in kg	152	102	126	88	116
Quantity sold in kg	65	78	71	50	64
Estimated Unit Price	586	667	411	614	499
Total Value (MK)	74,388	46,000	96,013	61,789	71,444

The table projects that more than 50 percent of the sampled population didn't harvest the groundnuts meanwhile crops 1st (49%) and livestock 2nd (49%) groups had the most population harvesting it. The labor 1st had the least number of population harvesting accounting for only 3 people out of 20. In the case of area planted, livestock 2nd had the largest acres of land used for planting, taking the second position by labor 1st group. Labor 2nd group (0.59) was the group with the least acres of land for planting followed by crops 1st group (0.93) despite which crops 1st group (152 kg) harvested the highest amount of groundnuts in comparison to other groups. However, the labor 1st group (77.05%) sold more of the quantity harvested than any other group. Following the same, labor 2nd (56.94%) and crop 2nd (56.37%) holds the second and third position to do the same respectively. Whereas crops 1st group sold the least amount of groundnuts among all. Another observation can be seen that the crop 2nd group held the highest total value among all the groups and the labor 1st group had the lowest total value.

5.2.4 Soybean

Table 10 Soybean growing smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labour 1st	Crop 2nd	Labour 2nd	Livestock 2nd
Growing	159	8	17	57	42
Not growing	92	12	17	33	33
Total (n)	251	20	34	90	75
Area planted in acres	2.6	0.4	0.6	5.8	1.1
Quantity harvested in kg	184	84	147	160	220
Quantity sold in kg	148	68	107	136	158
Estimated Unit Price	277	203	286	248	278
Total Value (MK)	46,111	19,000	32,041	39,018	52,105

The table suggests that crop 1st (63%) and labor 2nd group (63%) had the highest percentage of the population's affirmation to grow soybeans which were followed by livestock 2nd group (56%). Here, labor 1st had a low number of people growing it. For the plantation, labor 2nd group had 5.8 acres (highest) of land for soybean, and labor 1st group had only 0.4 (lowest) acres of land used. Meanwhile, the livestock 2nd group was able to harvest a huge amount of soybean (220 kg) from 1.1 acres of land. Similarly, crops 1st group was successful in harvesting 184kg of soybean from 2.6 acres of land. Another commendable data is that the crop 2nd group with only half of the sampled population growing the soybean harvested 147 kg of it out of 0.6 acres of land. Whilst 5.8 acres of land were used by labor 2nd group harvested only 160 kg of soybean.

According to the statistics, the labor 2nd group sold practically all of the soybeans that the group harvested (86%) whereas the crop 2nd group and the livestock 2nd group sold the least amount of soybeans (both at 72%). In contrast to other commodities, the predicted unit prices for each category varied relatively little from one another. The livestock 2nd group, with a total value of 0.052 million, came in first, followed by the crops 1st group, with a total value of 0.046 million. Because the labor 1st group had the smallest population involved in soybeans cultivation, they also had the smallest overall value (only 0.019 million) of any group.

5.2.5 Beans

Table 11 Beans growing smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Growing	63	2	8	18	21
Not growing	188	18	26	72	54
Total (n)	251	20	34	90	75
Area planted in acres	0.6	0.5	0.8	0.6	0.5
Quantity harvested in kg	383	30	2,593	60	86
Quantity sold in kg	39	20	64	43	48
Estimated Unit Price	381	250	163	453	340
Total Value (MK)	39,330.3	20,000.0	190,000.0	37,153.8	51,000.0

The involvement of sampled population of each group in growing the beans had a very low percentage, the highest being 28% of the population from the livestock 2nd group. As a result, just a tiny amount of land was planted in each group, with the crop 2nd group utilizing the most land (0.8 acres). Additionally, compared to other groups, crop 2nd group's harvest appeared to be significantly superior. They harvested 2593 kg of beans, compared to the crops 1st group's 383 kg and the rest's failure to even harvest 90 kg on their own. The statistics also revealed that although two members of the labor 1st group and twenty-one members of the livestock 2nd group used the same 0.5 acres of land for cultivation, the latter group yielded 56 kg more beans than the labor 1st group. Unlike the huge variance in quantity harvested among groups, the quantity sold had a low variance. The crop 2nd group didn't even sell its 3 percent of the total harvest (64kg out of 2593kg) whereas labor 2nd sold more than 70 percent of its harvest. Similarly, crops 1st group sold only 39 kg of beans out of 383kg harvested. Lastly, the overall value of crop 2nd scored 0.19 million (highest), the livestock 2nd second (0.051 million), and least by labor 1st group (0.020 million).

5.2.6 Maize

Based on the above tables, the maize had the highest allegiance from the sample population for planting it. The data below explore the detailed economic analysis of maize for different sampled groups.

Table 12 Maize growing smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Growing	250	16	30	90	75
Not growing	1	4	4	-	-
Total (n)	251	20	34	90	75
Area planted in acres	1.6	1.2	1.5	1.3	1.7
Quantity harvested in kg	1,970	764	3,091	1,283	2,382
Quantity sold in kg	289	81	407	222	360
Estimated Unit Price	57	33	34	57	60
Total Value (MK)	43,226	18,583	109,091	30,868	54,606

Apart from the labor 1st group and the crop 2nd group, every sampled population in the other categories farmed maize. A similar number of acres of land were also employed for agriculture by the tested groups. The group of livestock 2nd planted on 1.7 acres of land, just behind the crop 1st group's 1.6 acres of crops. By labor 1st group, 1.2 acres were the least amount of land utilized for agriculture. The data represents that crop 2nd group harvested the highest amount of maize (3091 kg) with 1.5 acres of land and only 88 percent of sampled population growing them from that group. The second group with the highest amount of maize harvested was livestock 2nd (2382kg) which had used the largest area of acres for plantation. After them, the quantity harvested by the groups descended as the declining order of area planted, crops 1st with 1970 kg (1.6 acres), labor 2nd with 1283 kg (1.3 acres), and lastly, labor 1st with 764 kg (1.2 acres).

Amongst all the sampled population, none of the groups sold the maize more than 18% of what they had harvested. Labor 2nd group had sold 222 kg of maize out of 1283kg harvested (highest) and labor 1st group had only sold 81 kg out of 764kg of maize (least). Moreover, maize had the

least expected unit price among all the commodities and the variance among them wasn't high as well. Crops 1st and labor 2nd groups had the same estimated unit price of 57, similarly, labor 1st and crop 2nd groups also had the close estimated unit price (33 and 34 respectively). For the concern of total value, crop 2nd had the highest value (0.11 million), on the queue to that group, livestock 2nd took the position next with 0.056 million total value. Crops 1st and labor 2nd group respectively carried 0.043 million and 0.031 million total value. Lastly, the labor 1st group had the least total value amounting to only 0.018 million.

5.2.7 Irish potato

Table 13 Irish potato growing smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Growing	12	0	2	0	3
Not growing	239	20	18	20	72
Total (n)	251	20	20	20	75
Area planted in acres	0.8	0.0	0.8	-	1.0
Quantity harvested in kg	906	-	400	-	1,423
Quantity sold in kg	775	-	175	-	1,250
Estimated Unit Price	225	-	165	-	238
Total Value (MK)	252,455	-	28,000	-	254,667

The above table projects that only three groups, namely, crop 1st, crop 2nd, and livestock 2nd had grown Irish potatoes that too by very few people (5%, 10%, and 4% respectively). While the livestock 2nd group had 1 acre of area planted, crops 1st and crop 2nd group both had 0.8 acres of land planted. Since two other groups didn't grow Irish potatoes so no other data were available for them. The quantity harvested and quantity sold by the groups followed the same rank order, livestock 2nd took the lead with 1423 kg harvest (88% sold), crops 1st ranked second with 906 kg harvest (86% sold) and crop 2nd came last with 400 kg harvest (44% sold). The estimated unit price of crop 1st and livestock 2nd had more variance with crop 2nd group. Additionally, the total value also had the same rank order as quantity harvested, sold, and estimated unit price.

5.2.8 Sweet potato

Table 14 Sweet potato growing smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Growing	44	2	3	4	11
Not growing	207	18	17	16	64
Total (n)	251	20	20	20	75
Area planted in acres	0.4	0.5	0.5	0.3	0.4
Quantity harvested in kg	519	275	250	370	521
Quantity sold in kg	239	50	83	288	259
Estimated Unit Price	241	50	100	63	137
Total Value (MK)	144,927	10,000	20,000	21,667	78,700

The data showcases that each sample group had contributed to growing sweet potato even though by a limited percentage of the population which accounted for 20% or less of the group's sampled population. Here, the labor 2nd group took the lead for participation and labor 1st had the least participation. In the case of area planted, labor 1st and crop 2nd group both had 0.5 acres; crops 1st and livestock 2nd group both had 0.4 acres and lastly labor 2nd had 0.3 acres. Additionally, livestock 2nd was able to harvest 521 kg of sweet potato (the highest) and crop 2nd harvested 250 kg (the lowest). In the comparison of quantity sold among groups, labor 2nd sold 77% of the quantity harvested, livestock 2nd sold 50%, crops 1st sold 46% percent, crop 2nd sold 33% and labor 1st sold only 19%. Under sweet potatoes, the estimated price among groups had a huge difference from each other where the minimum price was 50 (labor 1st) and the maximum was 241 (crops 1st). Moreover, the total value of each group also ranges from a maximum of 0.15 million (crop 1st) to a minimum of 0.01 million (labor 1st).

5.2.9 Vegetables

Table 15 Vegetables growing smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Growing	77	2	3	24	30
Not growing	174	18	17	66	45
Total (n)	251	20	20	90	75
Area planted in acres	0.5	0.2	0.3	0.4	0.6
Quantity harvested in kg	748	63	1,208	605	1,107
Quantity sold in kg	674	60	1,207	506	1,048
Estimated Unit Price	3,242	75	117	316	1,090
Total Value (MK)	204,120	3,500	150,667	160,326	249,679

The table depicts that not more than 40% of the sampled population of each group participated in growing vegetables where livestock 2nd and crops 1st led in affirmation for plantation (40% and 31% respectively) and crop 2nd and labor 1st ranked last (15% and 10% respectively). Likely in the same order, livestock 2nd group planted in 0.6 acres of land and labor 1st planted in 0.2 acres of land. In contrast, the crop 2nd group harvested the highest quantity of vegetables (1208 kg) whilst the livestock 2nd group ranks second with 1107 kg harvest. Labor 1st group scored last in harvest as well (63 kg only). Furthermore, the data represents that every group of sampled population sold almost every quantity of vegetables they harvested, none of them were less than 84% of the quantity harvested. Crop 2nd sold almost 100% whereas labor 1st, livestock 2nd, crops 1st group, and labor 2nd sold 96%, 95%, 90%, and 84% of the quantity harvested respectively. The estimated unit price among the groups had a great amount of difference among them. Meanwhile, livestock 2nd had the maximum total value of 0.25 million, closely followed by crops 1st (0.21 million) and the minimum total value of 0.003 million only for labor 1st group.

5.2.10 Average income of various farm commodities

The data of total value from each commodity grouped based on their importance for livelihood sources are listed together to get a closure understanding and compare them accordingly. They are compared solely based on their average income only without any influence of estimated unit price, the area planted, quantity harvested and sold, and participation of the sampled population.

Table 16 The average total income from various farm commodities grown by the smallholders in the Dowa district, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Ground nuts	74,388	46,000	96,013	61,789	71,444
Soybeans	46,111	19,000	32,041	39,018	52,105
Beans	39,330	20,000	190,000	37,154	51,000
Maize	43,226	18,583	109,091	30,868	54,606
Irish potato	252,455		28,000		254,667
Sweet potato	144,927	10,000	20,000	21,667	78,700
Vegetables	204,120	3,500	150,667	160,326	249,679

Irish potato and vegetables had the greatest average revenue of all the commodities, according to the aforementioned figure, with Irish potato holding the lead. The livestock 2nd group and the crops 1st group each received an average revenue from Irish potatoes of 0.26 million and 0.25 million, respectively. Second, the average revenue from vegetables for the crops 1st and the livestock 2nd group was 0.21 million and 0.25 million, respectively. Additionally, beans secured the third position having 0.19 million average income under crop 2nd group. Furthermore, vegetables from labor 2nd group and crop 2nd group averaged revenue of 0.16 million and 0.15 million respectively. The sweet potato was the fourth commodity to secure 0.14 million average income individually from crops 1st group. Maize entered the fifth position with crop 2nd group averaging an income of 0.11 million. Ground nuts took the sixth position averaging a value of 0.096 million from crop 2nd group. Lastly, soybeans took the last ranking position based on individual groups. Based on the groups, labor 1st had the least amount of average income among different commodities. Livestock 2nd and crop 1st groups had the highest average income amongst almost every commodity which was followed by crop 2nd and labor 2nd groups.

5.2.11 Livestock

The sampled population was also interviewed on their income fr0m livestock for each group of a different important source of livelihood. The livestock that was considered for data were cattle, goats, sheep, chickens, and pigs. The data were collected based on if they kept the livestock or not, how many they had, how many they sold in the last 12 months and total income. The data collected are sorted from large data and average values are inserted for better understanding.

Table 17 Livestock and chicken keeping smallholders' economic analysis, grouped based on their importance for the livelihood sources

	Crops 1st	Labor 1st	Crop 2nd	Labor 2nd	Livestock 2nd
Cattle					
Keeping	7	0	1	0	1
Not keeping	244	20	19	90	74
Animal heads	5	-	2	-	-
Sold in last 12 months (Y/N)	1	-	1	-	-
Heads sold	8	-	1	-	-
Total income (MK)	960,000	-	200,000	-	-
Goats					
Keeping	101	6	8	24	44
Not keeping	150	14	12	66	31
Animal heads	3		3	2	4
Sold in last 12 months (Y/N)	38		2	11	19
Heads sold	2		4	1	2
Total income (MK)	59,921		97,500	37,000	62,263
Sheep					
Keeping	3	0	0	1	1
Not keeping	248	20	20	89	74
Animal heads	3	-	-	3	3
Sold in last 12 months (Y/N)	1	-	-	0	0
Heads sold	1	-	-	-	-
Total income (MK)	15,000	-	-	-	-

Chicken					
Keeping	156	7	12	47	56
Not keeping	95	13	8	43	19
Animal heads	11	5	9	9	13
Sold in last 12 months (Y/N)	66	4	6	16	25
Heads sold	4.	6	7	5	3
Total income (MK)	11,546	15,375	18,833	12,343	10,424
Pigs					
Keeping	83	2	7	15	41
Not keeping	168	18	13	75	34
Animal heads	3	4	7	2	3
Sold in last 12 months (Y/N)	27	0	6	5	16
Heads sold	2	-	4	1	2
Total income (MK)	64,444	-	125,333	31,200	73,187

Based on the data, the different groups kept the chicken more than any other livestock. After that, goats and pigs were equally popular among the sampled group population. The least favorite livestock were cattle and sheep as almost every group answered negatively about keeping them. The livestock 2nd group has 75 percent of their population answered in keeping the chicken followed by crops 1st group. Similarly, 54% of livestock 2nd group has kept pigs as livestock, followed by 35 percent of crop 2nd group. Labor 1st group was the least keen on keeping the livestock. Despite the lowest turnout for cattle, it reared the highest amount of total value for crop 1st group (0.96 million). Also same pattern for crop 2nd group with cattle owning 0.2 million. Even though there was more inclination for chicken and pigs, they didn't render any good income as cattle did. The crop 2nd group for pigs was able to generate 0.12 million (the third highest).

Chapter 6: Discussion

The findings discussed in the previous chapter have shaped the variables and their relation to each other which will be explored more in this chapter that can answer our research objectives. The diversification of livelihood in terms of the whole farm approach was approached with the questionnaires survey that would cover them and answer our queries regarding them. First of all, the diversification of crops has been prevalent in almost every group with respect to their source of livelihood which might be the result of the introduction of the government's Farm Impact of Input Subsidy Program (FISP) (Kankwamba et al., 2018). As stated by Fatch et al. (2021) that maize, mango tree, and chicken were prime produced in Malawi, the above results also showed maize and chicken as the prime commodities for every group with respect to their source of livelihood. This can be interpreted as a result of maize being almost 80% of their daily calorie intake (Esser et al., 2005). The rearing of chicken was also hassle-free and had low land use compared to the other livestock thus the preference of the sampled population. Also, the rearing of the livestock is obstructed by the limited farm size in Malawi (Rege et al., 2022) which aligns with our findings that cattle were the least reared livestock, as well as the sampled population, had unequal land distribution. Beans had been also consumed more than sold among crops 1st and crop 2nd group which delivers the potential of beans for consumption.

The results were compared without any inclusion of tobacco. This research is focused to generate ethnic results so tobacco was not considered while evaluating the results still it is to be noted that tobacco generated the highest income value amongst other commodities (livestock 2nd group).

Meanwhile, the Irish potato was the highest value generating commodity despite the least amount of the sampled population growing it but almost eighty percent of harvested quantity was sold. Similarly, the vegetables that are inclined to generate income and increase the commercialization of the rural market (Weinberger & Lumpkin, 2007) were sold almost every kilogram harvested by each group which resulted in the second highest total value. Whereas maize stood fifth in the line of total value as around twenty percent of the quantity was sold by each group despite generating the highest quantity amongst other commodities. This interprets that the commercialization of the commodity is directly related to the economic benefits of the commodity. It also showed the presence of subsistence farmers and allies as a result of Maggio and Sitko (2021) where the Malawi

population consumed the commodity rather than selling them. The same result also interpreted the dependence of the population on maize as a staple food.

Furthermore, the acres of the area used for planting wasn't positively correlated to the amount of quantity harvested, for instance, soybeans' production under five acres of land was less than production under around two and a half acres of land. As well as soybean was planted on the largest acre of land which might be to gain soil fertility (Kabuli et al., 2007), and the harvesting quantity of soybean for livestock 2nd group who kept cattle yielded the most because of the establishment of cattle pasture (Dias et al., 2022). Also, beans had an exponential amount of quantity harvested under less than one acre of land by crop 2nd group which might be the result of the incorporation of legume residues (Mhango et al., 2013). The dairy sector in livestock is vital in terms of creating economic resilience for smallholders' livelihoods (Banda et al. 2021).

Moreover, despite the popularity of chicken among the sampled groups, cattle generated the highest income for crops 1st and crop 2nd group amongst every livestock which aligned with a similar result as Bhatti et al. (2021). Following that, pigs and goats were next in the line with popularity among a sampled population which partially contrast with cattle's popularity claim above pig by Banda and Tanganyika (2021).

The result concluded with a clearer understanding of the economic benefits of different commodities and livestock based on their importance as the source of livelihood. According to the statistics, those who favored livestock as a secondary source of income outperformed the other sampled population in terms of income values for various commodities, which is consistent with what has been reported by the effect of intensification measures in terms of higher crop and animal productivity (Ayantunde et al., 2020). The same group had also full allegiance to grow crops in the year 2020/21 which showcased their diversity in growing different crops and had rear every kind of livestock. The population harboring labor as the first source of livelihood suffered with the lowest income values because they were the group with the least percentage of growing different crops and livestock and had the highest illiteracy rate.

The sole purpose of the diversification is to avoid the risk and attain maximum income for the farmers but sometimes the diversification on different crops might bear more loss than expected so growing at least one crop that can be quickly sold to meet their liquidity needs is a solid approach for farmers (Kankwamba et al., 2018; Kassie, 2014). Here, the results suggested the harvesting of

Irish potato, vegetables, and sweet potato as cash crops which yield more value than the others under limited land acres, and the maize and beans as the staple food for consumption.

The data didn't explore the detailed demography of the sampled population which creates the space to explore on a more demographic basis such as the importance of female-headed and male-headed households in diversification based on the source of livelihood. The results were pooled from a large quantity of primary data and averaged down which might not be reliable in comparing the groups all the time.

Chapter 7: Conclusion

Diversification of income for smallholders is critical; nevertheless, it has not been fully explored, opening up the possibility of studying the effect of diversification on smallholder livelihoods depending on their diverse revenue choices from crops and animals. The results showed that in the studied population, smallholders involved in crop production alongside livestock farming as a secondary source of income generated the highest income value for almost every commodity, with Irish potatoes and vegetables being the highest yielders. Despite the huge amount of maize harvested, more than 80% of the total amount was not commercialized across the board. When compared to other crops, soybean yield was lower per unit of land area. Cattle rearing appeared to be less popular than goat, pig, and chicken rearing, yet it yielded more in the end. Livestock farming in conjunction with crop production appears to provide a solid income stream as well as a feasible approach to managing risk associated with farm losses or bad climatic circumstances.

Reference

Adjimoti, G. O., Kwadzo, G. T.-M., Sarpong, D. B., & Onumah, E. E. (2017). Input Policies and Crop Diversification: Evidence from the Collines Region in Benin. *African Development Review*, *29*(3), 512-523. https://doi.org/https://doi.org/10.1111/1467-8268.12286

Allison, E. H., & Ellis, F. (2001). The livelihoods approach and management of small-scale fisheries. *Marine policy*, *25*(5), 377-388.

Alobo Loison, S. (2015). Rural Livelihood Diversification in Sub-Saharan Africa: A Literature Review. *The Journal of Development Studies*, *51*(9), 1125-1138. https://doi.org/10.1080/00220388.2015.1046445

Altieri, M. A., Nicholls, C. I., Henao, A., & Lana, M. A. (2015). Agroecology and the design of climate change-resilient farming systems. *Agronomy for sustainable development*, *35*(3), 869-890.

Amadu, F. O., Miller, D. C., & McNamara, P. E. (2020). Agroforestry as a pathway to agricultural yield impacts in climate-smart agriculture investments: Evidence from southern Malawi. *Ecological Economics*, *167*, 106443. https://doi.org/https://doi.org/10.1016/j.ecolecon.2019.106443

Asfaw, S., Lipper, L., Dalton, T. J., & Audi, P. (2012). Market participation, on-farm crop diversity and household welfare: micro-evidence from Kenya. *Environment and Development Economics*, *17*(5), 579-601. https://doi.org/10.1017/S1355770X12000277

Asfaw, S., Scognamillo, A., Di Caprera, G., Sitko, N., & Ignaciuk, A. (2019). Heterogeneous impact of livelihood diversification on household welfare: Cross-country evidence from Sub-Saharan Africa. *World Development*, *117*, 278-295.

Ayantunde, A. A., Oluwatosin, B. O., Yameogo, V., & van Wijk, M. (2020). Perceived benefits, constraints and determinants of sustainable intensification of mixed crop and livestock systems in the Sahelian zone of Burkina Faso. *International Journal of Agricultural Sustainability*, *18*(1), 84-98. https://doi.org/10.1080/14735903.2019.1698494

Bacon, C. M., Sundstrom, W. A., Gómez, M. E. F., Méndez, V. E., Santos, R., Goldoftas, B., & Dougherty, I. (2014). Explaining the 'hungry farmer paradox': Smallholders and fair trade cooperatives navigate seasonality and change in Nicaragua's corn and coffee markets. *Global environmental change*, *25*, 133-149.

Bai, Y.-l., Fu, C., Thapa, B., Rana, R. B., & Zhang, L.-x. (2022). Effects of conservation measures on crop diversity and their implications for climate-resilient livelihoods: the case of Rupa Lake Watershed in Nepal. *Journal of Mountain Science*, *19*(4), 945-957.

Banda, J. W. (2008). Revolutionising the livestock industry in Malawi. *The 12th University of Malawi Inaugural Lecture*.

Banda, L. J., & Tanganyika, J. (2021). Livestock provide more than food in smallholder production systems of developing countries. *Animal Frontiers*, *11*(2), 7-14.

Barnett, A., Blas, E., & Whiteside, A. (1997). AIDS briefs: subsistence agriculture. *USAID Health and Human Resources Analysis and Research for Africa Project*.

Bezner Kerr, R., Kangmennaang, J., Dakishoni, L., Nyantakyi-Frimpong, H., Lupafya, E., Shumba, L., Msachi, R., Boateng, G. O., Snapp, S. S., Chitaya, A., Maona, E., Gondwe, T., Nkhonjera, P., & Luginaah, I. (2019). Participatory agroecological research on climate change adaptation improves smallholder farmer household food security and dietary diversity in Malawi. *Agriculture, Ecosystems & Environment*, *279*, 109-121. https://doi.org/https://doi.org/10.1016/j.agee.2019.04.004

Bhatti, M. A., Godfrey, S. S., Ip, R. H., Kachiwala, C., Hovdhaugen, H., Banda, L. J., Limuwa, M., Wynn, P. C., Ådnøy, T., & Eik, L. O. (2021). Diversity of Sources of Income for Smallholder Farming Communities in Malawi: Importance for Improved Livelihood. *Sustainability*, *13*(17), 9599.

Birthal, P. S., Joshi, P. K., Roy, D., & Thorat, A. (2013). Diversification in Indian agriculture toward high-value crops: The role of small farmers. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, *61*(1), 61-91.

Bryman, A. (2016). *Social research methods*. Oxford university press.

Carter, M. R., & May, J. (1999). Poverty, livelihood and class in rural South Africa. *World Development*, *27*(1), 1-20.

Clements, R., Haggar, J., Quezada, A., & Torres, J. (2011). Technologies for climate change adaptation: agricultural sector. In: UNEP Risø Centre on Energy, Climate and Sustainable Development/Practical Action.

Cornish, G. (1998). *Modern irrigation technologies for smallholders in developing countries*. Intermediate Technology Publications Ltd (ITP).

Culas, R. J., & Mahendrarajah, M. (2005). *Causes of diversification in agriculture over time: Evidence from Norwegian farming sector*.

Das, R., & Shivakoti, G. P. (2006). Livestock carrying capacity evaluation in an integrated farming system: A case study from the mid-hills of Nepal. *The International Journal of Sustainable Development and World Ecology*, *13*(3), 153-163.

Deogharia, P. C. (2018). Diversification of agriculture: a review. *J Econ Soc Develop*, *15*(1), 46-59.

Dhakal, A., Cockfield, G., & Maraseni, T. N. (2012). Evolution of agroforestry based farming systems: a study of Dhanusha District, Nepal. *Agroforestry systems*, *86*(1), 17-33.

Dias, M. B. d. C., Costa, K. A. d. P., Severiano, E. d. C., Bilego, U. O., Vilela, L., de Souza, W. F., de Oliveira, I. P., & da Silva, A. C. G. (2022). Cattle performance with Brachiaria and Panicum maximum forages in an integrated crop-livestock system. *African Journal of Range & Forage Science*, *39*(2), 230-243.

Djurfeldt, G., Holmen, H., Jirström, M., & Larsson, R. (2005). *The African food crisis: Lessons from the Asian green revolution*. CABI publishing.

Ellis, F. (2000a). The determinants of rural livelihood diversification in developing countries. *Journal of Agricultural Economics*, *51*(2), 289-302.

Ellis, F. (2000b). *Rural livelihoods and diversity in developing countries*. Oxford university press.

Ellis, F., Kutengule, M., & Nyasulu, A. (2003). Livelihoods and Rural Poverty Reduction in Malawi. *World Development*, *31*(9), 1495-1510. https://doi.org/https://doi.org/10.1016/S0305-750X(03)00111-6

Esser, K., Øygard, R., Chibwana, C., & Blackie, M. (2005). Opportunities for Norwegian support to agricultural development in Malawi.

Fatch, P., Masangano, C., Hilger, T., Jordan, I., Mambo, I., Kamoto, J. F. M., Kalimbira, A., & Nuppenau, E.-A. (2021). Holistic agricultural diversity index as a measure of agricultural diversity: A cross-sectional study of smallholder farmers in Lilongwe district of Malawi. *Agricultural Systems*, *187*, 102991.

Feliciano, D. (2019). A review on the contribution of crop diversification to Sustainable Development Goal 1 “No poverty” in different world regions. *Sustainable Development*, *27*(4), 795-808. https://doi.org/https://doi.org/10.1002/sd.1923

Fireman Kramer, R. (1985). A overview of descriptive research. *Journal of the Association of Pediatric oncology nurses*, *2*(2), 41-45.

Gajigo, O. (2013). Credit Constraints and Agricultural Risk for Non-F arm Enterprises. *African Development Review*, *25*(4), 648-662.

Gautam, Y., & Andersen, P. (2016). Rural livelihood diversification and household well-being: Insights from Humla, Nepal. *Journal of rural studies*, *44*, 239-249.

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evidence-based nursing*, *18*(3), 66-67.

Heumesser, C., & Kray, H. A. (2019). Productive Diversification in African Agriculture and its E ects on Resilience and Nutrition.

Kabuli, A., Phiri, M., & Khalil, A. (2007). Economic assessment of the benefits of soybeans incorporation in smallholder maize-based farming systems and the factors affecting its adoption in Malawi.

Kankwamba, H., Kadzamira, M., & Pauw, K. (2018). How diversified is cropping in Malawi? Patterns, determinants and policy implications. *Food Security*, *10*(2), 323-338. https://doi.org/10.1007/s12571-018-0771-x

Karki, S., Burton, P., & Mackey, B. (2020). Climate change adaptation by subsistence and smallholder farmers: Insights from three agro-ecological regions of Nepal. *Cogent Social Sciences*, *6*(1), 1720555. https://doi.org/10.1080/23311886.2020.1720555

Kassie, M. (2014). Low Risk, High Returns: How adoption of crop diversification and minimum tillage is a win-win for smallholder farmers in Malawi. *Socioeconomics program policy brief*, *5*, 1-4.

Kennedy, E. (1991). *Income sources of the rural poor in southwestern Kenya*.

Key, N., Sadoulet, E., & Janvry, A. D. (2000). Transactions costs and agricultural household supply response. *American Journal of Agricultural Economics*, *82*(2), 245-259.

Koppmair, S., Kassie, M., & Qaim, M. (2017). Farm production, market access and dietary diversity in Malawi. *Public Health Nutrition*, *20*(2), 325-335. https://doi.org/10.1017/S1368980016002135

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Lin, B. B. (2011). Resilience in agriculture through crop diversification: adaptive management for environmental change. *BioScience*, *61*(3), 183-193.

Losch, B., Fréguin-Gresh, S., & White, E. T. (2012). *Structural transformation and rural change revisited: challenges for late developing countries in a globalizing world*. World Bank Publications.

Madsen, S., Bezner Kerr, R., Shumba, L., & Dakishoni, L. (2021). Agroecological practices of legume residue management and crop diversification for improved smallholder food security, dietary diversity and sustainable land use in Malawi. *Agroecology and Sustainable Food Systems*, *45*(2), 197-224.

Maggio, G., & Sitko, N. J. (2021). Diversification is in the Detail: Accounting for Crop System Heterogeneity to Inform Diversification Policies in Malawi and Zambia. *The Journal of Development Studies*, *57*(2), 264-288. https://doi.org/10.1080/00220388.2020.1769072

Mango, N., Makate, C., Mapemba, L., & Sopo, M. (2018). The role of crop diversification in improving household food security in central Malawi. *Agriculture & Food Security*, *7*(1), 1-10.

Martin, S. M., & Lorenzen, K. (2016). Livelihood Diversification in Rural Laos. *World Development*, *83*, 231-243. https://doi.org/https://doi.org/10.1016/j.worlddev.2016.01.018

McPeak, J. G., & Little, P. D. (2006). *Pastoral livestock marketing in Eastern Africa: research and policy challenges*. Intermediate Technology Publications Ltd.

Menon, R. (2007). Famine in Malawi: Causes and consequences. *Occassion Paper. Human Development Report Office. http://hdr. undp. org/en/reports/global/hdr2007-2008/papers/menon_roshni_2007a_malawi. pdf. Accessed on*, *17*, 02-10.

Mhango, W. G., Snapp, S. S., & Phiri, G. Y. (2013). Opportunities and constraints to legume diversification for sustainable maize production on smallholder farms in Malawi. *Renewable Agriculture and Food Systems*, *28*(3), 234-244.

Ministry of Economic Planning and Development (2004). *Malawi Economic Growth Strategy Volume II: Main Report*. M. o. E. P. a. Development. http://www.sdnp.org.mw/malawi/malawi-econo-growth-strategy-july04.pdf

Morton, J. F. (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Sciences*, *104*(50), 19680-19685.

Mtshali, S. M. (2002). *Household Livelihood Security in Rural KwaZulu-Natal, South Africa*. Wageningen University and Research.

Mulenga, B. P., Ngoma, H., & Nkonde, C. (2021). Produce to eat or sell: Panel data structural equation modeling of market participation and food dietary diversity in Zambia. *Food Policy*, *102*, 102035.

Niehof, A. (2004). The significance of diversification for rural livelihood systems. *Food Policy*, *29*(4), 321-338.

Okori, P., Munthali, W., Msere, H., Charlie, H., Chitaya, S., Sichali, F., Chilumpha, E., Chirwa, T., Seetha, A., & Chinyamuyamu, B. (2022). Improving efficiency of knowledge and technology diffusion using community seed banks and farmer-to-farmer extension: experiences from Malawi. *Agriculture & Food Security*, *11*(1), 1-14.

Orr, A., & Mwale, B. (2001). Adapting to adjustment: smallholder livelihood strategies in Southern Malawi. *World Development*, *29*(8), 1325-1343.

Ragasa, C., Mzungu, D., Kalagho, K., & Kazembe, C. (2021). Impact of interactive radio programming on agricultural technology adoption and crop diversification in Malawi. *Journal of Development Effectiveness*, *13*(2), 204-223.

Rege, J., Kiambi, D., & Ochieng, J. W. (2022). The State of the Enabling Environment for Agricultural Biotechnology Applications in Crop and Livestock Sectors. In *Agricultural Biotechnology in Sub-Saharan Africa* (pp. 33-55). Springer.

Sekaran, U., Lai, L., Ussiri, D. A. N., Kumar, S., & Clay, S. (2021). Role of integrated crop-livestock systems in improving agriculture production and addressing food security – A review. *Journal of Agriculture and Food Research*, *5*, 100190. https://doi.org/https://doi.org/10.1016/j.jafr.2021.100190

Sen, B., Venkatesh, P., Jha, G. K., Singh, D., & Suresh, A. (2017). Agricultural diversification and its impact on farm income: a case study of Bihar. *Agricultural Economics Research Review*, *30*(conf), 77-88.

Snapp, S. S., & Fisher, M. (2015). "Filling the maize basket" supports crop diversity and quality of household diet in Malawi. *Food Security*, *7*(1), 83-96.

Thangata, P. H., & Alavalapati, J. R. R. (2003). Agroforestry adoption in southern Malawi: the case of mixed intercropping of Gliricidia sepium and maize. *Agricultural Systems*, *78*(1), 57-71. https://doi.org/https://doi.org/10.1016/S0308-521X(03)00032-5

Thapa, G., Kumar, A., & Joshi, P. K. (2017). *Agricultural diversification in Nepal: Status, determinants, and its impact on rural poverty* (Vol. 1634). Intl Food Policy Res Inst.

The World Bank. (2019). *World Development Indicators DataBank*. World Bank. http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators

Thorne, P., & Tanner, J. (2002). Livestock and nutrient cycling in crop–animal systems in Asia. *Agricultural Systems*, *71*(1-2), 111-126.

Timmer, C. P. (2009). *A world without agriculture: The structural transformation in historical perspective*. Aei Press Washington, DC.

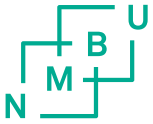
Tittonell, P., Muriuki, A., Shepherd, K. D., Mugendi, D., Kaizzi, K. C., Okeyo, J., Verchot, L., Coe, R., & Vanlauwe, B. (2010). The diversity of rural livelihoods and their influence on soil fertility in agricultural systems of East Africa – A typology of smallholder farms. *Agricultural Systems*, *103*(2), 83-97. https://doi.org/https://doi.org/10.1016/j.agsy.2009.10.001

United Nations. (2019). *World Population Prospects*. https://population.un.org/wpp/

United Nations. (2022). *Sustainable Developmental Goals* United Nations. Retrieved 2022 from https://sdgs.un.org/goals

Vyas, V. S. (1996). Diversification in agriculture: concept, rationale and approaches. *Indian Journal of Agricultural Economics*, *51*(4), 636.

Weinberger, K., & Lumpkin, T. A. (2007). Diversification into horticulture and poverty reduction: a research agenda. *World development*, *35*(8), 1464-1480.



Norges miljø- og biovitenskapelige universitet
Noregs miljø- og biovitskapelege universitet
Norwegian University of Life Sciences

Postboks 5003
NO-1432 Ås
Norway