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Management Institute

Water and Soil Accelerator (WASA) Malawi Baseline Report

*Baseline Assessment of Agricultural Production,
Water Security, Food Systems, and Resilience Pathways*

Greenwell C. Matchaya, Agrey Wapamesa, Munyaradzi Mutenje,
Winnie Kasoma-Pele, Keagan Kakwasha, Inga Jacobs-Mata, Zolo Kiala,
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Disclaimer

This report presents findings from the baseline assessment conducted under the Water and Soil Accelerator (WASA) program in Malawi. It reflects the baseline conditions existing prior to program implementation and should not be interpreted as evidence of program impacts.

The analysis and conclusions presented in the report are based on data collected during the baseline survey and are intended to inform program design, implementation planning, monitoring, learning, and future evaluation activities.

The views expressed in this publication are those of the authors and do not necessarily reflect the official positions of the International Water Management Institute (IWMI), consortium partners, funding agencies, or the Government of Malawi. While every effort has been made to ensure the accuracy of the information presented, the authors accept responsibility for any errors, omissions, or interpretations contained in this report.

The boundaries, names, and designations used in the map in this report do not imply official endorsement or acceptance by IWMI, CGIAR, or WASA program partners.

Cover photo: Sailing in Lake Chilaw, Malawi. (Matthew McCartney/IWMI)

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Any errors or omissions remain the responsibility of the authors.

Project

The Water and Soil Accelerator (WASA) program in Malawi brings together consortium partners working to strengthen resilient agricultural livelihoods through improved water and soil management. This baseline report was prepared through the collaborative efforts of these partners and provides evidence to support program implementation, learning, monitoring, and future assessment of WASA results.

Collaborators



Catholic Relief Services (CRS)



Total LandCare (TLC)



Churches Action in Relief and Development (CARD)



African Fertilizer and Agribusiness Partnership (AFAP)

These consortium implementation partners provided operational support, field coordination, and implementation insights that strengthened both data collection and interpretation of findings.

Donor

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Acronyms and Abbreviations

AFAP	African Fertilizer and Agribusiness Partnership
CAP	Computer assisted personal interviewing
CARD	Churches Action in Relief and Development
CRS	Catholic Relief Services
CSA	Climate Smart Agriculture
FAO	Food and Agriculture Organization of the United Nations
Ha	Hectare
HH	Household
IFPRI	International Food Policy Research Institute
IWMI	International Water Management Institute
Kg	Kilogram
MEAL	Monitoring, Evaluation, Accountability and Learning
MELIA	Monitoring, Evaluation, Learning and Impact Assessment
PPS	Probability proportional to size
TLC	Total LandCare
WASA	Water and Soil Accelerator

Executive Summary

Malawi's agriculture sector is central to livelihoods, food security, and rural employment; yet it continues to face persistent structural constraints that limit productivity growth, and resilience. Though the sector contributes significantly to employment and household (HH) livelihoods, it is heavily dependent on rainfed production systems that are increasingly vulnerable to climate shocks, land degradation, declining soil fertility, weak market integration, and recurring food insecurity. These structural vulnerabilities are particularly pronounced among smallholder farming households, whose livelihoods are highly exposed to droughts, floods, price instability, fragmented markets, and weak rural service systems. National policy frameworks including the Government of Malawi's Malawi 2063, the National Agriculture Policy (NAP), and the National Resilience Strategy all recognize the urgent need for more resilient, diversified, and market-responsive agricultural systems.

The Water and Soil Accelerator program baseline was designed to establish a comprehensive benchmark for implementation, learning, and ongoing monitoring and outcome tracking across seven program districts in Malawi's Central and Southern Regions: Chikwawa, Mulanje, Mangochi, Salima, Dowa, Lilongwe, and Mchinji. These districts represent diverse combinations of climate vulnerability, water insecurity, land degradation, commercialization potential, and livelihood stress. A total of 997 households were surveyed using a multistage stratified random sampling framework that enables district-level and gender-disaggregated analysis. The household survey generated detailed information on land ownership, water access, production systems, technology adoption, productivity, food security, income diversification, and access to institutions and services. The quantitative survey was complemented by district-level focus group discussions (FGDs), typically involving approximately 20 participants per district with a balanced participation of men and women, except where otherwise noted. These discussions provided important insights into local infrastructure failures, governance constraints, labor shortages, and operational barriers that were not fully captured through household survey data alone.¹

Water and Soil Accelerator (WASA) is a scaling initiative rather than a first entry into these districts: consortium partners were already promoting similar soil and water management practices in these areas prior to WASA, and the baseline is intended to identify what to scale, and where, building on this existing platform rather than starting from scratch.

The baseline reveals that Malawi's challenge is not primarily the lack of technology awareness. Across many districts, farmers are already adopting foundational climate-smart agricultural practices such as manure application, composting, contour ridges, tied ridges, crop diversification, agroforestry practices, and basic water harvesting techniques. However, adoption often occurs in fragmented ways that limit productivity gains because complementary investments in irrigation, soil restoration, finance, extension support, and market systems are weak. The analysis shows that households using multiple complementary technologies often performed better than those relying on isolated interventions. While the baseline does not establish causal relationships, the findings strongly suggest that future productivity growth will depend less on introducing entirely new technologies and more on strengthening complementarities between existing practices.

Agricultural productivity is low and highly uneven across these districts. Maize is the dominant crop across most farming systems, reflecting its continued importance for household food security, yet heavy dependence on maize also strengthens vulnerability to climate shocks. Districts such as Mchinji and Salima show immense opportunities for legume commercialization and diversification, while Dowa and Lilongwe demonstrate relatively strong commercialization potential linked to larger asset bases, better market integration, and higher adoption levels. Chikwawa and Mulanje face deeper structural vulnerabilities driven by recurrent flooding, droughts, degraded infrastructure, and acute food insecurity. Mangochi presents a mixed pathway where irrigation potential exists alongside recurring water-related risks.

Water access is one of the most binding constraints across the program districts. Irrigation access is limited despite clear evidence that water control strongly influences production stability, diversification opportunities, and resilience. Focus group discussions revealed multiple cases of damaged irrigation systems, destroyed water infrastructure, riverbank degradation, and weak maintenance systems. In several districts, communities emphasized that restoring damaged water systems and strengthening watershed protection may be more urgent than prematurely expanding new technologies.

¹ Ethical clearance for the study was obtained through the International Water Management Institute (IWMI) Institutional Review Board (IRB). The approved research protocol covered the study's primary data collection activities, including household surveys, key informant interviews, and FGDs, with provisions for informed consent, confidentiality, and protection of research participants.

Food insecurity is widespread, reflecting broader structural vulnerability. Many households depend on own production while simultaneously relying on market purchases and distress coping mechanisms during periods of stress. Seasonal hunger was common in multiple districts, particularly where climate shocks repeatedly disrupt production systems.

This baseline identified differentiated implementation pathways rather than a uniform intervention model. District typologies developed through the analysis classified districts according to vulnerability levels, production potential, and market readiness. These typologies inform district-specific technology bundles and implementation sequencing strategies. In highly vulnerable districts such as Chikwawa and Mulanje, priority interventions include water rehabilitation, erosion control, and production stabilization. In transition districts such as Salima and Mchinji, priorities shift toward irrigation expansion, diversification, and market preparation. In higher potential districts such as Dowa and Lilongwe, emphasis moves toward commercialization, mechanization, and service integration. Mangochi requires a blended strategy centered on irrigation strengthening, riverbank stabilization, and diversification. Focus group discussions further identified immediate readiness constraints that must be resolved before large-scale scaling efforts can succeed.

Gender disparities were significant but driven mainly by unequal access to resources and services, not by differences in what women and men choose to do. Female-headed households often demonstrated strong participation in agricultural production and adoption of key practices but continue to face persistent disadvantages in irrigation access, land quality, labor availability, finance access, and ownership of productive assets. These constraints require more deliberate gender-responsive implementation strategies.

In summary, the baseline provides a comprehensive foundation for adaptive implementation under the WASA program. It strengthens the program's Monitoring, Evaluation, Learning and Impact Assessment (MELIA) system by establishing measurable benchmarks across watershed management, productivity improvement, food security, inclusion, service delivery, and scaling readiness. The central lesson from the baseline is that Malawi's smallholder farmers do not primarily need more technologies. They need stronger systems that allow existing technologies to work together more effectively under increasingly difficult climatic and economic conditions.

Chapter 1. Introduction and Context

Malawi's agricultural sector is the backbone of the economy, providing livelihoods for over 80% of the population and serving as a central pillar for food security, employment, and rural development. Despite its importance, the sector continues to operate under significant structural and climatic constraints, characterized by persistently low productivity, limited diversification, and high exposure to climate variability and shocks (World Bank 2024; FAO, European Union, and CIRAD 2023). Smallholder-led production systems dominate the sector and are largely subsistence-oriented, relying heavily on rainfed agriculture. These systems are further constrained by limited access to improved inputs, weak land tenure arrangements, low levels of mechanization, and underdeveloped rural service delivery systems (IFPRI 2021). Collectively, these factors restrict the capacity of farmers to intensify production, adopt modern technologies, and transition toward more market-oriented agricultural systems.

Recent agricultural performance trends underscore the fragility of Malawi's production systems under increasing climate stress. The 2024/25 agricultural season, for instance, recorded maize production levels significantly below the five-year average, primarily due to erratic rainfall patterns, prolonged dry spells, and uneven spatial distribution of precipitation (Government of Malawi 2025). These climate-induced shocks have heightened production risks, particularly for resource-constrained smallholders who lack access to irrigation and climate-resilient technologies. Beyond climatic factors, structural challenges persist, including an unpredictable policy environment, inconsistent implementation of agricultural support programs, and weak coordination between public investments and private sector engagement. These systemic inefficiencies continue to undermine productivity growth and hinder progress toward national agricultural transformation targets (World Bank 2024).

In response to these persistent bottlenecks, the Government of Malawi introduced the National Agriculture Policy 2024 (NAP 2024), which aligns with the long-term development aspirations outlined in Malawi 2063 (MW2063). The policy sets out a strategic shift from subsistence-based agriculture toward a more diversified, market-oriented, and climate-resilient agricultural sector. Its key priorities include the expansion of irrigation infrastructure, promotion of high-value crops, and strengthening of agrifood value chains (Government of Malawi 2024b). However, despite the clarity of this strategic direction, substantial barriers remain. High input costs, limited access to affordable finance, inadequate rural infrastructure, and weak market linkages constrain smallholder participation in commercial agriculture and limit progress toward food security and income growth (IFPRI 2021). Addressing these constraints requires moving beyond fragmented and short-term interventions toward a more integrated and systems-based approach that strengthens both production and enabling environments.

Within this context, water and soil resources emerge as basic determinants of agricultural productivity, resilience, and sustainability in Malawi's predominantly rainfed systems. The interaction between soil health and water availability not only determines crop yields but also shapes the capacity of farming systems to absorb, adapt to, and recover from climate shocks (Government of Malawi 2024b). Strengthening water-soil systems is therefore a critical pathway to transition from reactive coping mechanisms to proactive resilience-building. Practices such as conservation agriculture, agroforestry, and rainwater harvesting enhance soil structure, increase water infiltration, reduce runoff and evaporation losses, and stabilize hydrological flows, thereby mitigating the impacts of droughts and erratic rainfall (World Bank 2024). These interventions generate multiple co-benefits, including improved soil fertility, reduced land degradation, enhanced ecosystem services, and increased carbon sequestration. Importantly, they also reduce production risks, making agriculture more predictable and investable for smallholder farmers, and creating stronger linkages with financial and market systems.

The Water and Soil Accelerator (WASA) program is a strategic response to the persistent gap between proven agricultural innovations and their limited adoption at scale within smallholder systems (Nkosi et al. 2026). It is a three-year (2024–2027) initiative led by the International Water Management Institute (IWMI) and funded by the United States Government. It aims to scale evidence-based water and soil management solutions within rainfed agrifood systems in Malawi and Zambia, with a strong emphasis on improving productivity, enhancing climate resilience, and strengthening sustainability outcomes. Unlike traditional approaches that often focus on isolated interventions, WASA adopts a systems-oriented model that integrates technology scaling, institutional strengthening, and market linkages to drive transformation at scale.

In Malawi, WASA is implemented across the Central and Southern regions, covering seven districts (Figure 1.1). These districts reflect the geographic footprint of the initiative's implementing consortium partners, and are characterized by high exposure to climate variability, significant land degradation, and strong potential for agricultural transformation, rather than having been chosen through a formal district-selection analysis. Implementation is delivered through two

consortia composed of diverse technical and last-mile delivery partners, strategically aligned to geographic zones and thematic priorities.

This consortia-based model is designed to leverage complementary expertise, enhance coordination across actors, and ensure context-specific delivery of interventions at scale. By aligning technical capabilities with localized implementation structures, the model strengthens both efficiency and accountability in program delivery.

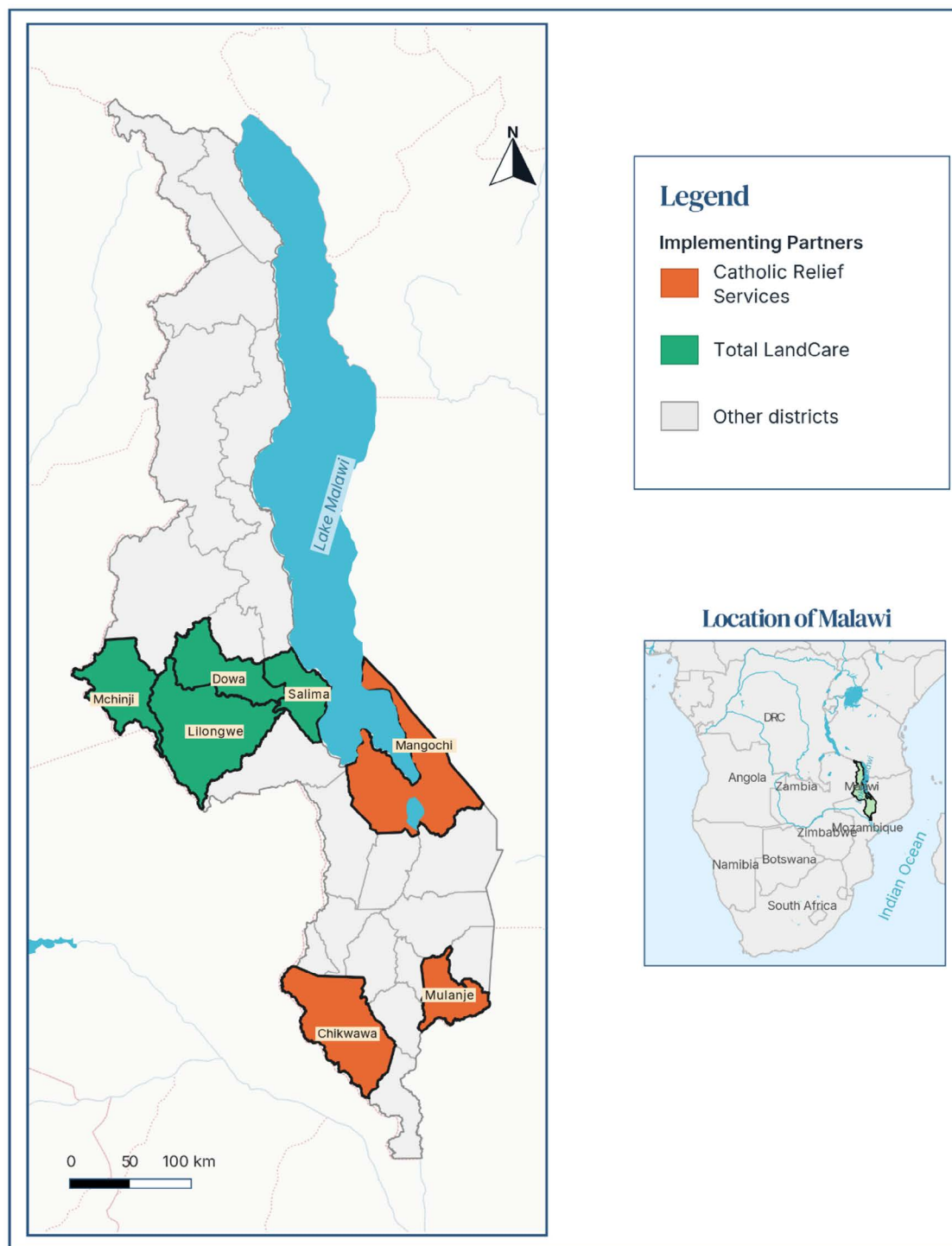


Figure 1.1 Water and Soil Accelerator (WASA) program’s intervention districts in Malawi and partner participation.

Source: Authors with WASA data

Note: The boundaries, names, and designations used in this map do not imply official endorsement or acceptance by IWMI, CGIAR, or WASA program partners.

The program footprint builds on prior investments and established partnerships within the Zambezi catchment and former Feed the Future Zones of Influence in Malawi and Zambia, thereby leveraging existing institutional networks, infrastructure, and knowledge systems to enhance reach and impact. Through this consortia-based delivery model, WASA connects multiple actors, including research institutions, development partners, private sector actors, and local communities, to facilitate coordinated implementation across scales. The emphasis on last-mile delivery, capacity building, and community-based natural resource governance ensures that interventions are not only technically robust but also socially embedded and sustainable. By strengthening coordination across these multiple actors and levels, WASA aims to catalyze a transition toward more resilient, productive, and inclusive agrifood systems in Malawi.

The WASA program has been explicitly designed as a scaling initiative: consortium partners were already promoting similar soil and water management practices in these districts prior to WASA, and the program builds on this existing platform of adoption and delivery capacity rather than introducing entirely new interventions. This baseline is intended, in part, to identify what to scale and where, based on where existing adoption and readiness are already strongest.

Table 1.1 reports the share of surveyed households who indicated awareness of, and/or participation in Total LandCare (TLC) or Catholic Relief Services (CRS) activities. The questions were asked only to respondents who first confirmed general awareness of partner activity in their area; the instrument did not separately distinguish awareness from active participation. Other (%) captures households who named a different organization, including free-text mentions of AFAP and CARD.

Table 1.1 Consortium presence and intervention footprint in Malawi

District	Region	Total LandCare (TLC) (%)	Catholic Relief Services (CRS) (%)	Other organizations (%)	Main climate smart agriculture (CSA) technologies adopted
Chikwawa	Southern	16.5	3.5	7.8	Agroforestry, conservation agriculture, manure management
Dowa	Central	53.8	1.1	9.9	Manure management, conservation agriculture, agroforestry
Lilongwe	Central	62.7	0	2.5	Manure management, agroforestry, conservation agriculture
Mangochi	Southern	19.0	4.5	10.6	Agroforestry, conservation agriculture, manure management
Mchinji	Central	67.0	1.1	1.6	Manure management, conservation agriculture, agroforestry
Mulanje	Southern	8.5	2.8	16.0	Manure management, agroforestry, conservation agriculture
Salima	Central	37.8	3.6	0.9	Conservation agriculture, manure management, agroforestry

Source: Authors, WASA Malawi baseline survey, 2024/25.

The survey did not offer AFAP or CARD as structured answer options, so awareness of these two partners specifically is likely undercounted relative to TLC and CRS, which were asked directly. The pattern is nonetheless consistent with each partner's expected footprint: TLC awareness was markedly higher in the four Central Region districts (Salima, Dowa, Lilongwe, Mchinji), where TLC and AFAP are active, while free-text mentions of CARD were concentrated in Mulanje and, to a lesser extent, Chikwawa and Mangochi, the three Southern Region districts where CRS and CARD operate. CRS awareness was low across all districts in absolute terms, which is expected given that CRS programming had not yet been rolled out as extensively as TLC's at the time of the baseline, rather than indicating a data quality issue.

The consortium footprint reveals marked spatial variation in partner presence across districts, with TLC demonstrating the most extensive reach, particularly evident in Central Region districts of Mchinji (67%), Lilongwe (62.7%), and Dowa

(53.8%), where it serves as the primary delivery actor. In contrast, its presence is comparatively limited in the Southern Region, notably in Mulanje (8.5%) and Chikwawa (16.5%), suggesting uneven geographic coverage and potential gaps in intervention intensity. Awareness of CRS was consistently low across all districts, peaking at only 4.5% in Mangochi and missing in Lilongwe. This indicates that CRS-led interventions either have limited scale, visibility, or depth of engagement within the surveyed areas, which is explained by the fact that many of their programs are yet to be rolled out. Other consortium partners exhibited more localized and heterogeneous presence, with relatively higher awareness in Mulanje (16%) and Mangochi (10.6%), pointing to district-specific partnerships that complement or substitute for TLC and CRS activities. Taken together, these patterns highlight an uneven consortium footprint, with implications for coordination, coverage, and the equitable distribution of interventions across districts.

Within this strategic and policy context, the WASA baseline survey was undertaken to establish a robust empirical foundation for program implementation, adaptive learning, and ongoing monitoring and outcome tracking. By systematically documenting prevailing farming systems, land and water use patterns, livelihood strategies, food security outcomes, and access to agricultural services, the baseline provides a comprehensive evidence base to inform program design and delivery. Importantly, it enables the identification of spatial and socioeconomic heterogeneity across districts, which is critical for tailoring interventions and prioritizing investments. In doing so, the baseline directly supports MELIA objectives by establishing measurable reference points against which progress can be tracked over time. It also facilitates evidence-based decision-making, including the development of district-specific technology packages, sequencing of interventions, and adaptive management strategies as implementation unfolds. This positions the baseline not merely as a descriptive exercise, but as a central instrument for guiding WASA's transition from pilot-driven activities to coordinated, scalable delivery.

The baseline report is structured to ensure that empirical evidence, analytical interpretation, and narrative insights are presented in an integrated manner, enabling decision makers to engage with findings within their full analytical context. The report progresses logically from contextual framing and program background (Chapter 1) and methodological foundations (Chapter 2), to detailed analysis of household systems, land and water resources, production systems, technology adoption, productivity outcomes, food security conditions, and access to markets, finance, and extension services (Chapters 3 to 9). Chapter 10 provides an overview of consortium partner footprints and intervention landscapes across the implementation districts, helping place the baseline findings within the program's operational context.

Building on this evidence base, Chapter 11 synthesizes findings into district typologies, strategic targeting frameworks, and indicative technology pathways designed to guide intervention prioritization and implementation sequencing. The report concludes in Chapter 12 by drawing together the key findings and presenting immediate, medium-term and long-term priorities for program implementation, scaling, and adaptive management. References are provided at the end of the report.

This cumulative structure ensures that each chapter builds analytically upon preceding sections, allowing conclusions and recommendations to emerge directly from the evidence presented. By linking empirical findings to strategic targeting and implementation guidance, the report provides a robust foundation for program planning, adaptive management, investment prioritization, and future monitoring, evaluation, learning, and impact assessment activities.

Chapter 2. Methodology

This chapter describes the methodological approach used to design, implement, clean, and analyze the WASA Malawi baseline survey. The methods were selected to generate a robust diagnostic understanding of farming systems, livelihoods, and enabling service environments at the start of project implementation. The approach is grounded in established survey and agricultural data standards, ensuring internal consistency, statistical reliability, and relevance to program design and monitoring. A clear distinction was maintained between descriptive baseline evidence, analytical synthesis, and areas where interpretation is subject to data and design limitations. This distinction is critical for ensuring that findings are used appropriately within the broader MELIA framework.

2.1 Sampling and coverage

The WASA baseline survey was designed as a cross-sectional agricultural household survey, with the household serving as the primary unit of analysis, a standard practice in agricultural survey systems, where household-level decision-making processes and plot-level production outcomes must be analyzed jointly while remaining analytically distinct (FAO 2014). Such an approach enables the integration of socioeconomic, demographic, and production data within a unified analytical framework.

District sample sizes were allocated disproportionately rather than through a strict population-proportional formula. Target samples of approximately 200 households were assigned to Lilongwe, Mchinji, and Mangochi, which combine relatively large populations with a larger program footprint and greater intervention intensity and diversity; the remaining districts were assigned approximately 100 households each. This design intentionally oversamples high-intensity districts to provide adequate precision for district-level and subgroup analysis. Within districts, probability proportional to size (PPS) or random sampling was then applied at Extension Planning Area and village level, as described. Minor deviations between the planned targets and the realized sample sizes shown in Table 2.1 reflect field-level nonresponse and coverage during data collection. Key data are summarized in the project website: <https://wasa-project.up.railway.app/baseline>

Table 2.1 Survey coverage and sample distribution

District	Region	Number of child-headed households	Number of female-headed households	Number of male-headed households	Total number of households
Chikwawa	Southern	0	18	98	116
Dowa	Central	0	12	79	91
Lilongwe	Central	1	52	148	201
Mangochi	Southern	1	66	116	183
Mchinji	Central	0	47	141	188
Mulanje	Southern	0	32	74	106
Salima	Central	0	22	90	112
Total		2	249	746	997

Source: Authors, WASA Malawi baseline survey, 2024/25.

A total of 997 households were sampled using a multistage stratified random sampling design to ensure adequate coverage and representativeness across the project's geographic focus areas. In the first stage, seven districts were selected purposively to reflect areas where WASA and its consortium partners are actively implementing or planning to scale water and soil management interventions. This ensures that the baseline captures the diversity of agroecological conditions, intervention intensities, and livelihood systems relevant to the program, while recognizing that findings are representative of project areas rather than the national population (United Nations 2005).

These seven districts were selected because they are where consortium partners TLC and CRS are actively implementing; WASA does not currently operate nationwide, and these districts represent the program's full geographic footprint in Malawi at the time of the baseline rather than a sample drawn from a larger set of eligible districts. The districts also differ by region: Lilongwe, Mchinji, Dowa, and Salima lie in the Central Region and are generally fertile, with strong farming potential; Chikwawa, Mulanje, and Mangochi lie in the Southern Region along the Shire Basin, where, with the exception of Mangochi, agricultural potential is constrained by recurrent flooding and related hazards. These regional and agroecological contrasts are reflected throughout the results chapters.

Within each selected district, low-level administrative units were sampled using PPS techniques, ensuring that areas with larger farming populations had a higher probability of inclusion. This approach reduces sampling bias and improves the precision of district-level estimates (United Nations 2005). At the final stage, households were selected through simple random sampling from validated farmer registers maintained by partner Monitoring, Evaluation, Accountability and Learning (MEAL) teams. This sampling approach supports reliable descriptive analysis at the district level and enables disaggregation by gender and other key household characteristics.

The MEAL registers are comprehensive household lists maintained for each selected subdistrict and are not limited to households already engaged with consortium partners; all households residing in the selected subdistricts were eligible for random selection.

It is important to note that the baseline survey was not designed as a counterfactual or experimental evaluation. The findings are interpreted as diagnostic and descriptive, rather than causal. While the design allows for robust characterization of baseline conditions and identification of spatial and socioeconomic patterns, it does not support attribution of observed outcomes to specific interventions (Gertler et al. 2016). This limitation is explicitly acknowledged to ensure appropriate use of results within program planning and evaluation processes.

This baseline received ethical clearance through IWMI's Institutional Review Board (IRB) process prior to data collection. All personally identifiable information (respondent names, phone numbers, GPS coordinates, and enumerator identifiers) was removed from the analysis dataset during data cleaning, in line with the anonymization and data protection protocol approved under the IRB data management plan. Only de-identified records were used for the analyses presented in this report, and access to the identified raw dataset is restricted to the core research team.

Throughout this report, descriptions of practices, systems, or conditions already present among surveyed households should not be interpreted as evidence of WASA impact. WASA is a scaling initiative: consortium partners were already promoting similar soil and water management practices in these districts prior to WASA, and existing adoption levels documented here reflect prior programming as well as farmers' own practices, rather than WASA's own effect. These conditions represent the baseline platform from which WASA's scaling strategy departs, and the reference point against which future program monitoring, evaluation, and learning will assess change.

2.2 Data collection approach

Data collection was done through a coordinated effort involving IWMI and WASA consortium partners, reflecting a collaborative and multi-institutional implementation model. Prior to field deployment, a reconnaissance and preparatory assessment was undertaken to map intervention typologies, scaling strategies, and levels of implementation maturity across districts. Such preparatory diagnostics are widely recommended in complex, multipartner agricultural programs to ensure alignment between survey instruments, program theory of change, and operational realities.

Primary data were collected using computer-assisted personal interviewing (CAPI) based on Open Data Kit (ODK) platforms. Digital data collection systems are widely recognized as best practice in large-scale household surveys due to their ability to incorporate real-time validation checks, automated skip logic, and built-in consistency controls.

These features significantly reduce nonsampling errors, transcription mistakes, and enumerator-induced biases. In addition, CAPI systems improve data timeliness and facilitate rapid quality assurance during fieldwork.

Built-in constraints and mandatory response fields were applied to core variables, including district identification, household composition, land access, and crop participation. As a result, remaining missing values largely reflect true nonparticipation or nonapplicability, rather than data quality deficiencies. This enhances the reliability of descriptive statistics and reduces the need for extensive postcollection imputation.

The final dataset provides sufficient statistical power for district-level comparisons and gender-disaggregated descriptive analysis, which form the analytical backbone of Chapters 3 through 11. Furthermore, the structure of the dataset allows for the integration of household-level socioeconomic characteristics with plot-level production data, enabling a more nuanced analysis of productivity, technology adoption, and resilience outcomes across different farming systems.

The quantitative survey was complemented by FGDs conducted in each of the seven districts. At least one FGD was held per district, with two conducted in each of the three districts with larger samples (Lilongwe, Mchinji, and Mangochi). Each FGD comprised up to 20 participants, with equal numbers of men and women. FGDs explored infrastructure failure, local governance constraints, labor shortages, and operational barriers to inform interpretation of the household survey findings, and are referenced throughout the results chapters and in the district typology developed in Chapter 11.

The target of 1,000 households (997 realized) was based on the precision required for estimating key baseline indicators rather than on allocation proportional to the population. For a binary indicator with $p = 0.5$ and a 95% confidence level, a sample of 600–1,067 households provides a margin of error of approximately ± 4 to ± 3 percentage points under simple random sampling. Allowing for the multistage sampling design, using a design effect of 1.5, and 5% anticipated nonresponse resulted in a required sample of approximately 947 households. This was rounded to 1,000 to provide an operational buffer. The sample was then allocated across districts taking into account both differences in district population and the expected intensity of WASA interventions, with target samples of approximately 200 households in Lilongwe, Mchinji, and Mangochi and approximately 100 households in the other districts. These sample sizes correspond to approximate margins of error of ± 7 and ± 10 percentage points, respectively, at 95% confidence for a binary indicator with $p = 0.5$.

2.3 Survey modules

Household data collection took place between January 21 and February 3, 2026 across all seven districts. Questions on crop production, yields, and input use asked households to recall the 2024/25 growing season, which had concluded by the time of the survey; questions on food security and coping strategy used shorter recall periods (7 and 30 days, consistent with the Food Consumption Score [FCS], Household Dietary Diversity Score [HDDS], and Coping Strategies Index [CSI] instruments). Since enumeration took place shortly after the main harvest period, yield and production estimates are less subject to recall decay than if collected midseason, though seasonal food security indicators reflect conditions specific to this postharvest period and may not capture lean-season stress.

The questionnaire was organized into thematic modules, each designed to capture a distinct dimension of household livelihoods, agricultural production, and access to enabling services. A modular survey structure is widely used in agricultural baseline studies as it allows for the integration of structural, production, and service-related indicators while preserving analytical clarity and flexibility. This approach is particularly relevant for multi-dimensional programs such as WASA, where outcomes depend on the interaction between farm-level practices, household characteristics, and broader service environments.

The baseline analysis draws on these multiple survey modules, each designed to capture a specific dimension of household livelihoods, production systems, and enabling conditions relevant to WASA's objectives. As summarized in

Table 2.2, all datasets were integrated through a central master file containing household demographic information, with thematic modules merged using household or plot-level identifiers, as appropriate. This integration ensures internal consistency while allowing for differentiated analysis across thematic domains.

Table 2.2 Module coverage and analytical use

Survey module / dataset	Main variables	Used in chapter(s)	Merge status	Comments / data quality notes
wasam_malaw_fina.csv	Household demographics, region, district, gender of household head	Chapters 3–10	Master dataset	Core baseline file; cleaned and validated
land_owner_ship.csv	Owned land area, rented land, land use categories	Chapters 4, 5, 7	Merged (HH ID)	Outliers reviewed using agronomic thresholds
household_assets.csv	Durable assets, livestock, asset indices	Chapters 3, 6	Merged (HH ID)	Asset values harmonized; extreme values checked
productive_renewable_assets.csv	Solar equipment, irrigation pumps, productive renewable assets	Chapters 6, 9	Merged (HH ID)	Low prevalence; analyzed as binary and count variables
income_sources.csv	Crop income, casual labor, off farm income	Chapters 3, 9, 10	Merged (HH ID)	Income shares normalized to 100%
food_sources.csv	Own production, market purchases, transfers	Chapters 8, 10	Merged (HH ID)	Seasonal bias acknowledged; cross-checked with food security indicators
summer_production.csv	Summer crop types, plot size, yields	Chapters 5, 7	Merged (Plot–HH)	Yield outliers reviewed using crop-specific plausibility thresholds
winter_production.csv	Winter crops, irrigation use, water source	Chapters 4, 7	Merged (Plot–HH)	Missing values largely reflect nonparticipation
weather_information.csv	Weather information sources, early warning access	Chapters 4, 8	Merged (HH ID)	Used for access and behavioral analysis
access_to_credit.csv	Credit demand, access, sources, unmet needs	Chapters 9, 10	Merged (HH ID)	High unmet demand; analyzed through access and gap indicators
access_training_extension.csv	Training, extension, and advisory services	Chapters 6, 9	Merged (HH ID)	Coverage is low; interpreted descriptively

The modular structure enables a clear analytical separation between three core dimensions. First, structural conditions, including land access, asset ownership, and household characteristics, provide the underlying context within which production decisions are made. Second, production outcomes, including crop choice, yields, and seasonal production patterns, capture the performance of farming systems. Third, enabling factors, such as access to extension services, climate information, and financial resources, reflect the broader service environment influencing adoption and productivity.

Importantly, this structure supports both cross-sectional and cross-module analysis, allowing relationships to be examined between, for example, asset ownership and productivity, access to extension and technology adoption, or

credit access and input use. At the same time, the modular design introduces certain analytical constraints, particularly where variables are collected at different levels (household versus plot) or where participation is partial across modules. These limitations are addressed through careful merging protocols, consistency checks, and conservative interpretation of results.

The modular dataset provides a coherent and flexible analytical framework that underpins the empirical analysis presented in subsequent chapters. It enables the baseline to move beyond descriptive reporting toward integrated analysis of farming systems, thereby supporting evidence-based decision-making, targeted intervention design, and alignment with WASA's broader MELIA framework.

2.4 Data cleaning, harmonization, and outlier treatment

Descriptive statistical techniques, including means, standard deviations, frequency distributions, proportions, and graphical summaries, were employed to analyze the baseline survey data. Interactive visualizations of the baseline indicators were also developed through the WASA Baseline Dashboard to facilitate exploration of district-level patterns and dissemination of findings (IWMI/WASA 2026). This analytical approach reflects the diagnostic objectives of the study, which focus on characterizing initial conditions, identifying heterogeneity, and highlighting key constraints, rather than establishing causal relationships or impact attribution. Such methods are widely recommended for agricultural baseline surveys, where the primary aim is to generate a comprehensive understanding of preintervention conditions (FAO 2014). Where analytically meaningful, results were disaggregated by district and gender of household head to capture spatial and social variations in production systems, access to services, and food security outcomes. This disaggregation is consistent with good practice in gender-responsive agricultural analysis and supports more targeted interpretation of program relevance.

All analytical computations were conducted using the RStudio environment and Microsoft Excel (Version 2025), depending on task requirements related to data cleaning, aggregation, and visualization. Statistical tests for differences across key groups were applied selectively to support interpretation and identify meaningful variation across districts and household types, while explicitly recognizing the descriptive and nonexperimental nature of the baseline design.

Prior to analysis, a structured data cleaning and validation process was implemented, consistent with recommended practices for agricultural household surveys (FAO 2014). This process included cross-module consistency checks, harmonization of units of measurement, and verification of household and plot identifiers to ensure internal coherence of the integrated dataset. Particular attention was given to plot-level variables, especially plot size and crop yields, which are commonly prone to reporting and measurement errors. These variables were subjected to agronomic plausibility checks using crop-specific thresholds and contextual production knowledge. Such procedures are standard in farm survey analysis for identifying and correcting nonsampling errors.

Plot area and crop output were collected in the units farmers use locally, predominantly acres, with a smaller number of observations reported directly in hectares (ha) where farmers used that unit. All area and yield values were harmonized to hectares for analysis, applying the standard conversion of 1 acre = 0.4047 hectares (equivalently, $\text{yield/ha} = \text{yield/acre} \times 2.471$) to observations recorded in acres.

Extreme values that were clearly inconsistent with biophysical constraints or survey logic were systematically flagged for review. Where validation against original survey records was not feasible, robust outlier treatment methods, including winsorization, were applied in the computation of descriptive statistics and derived indicators. Winsorization reduces the influence of extreme observations while preserving the overall distributional structure of the data, thereby improving the reliability of summary measures (Cheng and Young 2023). Importantly, outlier treatment was applied only for analytical summaries; original observations were retained in the cleaned dataset to ensure transparency and allow for future reanalysis.

To capture the complexity of farming systems and their implications for resilience and nutrition, the analysis employed two complementary indicators of farm production diversity. The first is a simple, unweighted count of crop and livestock groups produced by a household over the previous 12 months. This indicator provides a transparent measure of diversification breadth and has been widely used in empirical studies examining relationships between production diversity and dietary outcomes (Powell et al. 2015; Jones 2017).

To assess the relationship between production diversity and household food security within the context of weak and imperfect agrifood markets, three complementary dietary and food security indicators were employed. These included the FCS, HDDS, and Household Food Insecurity Access Scale (HFIAS). The FCS and HDDS capture the utilization dimension of food security by reflecting dietary diversity and nutritional quality, while HFIAS captures access constraints related to food insecurity. In addition, the CSI was used to assess behavioral responses to food shortages, providing insight into the severity of access-related stress. The Months of Adequate Household Food Provisioning (MAHFP) indicator was also included to capture seasonal dynamics of food availability and stability over the agricultural calendar.

Together, these indicators provide a multidimensional assessment of food security, enabling the analysis to move beyond single-metric interpretations and to capture the interconnected dimensions of availability, access, utilization, and stability. This integrated analytical approach strengthens the baseline's ability to inform program design, particularly in identifying where constraints are most binding and where interventions can most effectively improve resilience, productivity, and nutritional outcomes.

2.5 Analytical methods and limitations

The baseline analysis relied primarily on descriptive and diagnostic statistical methods, including frequencies, percentages, means, cross tabulations, and graphical summaries. These approaches form the standard analytical foundation of agricultural baseline surveys, as they enable systematic characterization of initial conditions, identification of spatial and socioeconomic heterogeneity, and diagnosis of key constraints prior to intervention (Cooksey 2020; FAO 2014). In this study, descriptive statistics were used not only to summarize key indicators but also to reveal patterns across districts, gender categories, and farming systems, thereby supporting a more nuanced interpretation of program relevance and targeting.

To complement these descriptive analyses, cross-tabulations and comparative summaries were used to examine trade-offs and complementarities across technology pathways, informing the design of context-specific intervention packages. These are exploratory and indicative, rather than predictive or causal.

No causal inference or impact attribution was attempted, as the study design does not incorporate a counterfactual framework, control groups, or baseline–endline comparisons. As such, observed relationships between variables should be interpreted as associative rather than causal. This limitation is inherent in most project baseline surveys and is explicitly acknowledged to ensure the appropriate use of findings in program design and evaluation (FAO 2014; Gertler et al. 2016). While the dataset allows for the identification of correlations and patterns, it does not support conclusions regarding the effectiveness of specific interventions.

Additional limitations relate to the cross-sectional nature of the data and the reliance on self-reported information. Cross-sectional data capture conditions at a single point in time and therefore cannot account for temporal variability, particularly in relation to seasonal dynamics, climate variability, and price fluctuations. Self-reported variables, such as yields, income, and consumption, may also be subject to recall bias or measurement error, despite the application of validation and consistency checks during data collection and cleaning. Furthermore, while the sampling design ensures strong representation at the district level within WASA intervention areas, the results are not intended to be nationally representative.

Despite these limitations, the methodological rigor applied in sampling, data collection, data cleaning, and analysis provides a credible and transparent foundation for WASA program design, prioritization, and future monitoring. The combination of structured sampling, high-quality digital data collection, systematic validation procedures, and integrated analytical frameworks ensures that the baseline offers a robust evidence base for identifying priority constraints, targeting interventions, and establishing reference points for MELIA. As such, the baseline serves not only as a descriptive benchmark but also as a strategic tool for guiding adaptive implementation and tracking progress over time.

Chapter 3. Household Systems

3.1 Household sociodemographics

The distribution of household types varied substantially across districts, revealing important differences in family structure, labor availability, and dependency burdens that have direct implications for agricultural production and resilience (Table 3.1). Across all districts, male-headed households with a spouse constituted the dominant household type, accounting for the majority in Chikwawa (91 households), Dowa (74), Lilongwe (134), Mangochi (105), Mchinji (135), Mulanje (72), and Salima (86). This pattern reflects the prevailing structure of smallholder farming systems in Malawi, where male-headed households typically have greater access to land, labor, and productive resources, which can influence both technology adoption and productivity outcomes.

However, female-headed households, both *de facto* and *de jure*, were also prominent across the sample, particularly in Mangochi (66 combined) and Lilongwe (52 combined). The prevalence of these households is analytically significant, as it reflects underlying structural and socioeconomic dynamics, including male outmigration, marital dissolution, or livelihood diversification strategies that shift labor away from the household. Female-headed households often face constraints related to labor availability, access to productive assets, and participation in input and output markets. As a result, their presence signals differentiated vulnerability profiles that require targeted intervention strategies, particularly in relation to labor saving technologies, access to finance, and extension services.

In this baseline, a household was classified as child-headed where the household head was aged 18 or below. Child-headed households are relatively rare, appearing only in Lilongwe and Mangochi, but their occurrence highlights pockets of extreme vulnerability within the study population. These households typically operate under severe labor and resource constraints and may have limited access to institutional support systems, making them highly susceptible to food insecurity and livelihood shocks. Although small in number, their inclusion in the baseline is important for ensuring that program design is inclusive and responsive to the most vulnerable groups.

Households were classified as *de facto* female-headed where the male household head had been absent for one year or more. Mangochi stood out for having the highest number of *de facto* female-headed households (19), reinforcing the importance of migration dynamics in shaping household structure. This pattern suggests that male outmigration, whether seasonal or long term, plays a significant role in local livelihood systems, with implications for labor allocation, decision-making authority, and risk management within farming households. In such contexts, women often take on a greater share of day-to-day farm management tasks. However, the literature on male outmigration cautions that this shift in labor does not automatically extend to formal decision-making authority over land, inputs, or major farm investments, which may rest with absent or returning male household members. This distinction has implications for how the adoption of climate smart practices and the effectiveness of extension services are targeted.

Generally, these sociodemographic patterns underscore the need for differentiated and context-specific approaches to intervention design under WASA. Household structure is not merely a descriptive characteristic but a key determinant of access to resources, capacity to adopt innovations, and resilience to shocks. Integrating these insights into program targeting and technology packaging will be essential for ensuring that interventions are both equitable and effective across diverse household types.

Table 3.1 Sociodemographic characteristics of the households in the districts

District	Number of child-headed households	Number of de facto female-headed households	Number of female-headed single households	Number of male-headed single households	Number of male-headed households with wife	Number of male-headed households with wives	Household head age (average years)	Number of adults (average)	Household head education (years)
Chikwawa	0	2	16	0	91	7	42.5	5.0	6.5
Dowa	0	0	12	1	74	4	41.9	4.2	6.8
Lilongwe	1	1	51	5	134	9	46.3	4.6	6.0
Mangochi	1	19	47	3	105	8	51.0	6.9	4.4
Mchinji	0	2	45	2	135	4	45.3	5.1	6.3
Mulanje	0	4	28	1	72	1	46.4	5.6	6.3
Salima	0	2	20	3	86	1	47.2	5.0	7.9

Source: Authors, WASA Malawi baseline survey, 2024/25.

Demographic indicators further highlight important differences in labor availability and human capital across districts. The average age of household heads ranged from about 42 years in Chikwawa and Dowa to 51 years in Mangochi, indicating a relatively older household structure in Mangochi that may constrain the adoption of labor-intensive agricultural practices. In this baseline, “older” household heads referred to those aged above 35 years. Older household heads may be less able or willing to engage in physically demanding or knowledge intensive innovations, particularly where these require behavioral change or sustained effort, a relationship supported by a broader evidence base linking household head age to lower technology adoption among smallholder farmers (Ayalew and Girma 2025).

Mangochi also recorded the highest average number of adults per household at 6.9, suggesting strong labor availability. However, this is coupled with the lowest average years of education at 4.4, pointing to a potential limitation in terms of information uptake, decision-making, and responsiveness to extension services. This combination of abundant labor and limited formal education presents a mixed profile, where physical capacity exists but may not fully translate into productivity gains without appropriate support mechanisms.

In contrast, Salima reports the highest average household education at 7.9 years, indicating comparatively stronger human capital and a greater potential for adopting improved technologies and management practices. This advantage is observed despite only moderate household size, suggesting that education rather than labor may be the key enabling factor shaping adoption pathways in this district. Across all districts, household size was relatively large, typically ranging between four and six adults. This indicates substantial labor potential within households, but also reflects significant demands on food, water, and income resources, which may constrain investment capacity.

These patterns reinforce the need for district-specific and household type-specific interventions under the WASA program. Districts with a high prevalence of female-headed households, particularly Mangochi and Lilongwe, require gender-responsive water and soil management solutions. These include labor saving technologies, inclusive financing approaches, and targeted extension services that address constraints in access to resources and information.

In districts characterized by older household heads and lower education levels, the effectiveness of interventions will depend on practical, demonstration-based approaches and strong local support systems that reduce reliance on formal

training. At the same time, the relatively large household sizes observed across most districts represent an opportunity for collective action. This latent labor can be mobilized for community-based natural resource management, watershed-level interventions, and the construction and maintenance of water and soil conservation structures. Aligning these labor resources with well targeted interventions will be essential for achieving sustained adoption and scaling of climate smart practices under WASA.

3.2 Assets and infrastructure

The grouped asset profile reveals pronounced asymmetries in household asset ownership, highlighting structural constraints that shape productivity, resilience, and inclusion outcomes across the study districts (Figure 3.1). Asset ownership was heavily concentrated in financial and basic household assets, while productive, water related, and mechanized assets were extremely limited. This pattern reflects a structural imbalance in asset accumulation, where households possess assets that support consumption smoothing but lack those required for production intensification and risk management.

The scarcity of productive and water-related assets such as irrigation equipment and mechanization tools directly constrains the ability of households to improve agricultural productivity, adopt climate smart practices, and reduce vulnerability to rainfall variability. Similarly, limited access to mechanized assets increases reliance on manual labor, which can be inefficient and insufficient, particularly in labor constrained or female-managed households. These constraints reinforce patterns observed in earlier analyses of productivity, water access, and food security, where low input use, limited irrigation, and high exposure to climatic shocks were identified as key challenges.

From an inclusion perspective, the unequal distribution of productive assets suggests that certain household groups, particularly female-headed and resource-constrained households, may face additional barriers to adopting improved technologies and participating in market-oriented agriculture. As such, asset gaps are not only a reflection of poverty but also a key determinant of differential access to opportunities within the agricultural system.

As a whole, these findings highlight the importance of targeted asset-building interventions under WASA, particularly those that improve access to water management technologies, small-scale mechanization, and productive inputs. Addressing these structural imbalances will be critical for enabling households to transition from subsistence-oriented systems toward more resilient and productive farming systems.



Figure 3.1 Asset Ownership Index

Source: Authors with WASA survey data.

Note: Asset categories were defined as follows: Financial and market assets – mobile money accounts, bank accounts, savings products, and credit-linked instruments; housing and infrastructure assets – roofing materials, storage facilities, processing equipment, and irrigation structures attached to the homestead; productive agricultural assets – hand tools, traditional farm implements, irrigation pumps, tractors, threshers, and other mechanized or labor-saving equipment; water and irrigation assets – household-level water infrastructure such as wells, boreholes, and irrigation equipment; energy and technology assets – solar power systems, water-lifting technologies, digital advisory tools, and postharvest technologies; and livestock and animal power assets – draught animals and livestock holdings used for production or traction.

Financial and market assets recorded the highest ownership levels, with 28.4% of households reporting access. This is largely driven by the widespread use of mobile money platforms rather than ownership of formal financial assets such as bank accounts, savings products, or credit-linked instruments. While this reflects growing digital financial connectivity in rural areas, it does not translate into meaningful productive investment capacity. Access to formal credit, irrigation finance, mechanization services, and productive loans was very limited. This finding aligns with later evidence showing high demand for credit but persistently low access to productive finance, suggesting that financial inclusion were low and consumption oriented rather than transformational.

Housing and infrastructure assets show moderate ownership levels, with 14.1% of households reporting access. This appears to be driven primarily by gradual improvements in housing quality, particularly roofing materials, rather than ownership of productive infrastructure such as storage facilities, processing equipment, or irrigation structures. As a result, these assets contribute more to household welfare and resilience against basic shocks than to agricultural transformation.

Ownership of productive agricultural assets was equally low at 14.3% and is dominated almost entirely by basic hand tools and traditional farm implements. Ownership of mechanized equipment such as irrigation pumps, tractors, threshers, and other labor-saving technologies was negligible. This significantly constrains households' ability to intensify production, expand cultivated area, improve labor efficiency, or adopt water efficient technologies. It also substantiates the structural nature of low productivity observed in later chapters on yields, technology adoption, and agricultural performance.

The most acute asset deficit was observed in water and irrigation assets, where only 2.2% of households reported ownership. This is one of the most strategically significant findings in the baseline survey because it directly sustains broader evidence on low irrigation use, high rainfall dependence, and widespread exposure to droughts and floods. The near absence of household level water infrastructure suggests that most households lack the physical capacity to manage climate risks independently. This explains why water insecurity emerges as a binding constraint across multiple district typologies and why household-led irrigation expansion is unlikely without external support.

Similarly, ownership of energy and technology assets was low at 13.9%, limiting the potential for uptake of solar powered irrigation systems, water lifting technologies, digital advisory tools, and postharvest technologies. Livestock and animal power assets were also limited at 8.3%, further reducing households' productive capacity and diversification opportunities.

Taken together, these findings reveal a structural asset deficit that goes beyond poverty and directly affects the feasibility of agricultural transformation. Households may be willing to adopt improved technologies, but many lack the foundational productive assets required to do so. For the WASA program, this has important implementation implications. Technology scaling strategies cannot assume that farmers possess the minimum asset base needed for adoption. In many districts, interventions may need to prioritize shared infrastructure models, asset financing mechanisms, community-based irrigation systems, and phased adoption pathways that reduce upfront costs for resource constrained households. These findings also provide a critical baseline for measuring whether the WASA program succeeds in strengthening productive asset ownership over time.

Table 3.2 used a separately documented construction, distinct from the national-level Asset Ownership Index in Figure 3.1: for each category, the percentage is the average share of the listed items a household owns (e.g., a household owning 1 of 6 water and irrigation items scores 16.7% on that category). Asset categories were defined as follows: Financial and market assets – mobile , animal-draft plough, thresher, knapsack sprayer, ox cart, farm implements, grinding mill; water and money, bank account; housing and infrastructure assets – improved housing, improved roofing, improved storage facility, separate housing for farm animals; productive agricultural assets – two-wheel tractor; water and irrigation assets – water pump, treadle pump, borehole, well, water storage tank, running tap water; and energy and technology assets – generator, LPG, grid electricity, internet access, biogas digester, solar agricultural technology, digital farm devices.

Table 3.2 Asset ownership index by district (household-level reconstruction)

District	Number	Financial and market assets (%)***	Housing and infrastructure assets (%)***	Productive agricultural assets (%)***	Water and irrigation assets (%) ns	Energy and technology assets (%)**	Livestock and animal power index (%)***
National	991	42.0	26.6	14.7	1.7	1.4	8.4
Chikwawa	115	36.5	27.4	13.2	1.9	1.2	8.0
Dowa	91	49.5	31.9	15.9	2.2	1.9	13.7
Lilongwe	201	40.3	23.1	15.0	1.3	0.9	8.0
Mangochi	179	39.7	28.8	12.8	1.5	2.7	4.7
Mchinji	188	44.7	25.5	17.3	1.9	0.8	11.3
Mulanje	106	35.4	20.0	12.0	1.9	0.8	4.1
Salima	111	50.0	32.4	16.2	1.7	1.8	10.5

Source: Authors, WASA Malawi baseline survey, 2024/25 (n=991 matched households).

The livestock and animal-power asset index averaged 8.4% nationally, with substantial variation across districts. Ownership was highest in Dowa (13.7%) and Mchinji (11.3%), followed by Salima (10.5%), while it was lowest in Mulanje (4.1%) and Mangochi (4.7%). Chikwawa and Lilongwe each recorded approximately 8.0%. Differences across districts were statistically significant ($p < 0.01$), indicating considerable spatial variation in household livestock and animal-power asset ownership. Significance markers report a one-way ANOVA testing whether category means differ across the seven districts: *** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.10$, ns = not significant. Differences across districts were significant for financial and market assets, housing and infrastructure assets, productive agricultural assets, and energy and technology assets, but not for water and irrigation assets, where ownership was low and largely undifferentiated across districts (1.3–2.2%). The lowest overall ownership levels were in Mulanje and Chikwawa and the highest in Salima and Dowa. As water and irrigation assets measure individual household ownership of hardware rather than access to shared or communal water infrastructure, low scores here should not be read as an absence of irrigation access; irrigation access is addressed separately in Chapter 4.

3.3 Livelihoods and income sources

The composition of household income across districts revealed distinct livelihood archetypes that differentiate areas characterized by livelihood stress, stronger market integration, and mixed resilience strategies (Table 3.3). These patterns are important because they shape households' capacity to absorb shocks, invest in productivity-enhancing technologies, and participate in climate resilient agricultural transformation.

In several districts, casual labor constituted the dominant income source, accounting for between 40 and 59% of total household income in Mulanje (58.5%), Mangochi (42.2%), and Chikwawa (40.6%). In these districts, reliance on

wage labor significantly exceeded income generated from own agricultural production. This pattern is often associated with distress-driven livelihood strategies, where households sell labor to compensate for limited landholdings, low agricultural productivity, recurrent climatic shocks, or weak access to productive assets. Such households are typically more vulnerable because labor income is often seasonal, unstable, and highly sensitive to broader economic shocks.

Mulanje presents one of the most worrying livelihood profiles. The district recorded negligible income from cereals (1.1%) and no contribution from cash crops (0%), suggesting severe structural constraints within farming systems. This level of dependence on casual labor indicates weak agricultural commercialization and limited resilience within local livelihood systems. In such contexts, households may struggle to adopt improved technologies unless interventions first address fundamental production constraints.

In contrast, cash crop income dominated in Lilongwe (50.9%) and Dowa (47.2%), signalling stronger market integration and higher monetization of agricultural production. These districts combine relatively low reliance on casual labor (10.1% in Lilongwe and just 4.9% in Dowa) with more diversified income portfolios that include cereals, legumes, and horticulture. This suggests comparatively stronger production systems, better access to land, improved market participation, and potentially greater adoption of productivity enhancing practices such as irrigation, soil fertility management, or improved seed use. These districts may therefore be better positioned for rapid scaling of market-oriented interventions under the WASA initiative.

Mchinji occupied an intermediate position, with a relatively diversified income structure that includes legumes (29.2%), cash crops (23.6%), cereals (15.9%), and off farm income (13.3%). This balanced portfolio reflects greater livelihood diversification, which can improve resilience by reducing dependence on a single income source. However, it also suggests continued exposure to climate and market risks, particularly where agricultural production is largely rainfed.

These livelihood patterns reveal important differences in household resilience and investment capacity across districts. Districts dominated by casual labor may require initial interventions focused on restoring productive capacity, strengthening water access, and reducing dependence on low return labor markets. In contrast, districts with stronger agricultural commercialization may be better suited for high value technologies, market linkages, and productivity enhancing investments. Mixed livelihood systems may require more flexible intervention packages that combine productivity support with risk management strategies.

From a WASA implementation perspective, these findings reinforce the importance of district-specific intervention sequencing. Households that rely heavily on casual labor are less likely to adopt labor intensive conservation practices or self-finance irrigation investments without targeted support. Meanwhile, households with stronger agricultural income streams may be better positioned to scale technologies more rapidly. These distinctions will become particularly important in later chapters that develop district typologies and investment pathways.

Table 3.3 Main household income sources as a percentage of total household income, by district

District	Cash crops	Casual labor	Cereals	Horticulture	Legumes	Off farm income
Chikwawa	9.5	40.6	24.0	9.6	7.2	9.2
Dowa	47.2	4.9	19.2	14.6	12.0	2.0
Lilongwe	50.9	10.1	14.6	6.2	8.1	10.0
Mangochi	0.7	42.2	20.7	7.7	16.0	12.6
Mchinji	23.6	10.4	15.9	7.7	29.2	13.3
Mulanje	0	58.5	1.1	6.3	19.7	14.4
Salima	3.0	27.2	23.1	5.5	14.1	27.2

Source: Authors, WASA Malawi baseline survey, 2024/25.

The dominance of casual labor income in Mulanje, Mangochi, and Chikwawa highlights districts where agricultural livelihoods appear to be under significant stress and where households rely heavily on labor markets to compensate for weak on farm income generation. These patterns may reflect a combination of low agricultural productivity, limited irrigation access, recurrent climate shocks, and constrained productive assets. They also suggest these are districts where existing water and soil management technologies may not yet be reaching sufficient scale to meaningfully alter household livelihood structures.

From a scaling perspective, these districts present important opportunities for expanding access to technologies that improve soil moisture retention, strengthen water reliability, and support dry season production. However, the baseline does not imply that such transitions will occur automatically. Rather, it highlights the structural conditions that may constrain adoption and suggests where labor-saving technologies, collective water systems, and more inclusive financing approaches may be particularly relevant for reducing barriers faced by poorer households.

In contrast, Lilongwe and Dowa emerged as strong market-oriented districts, where relatively high cash crop incomes indicate more commercialized farming systems and stronger integration into agricultural markets. These districts appear to have greater capacity to absorb incremental improvements in water and soil management, particularly where farmers are already participating in high value production systems. Existing adoption patterns in these districts may therefore offer useful lessons for scaling strategies in other locations.

Mchinji represented a more diversified livelihood structure, with income distributed across legumes, cash crops, cereals, and off farm activities. This balanced portfolio may provide greater resilience against individual market or climate shocks, although vulnerability remains where production systems are still largely dependent on rainfall.

These income patterns reinforce the need for differentiated scaling pathways across districts. Some districts face basic productivity constraints that require stronger attention to risk reduction and asset access, while others appear better positioned for scaling more advanced productivity and market interventions. The baseline therefore helps identify where existing technologies are already gaining traction, where adoption barriers are highest, and where future scaling efforts may require different implementation models.

Chapter 4. Land, Water, and Risks

This chapter distinguishes between two categories of agricultural water. Blue water refers to water abstracted from rivers, streams, and groundwater for irrigation, covered in Section 4.2. Green water refers to rainfall stored as soil moisture, managed through practices such as water harvesting, contour bunds, and soil and moisture conservation, covered in Section 4.4. The two are governed by different infrastructure, access constraints, and technology options, and are treated separately in the analysis that follows.

4.1 Landholding structure

Patterns of land ownership and land use varied considerably across districts, revealing important structural constraints and opportunities for agricultural production (Table 4.1). Owned landholdings were generally small, ranging from 0.43 hectares in Mulanje to 1.66 ha in Salima, reinforcing the predominance of smallholder farming systems across all project areas. These relatively small land sizes limit the potential for expansion-based growth and increase pressure on households to improve productivity on existing land.

These findings are broadly consistent with national patterns of land fragmentation in Malawi. The Ministry of Agriculture notes that the average national smallholder landholding is approximately 0.6 ha, reflecting widespread land pressure across rural farming systems (Government of Malawi 2023b). WASA districts such as Mulanje (0.43 ha) and Mangochi (0.64 ha) fall at or are near this national benchmark, highlighting acute land constraints. By contrast, Salima (1.66 ha), Mchinji (1.27 ha), and Dowa (1.20 ha) appear relatively less land constrained, potentially offering greater opportunities for scaling land intensive interventions where water access constraints can also be addressed.

In several districts, households supplement owned land through cash lease arrangements, the predominant rental type in these districts (sharecropping is uncommon), particularly in Salima (0.84 ha), Chikwawa (0.61 ha), Lilongwe (0.54 ha), and Mchinji (0.49 ha). This reliance on rented land suggests growing land scarcity and competition for productive land, but it also reflects some flexibility within local land markets that allows households to temporarily expand production. However, rental arrangements may create tenure insecurity, which can discourage long-term investments in soil restoration, irrigation infrastructure, and other land improving technologies.

By contrast, Mulanje and Dowa reported relatively limited rented land, suggesting tighter local land markets, greater land scarcity, or production systems more constrained by geography and land fragmentation. These structural differences are important because they shape the feasibility of scaling water and soil technologies that require medium- to long- term investments.

Table 4.1 Land ownership and cultivation by district

District	Average owned land (ha)	Average rented land (ha)	Average food crop area (ha)	Average horticulture area (ha)	Average aquaculture area (ha)	Average fallow area (ha)
Chikwawa	0.80	0.61	0.72	0.06	0.03	0.05
Dowa	1.20	0.27	0.93	0.05	0	0.06
Lilongwe	0.92	0.54	0.77	0.09	0.02	0.02
Mangochi	0.64	0.33	0.56	0.05	0.04	0.07
Mchinji	1.27	0.49	1.00	0.11	0.03	0.04
Mulanje	0.43	0.18	0.38	0.02	0	0.01
Salima	1.66	0.84	1.22	0.01	0	0.38
Mean	0.99	0.47	0.80	0.06	0.02	0.09

Source: Authors, WASA Malawi baseline survey, 2024/25.

Cultivation patterns revealed significant differences in land allocation across farming systems. Food crops dominated land use in all districts, confirming the continued importance of staple crop production for household food security. Average food crop area ranged from 0.38 ha in Mulanje to 1.22 ha in Salima, broadly tracking the pattern of land ownership and rental access across districts. This corrected pattern suggests that food crop cultivation was largely shaped by available land rather than by expansion into large cultivated areas.

Across all districts, horticulture and aquaculture occupied meagre land areas, typically below 0.1 ha. This suggests that diversification into high value and water-dependent enterprises was limited at baseline. This is particularly important because such enterprises often represent key pathways for income diversification and resilience building.

Fallow land was minimal across most districts, with the exception of Salima (0.38 ha). This suggests widespread land pressure and limited opportunities for natural soil regeneration through traditional fallowing practices. Continuous cultivation without sufficient soil restoration increases the importance of alternative soil fertility management approaches.

These land use patterns have significant implications for scaling under the WASA program. The combination of small owned landholdings, limited fallow land, and continued dominance of food crop cultivation suggests that future productivity gains are more likely to come from improving water productivity, soil health, and climate resilience than from expansion of cultivated land.

Districts with relatively larger landholdings and cultivated areas, such as Salima, Mchinji, and Dowa, may provide opportunities for scaling watershed management, soil moisture conservation, and climate smart production packages where water access constraints can also be addressed. However, these opportunities should be validated through implementation-level planning rather than assumed from baseline figures alone.

At the same time, districts with rigid land constraints, particularly Mulanje, Mangochi, and Chikwawa, may require technologies that stabilize productivity on small land parcels. These include water harvesting systems, soil restoration practices, intercropping, manure management, and low-cost productivity-enhancing technologies that can generate returns within constrained land systems.

4.2 Water access for production

The baseline results revealed significant spatial differences in access to water sources for winter crop production, reflecting variations in hydrological conditions, infrastructure availability, and existing irrigation practices across districts (Table 4.2). These patterns are particularly important because they shape the feasibility of scaling water management technologies under the WASA program and determine the extent to which households can reduce dependence on increasingly unreliable rainfall systems.

River and stream abstraction dominated winter production in Chikwawa and Mchinji, where 93.8% and 100% of winter producing households, respectively, rely on surface water sources. This suggests that households in these districts already depend heavily on naturally available surface water systems to sustain dry season production. While this may create opportunities for expanding low-cost irrigation and water management technologies, it also exposes households to significant risks associated with declining river flows, upstream abstraction pressures, sedimentation, and climate-induced variability in water availability.

In Chikwawa, a small proportion of households (6.2%) supplemented river use with shallow wells, indicating limited diversification of water sources. The narrow range of available water options suggests that many households were highly vulnerable to disruptions in surface water availability, particularly during drought periods or years of erratic rainfall.

At the same time, heavy dependence on natural water sources raises important concerns regarding long-term sustainability. Without improved watershed management, soil conservation, and water governance systems, increased pressure on rivers and streams could undermine both agricultural production and ecosystem health.

From a scaling perspective, districts with existing access to surface water may have relatively lower entry barriers for introducing improved irrigation scheduling, water harvesting, solar pumping, and water use efficiency technologies. However, districts with limited or highly concentrated water access may require different models, including community-managed infrastructure, groundwater development where feasible, and stronger institutional coordination around water allocation.

These findings reinforce the fact that water access is not simply a matter of infrastructure availability. It is shaped by geography, hydrology, institutional arrangements, and household asset constraints. Understanding these pre-existing patterns is essential for identifying where water interventions can realistically scale and where more foundational investments may be required.

Table 4.2 Primary water sources used for winter production by district

District	River/stream	Shallow well	Dambo/wetland	Borehole	Other / unspecified water source
Chikwawa	15 (93.8%)	1 (6.2%)			
Dowa			1 (100%)		
Lilongwe		2 (28.6%)	5 (71.4%)		
Mangochi	12 (66.7%)		2 (11.1%)	2 (11.1%)	2 (11.1%)
Mchinji	7 (100%)				

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Rainwater harvesting is practised in these districts, primarily through box ridges and small ponds, but is not shown as a separate column here as it was not captured as a distinct category in the winter production water source module.

Lilongwe and Mangochi exhibited comparatively more diversified water source portfolios. In Lilongwe, winter production relied primarily on wetlands (71.4%) and the rest dependent on shallow wells (28.6%). This pattern suggests widespread use of seasonally saturated landscapes that support dry season production but are vulnerable to degradation, overextraction, and changing rainfall patterns.

Dowa stood out as being entirely dependent on dambo and wetland systems for winter production. While these ecosystems play an important role in supporting dry season agriculture, complete reliance on them raises sustainability concerns, particularly where cultivation intensifies without appropriate management of fragile wetland systems.

Mangochi presented a relatively more diversified profile, with households drawing water from rivers, wetlands, boreholes, and other informal sources. Although this diversification may reduce dependence on a single water source, it also highlights fragmented water access systems and possible inconsistencies in infrastructure development. The presence of unspecified water sources further suggests limitations in formal water infrastructure and documentation.

These patterns show that winter crop production across project districts is heavily dependent on surface water and shallow groundwater systems that are often informal, environmentally sensitive, or vulnerable to climate variability. Districts with heavy reliance on a single source, particularly river-dependent systems in Chikwawa and Mchinji, or wetland-dependent systems in Dowa and Lilongwe, may face elevated sustainability risks as pressure on these resources increases.

From a scaling perspective, river-dependent districts may present opportunities for improving water use efficiency, strengthening abstraction practices, and expanding access to appropriate pumping technologies where feasible. Wetland-dependent districts may require a stronger emphasis on sustainable wetland management and ecosystem protection. Areas with emerging groundwater use may offer opportunities for expansion, but only where hydrological sustainability and governance systems are adequately understood.

These findings underline that improving water security is not simply about expanding infrastructure. It requires careful alignment between hydrological realities, environmental sustainability, household asset capacity, and institutional management systems. These pre-existing conditions are critical for understanding where future scaling efforts may be most viable.

4.3 Climate and production risks

Across all the surveyed districts, drought emerged as the dominant primary climate risk, ranked first by between 33.5% of households in Lilongwe and 45.9% in Mchinji (Table 4.3). This highlights the chronic nature of rainfall deficit across Malawi's predominantly rainfed farming systems and worsens the structural vulnerability of households that are heavily dependent on increasingly unreliable precipitation patterns.

In Dowa (40.8%), Mangochi (36.5%), Mulanje (37.7%), and Salima (43.7%), drought clearly outweighed other climate hazards. This suggests widespread exposure to prolonged moisture stress that affects crop establishment, reduces yields, weakens household income generation, and increases food insecurity risks. In these areas, rainfall variability appears to be a persistent structural constraint rather than an isolated seasonal shock.

The widespread reporting of drought is particularly significant when viewed alongside earlier findings on limited irrigation access, low ownership of water related assets, and high dependence on rainfed crop production. These overlapping constraints suggest that many households have very limited capacity to provide a buffer against rainfall shocks through independent investments in irrigation, water storage, or alternative livelihood strategies.

Beyond drought, households in some districts also face multiple and overlapping production risks, including floods, pest outbreaks, soil degradation, and erratic rainfall distribution. These compounding risks increase production uncertainty and reduce farmers' willingness to invest in technologies where returns appear unpredictable. This is particularly important in smallholder systems where repeated climate shocks can quickly erode household assets and coping capacity.

From a scaling perspective, districts with high drought exposure may present a strong demand for technologies that improve soil moisture retention, rainwater harvesting, supplementary irrigation, and drought resilient cropping systems. However, the baseline also suggests that adoption may be constrained where households lack productive assets, access to finance, or secure water sources.

The findings further reinforce the importance of combining farm-level technologies with broader watershed management, soil restoration, and climate information systems. Without addressing these wider systemic risks, isolated technology adoption may generate only limited resilience gains.

Collectively, drought is not simply a climatic challenge in these districts. It is a structural production risk that shapes livelihood strategies, technology choices, and long-term investment behavior. Understanding these pre-existing risks is essential for identifying where scaling efforts are most feasible and where more foundational resilience investments may be required.

Table 4.3 Climate and resource constraints by district

Indicator	Chikwawa	Dowa	Lilongwe	Mangochi	Mchinji	Mulanje	Salima
Rank 1 climate event	Floods	Drought	Drought	Drought	Drought	Drought	Drought
Rank 1 (%)	35.9	40.8	33.5	36.5	45.9	37.7	43.7
Rank 2 climate event	Drought dry spells	Prolonged dry spells	Prolonged dry spells	Floods	Prolonged dry spells	Floods	Prolonged dry spells
Rank 2 (%)	34.9	14.6	17.2	23.1	14.9	37.0	14.1
Rank 3 climate event	Prolonged dry spells	Diseases	Pests	Prolonged dry spells	Heat waves	Prolonged dry spells	Pests
Rank 3 (%)	9.4	10.7	12.4	15.9	10.4	11.0	12.0

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: The ranks reflect each household's self-reported ordering of the climate hazards they experienced, from most (Rank 1) to third most (Rank 3) significant; percentages show the share of households citing that hazard at each rank.

Prolonged dry spells consistently ranked as the second most significant climate risk across most districts, with the reported share ranging between 14 and 17%. This validates the fact that rainfall variability within seasons is as important as total seasonal rainfall deficits. The combined dominance of drought and prolonged dry spells points to systemic water stress rather than isolated climate shocks. For many households, the challenge is not simply whether rainfall occurs, but whether it arrives at the right time and in sufficient quantities to support crop growth throughout the season.

Flood risks were more geographically concentrated but severe in specific districts. Chikwawa stood out as the only district where floods are ranked as the primary climate risk, affecting 35.9% of households and narrowly exceeding drought. Mulanje also faces significant flood exposure, where floods ranked as the second most important risk at 37%. These patterns highlight districts facing compound climate risks, where households simultaneously experience both water scarcity and water excess at different times of the year.

Additional production risks such as pests, diseases, and heat waves emerged as third ranked concerns across districts, typically affecting between 9 and 12% of households. Although these risks are less prominent than drought and floods, they are important as they compound existing production vulnerabilities and may become more severe under changing climatic conditions.

Districts where drought and prolonged dry spells dominate, such as Mchinji, Salima, Dowa, and Lilongwe, appear to face persistent water stress conditions that may create a demand for stronger soil moisture retention practices, rainwater harvesting approaches, and landscape-level water regulation systems. However, adoption potential will continue to depend on household assets, labor availability, land constraints, and access to technical support.

In contrast, districts such as Chikwawa and Mulanje face dual exposure to both flooding and drought related risks, which may require more integrated approaches that address both water scarcity and excess, including improved drainage systems, flood management infrastructure, watershed planning, and nature-based solutions that enhance both resilience and long-term water availability.

The climate risk profile reinforces one of the central findings of the baseline. The challenge facing households is not only insufficient water, but increasingly unpredictable water. This distinction is critical because it shifts the focus from simply expanding irrigation infrastructure toward building broader resilience within farming systems, landscapes, and local water governance arrangements.

4.4 Landscape opportunities and watershed logic

Across all districts, households predominantly relied on water and soil-based adaptation strategies, indicating a strong awareness of the relationship between climate shocks, water availability, and land productivity (Table 4.4). This was an important baseline finding because it demonstrates that farmers are already responding to climate stress through locally relevant practices rather than relying solely on short-term coping mechanisms.

Soil improvement practices, including manure application, mulching, and conservation agriculture, emerged as the most frequently ranked primary coping strategy in Dowa (25.0%), Lilongwe (28.5%), Mangochi (25.3%), Mchinji (27.3%), and Salima (26.6 %). These practices suggest that many households already recognize declining soil fertility and moisture retention as major production constraints and are attempting to address them through low-cost land management strategies.

Water catchment measures, including water harvesting, small bunds, and local storage systems, consistently ranked either first or second across all districts. Adoption was particularly high in Chikwawa (24.7%), Lilongwe (24.7 %), Dowa (23.4%), and Mchinji (21.9%). This widespread use of water related adaptation strategies reflects efforts by households to reduce exposure to drought and prolonged dry spells through practical farm-level responses.

Table 4.4 Main climate-coping strategies ranked by households (%) by district

District	Rank 1 coping strategy	Rank 1 (%)	Rank 2 coping strategy	Rank 2 (%)	Rank 3 coping strategy	Rank 3 (%)
Chikwawa	Water catchment	24.7	Soil improvement	20.9	Tree nursery	13.7
Dowa	Soil improvement	25.0	Water catchment	23.4	Savings and credit	10.5
Lilongwe	Soil improvement	28.5	Water catchment	24.7	Tree nursery	10.9
Mangochi	Soil improvement	25.3	Water catchment	20.3	Tree nursery	18.8
Mchinji	Soil improvement	27.3	Water catchment	21.9	Tree nursery	11.5
Mulanje	Water catchment	22.2	Soil improvement	20.5	Tree nursery	15.2
Salima	Soil improvement	26.6	Water catchment	18.2	Savings and credit	14.9

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: The ranks reflect each household's self-reported ordering of the coping strategies they used in response to climate shocks, from most (rank 1) to third most (rank 3) frequently relied upon; percentages show the share of households citing that strategy at each rank.

Secondary and tertiary strategies point to emerging diversification and long-term resilience pathways. Tree nursery activities ranked among the top three coping strategies in all the districts except Dowa and Salima, reaching relatively high levels in Mangochi (18.8%), Mulanje (15.2%), and Chikwawa (13.7%). This suggests growing engagement with agroforestry and tree-based systems that may improve soil structure, enhance moisture retention, reduce erosion, and create future income opportunities.

Savings and credit mechanisms also appeared among the top three strategies in Dowa (10.5%) and Salima (14.9%), indicating that some households are beginning to complement biophysical adaptation strategies with financial coping mechanisms. This may reflect efforts to smoothen income volatility during climate affected seasons and reduce vulnerability to production shocks.

Importantly, these findings show that many households were already experimenting with water management, soil restoration, and resilience strategies before large scale WASA implementation. This is consistent with the project's role as a scaling initiative rather than a technology originator. The baseline therefore highlights where adaptation practices already exist, where adoption is partial, and where barriers continue to limit expansion.

From a scaling perspective, these patterns suggest that the challenge is often less about introducing entirely new technologies and more about improving effectiveness, expanding coverage, strengthening coordination, and addressing constraints that prevent wider adoption. These constraints include limited productive assets, weak financing systems, land fragmentation, and unequal water access.

The findings also reinforce the importance of watersheds. Many of the practices reported by households generated stronger returns when implemented beyond individual farm plots and coordinated across landscapes. Water harvesting, soil conservation, agroforestry, and watershed restoration become significantly more effective when aligned at catchment level rather than implemented in isolation.

The evidence suggests that households are already building the foundation of resilience through locally-driven adaptation strategies. The key question for future scaling efforts is how to strengthen, coordinate, and expand these existing practices in ways that generate broader and more sustainable landscape-level outcomes.

Chapter 5. Production Systems

5.1 Crop systems by district

Crop frequency patterns show that maize dominates summer cropping systems across all districts, confirming its role as the primary staple crop and the foundation of household food security. In all districts, maize appeared on the majority of plots, reaching 100% of plots in Chikwawa and Mulanje and above 60% elsewhere. This near universal presence highlights strong dependence on maize-based production systems (Table 5.1).

While maize's dominance reflects its importance in household consumption and national food systems, it also creates structural vulnerability. Heavy concentration in a single staple crop increases exposure to maize-specific shocks, including rainfall variability, pest outbreaks, disease pressures, and input price fluctuations. The persistence of maize's dominance despite significant agroecological variation across districts suggests limited substitution toward alternative staples and reinforces the structural rigidity of existing cropping systems.

Table 5.1 Crop frequency pattern by district

District	Maize	Cassava	Tobacco	Cowpea	Rice	Groundnut bean	Common bean	Soybean	Sweet potato	Other	Total
Chikwawa	57			2	9				1	21	90
Dowa	110		30	1		12	4	34	4	1	196
Lilongwe	214		51			44	1	49	7	3	369
Mangochi	196	4			40	7	5	17	7	2	278
Mchinji	201	1	21		1	44	5	91	3	1	368
Mulanje	118	11			8	3	2		2	1	145
Salima	127			7	1	46	1	21	2	9	214

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Figures show the number of plots on which each crop was grown per district, not the number of households or land area; households may cultivate more than one plot with the same crop, so district totals can exceed the number of surveyed households.

Substantial variation was found in secondary crops, reflecting differences in agroecology, market access, dietary preferences, and household livelihood strategies. Legumes such as groundnut and soybean showed relatively high prevalence in Lilongwe, Dowa, Salima, and Mchinji. This suggests that diversification is already occurring in some districts and may be linked to both soil fertility management and income generation. Legumes are particularly important because they can improve soil nitrogen levels while also offering market opportunities.

Cowpea showed high prevalence in Salima and Chikwawa, which is consistent with its drought tolerance and role as a resilience crop in areas facing greater climatic stress. This suggests that households are already making crop choices that respond to local climatic realities.

Cassava and sweet potato displayed more localized importance, with cassava particularly prominent in Mulanje. This amplifies the role of root crops as food security buffers in districts exposed to greater climate uncertainty or production instability.

Tobacco appeared primarily in Dowa, Lilongwe, and Mchinji, highlighting localized commercial specialization rather than broad-based adoption. This suggests that some districts were more integrated into formal agricultural markets than others.

The relatively large "other crops" category in several districts indicated experiments with additional crops, although these are less central to production systems.

From a scaling perspective, the findings suggest that improving resilience within maize systems is essential because maize continues to dominate household food systems. At the same time, districts already showing stronger diversification into legumes, root crops, and drought-tolerant crops may provide opportunities for scaling practices that strengthen water productivity, soil fertility, and market resilience within existing production systems.

Rather than introducing entirely new crop systems, future scaling efforts may be more effective when they build on crops that farmers are already producing and where adaptation pathways are already emerging.

Table 5.2 presents crop share by district, measured as the percentage of total summer cultivated area allocated to each crop. Unlike crop frequency, which reflects how widely a crop is grown, crop share provides deeper insights into land allocation priorities and production intensity. Together, the two indicators help distinguish between crops that are widely grown on small plots and those that command larger shares of land and household investment.

Table 5.2 Crop share (%) by district

District	Maize (%)	Groundnut (%)	Soybean (%)	Sweet potato (%)	Cassava (%)	Tobacco (%)	Cowpea (%)
Chikwawa	32.0	0	0	0.6	0	0	1.8
Dowa	41.9	8.9	18.7	2.8	0	21.0	0.6
Lilongwe	41.2	10.2	12.9	3.8	0	27.0	0
Mangochi	43.6	10.2	8.3	4.2	6.0	0	0
Mchinji	36.8	24.2	24.8	1.4	0.2	9.6	0
Mulanje	22.2	6.1	0	2.5	36.3	0	0
Salima	30.9	35.6	11.2	1.2	0	0	3.8

Source: Authors, WASA Malawi baseline survey, 2024/25.

Across all districts, maize occupied the largest share of cultivated land, ranging from 22.2% in Mulanje to more than 40% in Dowa, Lilongwe, and Mangochi. This its dominant role not only in household participation but also in land allocation, reinforcing its continued importance within local food systems. However, maize does not occupy the majority of cultivated land in any district. This suggests that households are deliberately allocating land across multiple crops as part of broader risk management, consumption smoothing, and income diversification strategies.

Clear district-specific land use specialization emerges beyond maize. In Mulanje, cassava accounts for 36.3% of cultivated land, far exceeding its share in other districts. This strengthens cassava's role as a drought tolerant and relatively resilient food security crop in areas exposed to production uncertainty.

Mchinji and Salima show strong specialization in legumes. Groundnut and soybean together account for nearly half of the cultivated land in Mchinji and a substantial share in Salima. These patterns may reflect both market opportunities and the agronomic benefits associated with legumes, particularly their role in soil fertility improvement.

In Dowa and Lilongwe, tobacco occupies a significant share of cultivated land at 21% and 27% respectively, despite missing in several other districts. This points to localized commercial specialization driven by market access, institutional arrangements, and agroecological suitability. However, heavy dependence on tobacco may expose households to price volatility and changing regulatory environments.

From a scaling perspective, maize systems are an important entry point because of their continued dominance in household food systems. At the same time, the significant allocation of land to cassava, legumes, and commercial crops

suggests that future scaling strategies may be more effective when they align with existing production realities rather than attempting to introduce entirely new cropping systems.

Districts with strong legume production may offer opportunities for scaling soil fertility practices and market linkages. Cassava-intensive systems may require greater attention to water management and climate resilience. Commercial crop districts may present opportunities for improving water productivity and reducing production risks. The baseline therefore highlights the importance of tailoring future interventions to existing land use systems rather than assuming a uniform agricultural model across districts.

5.2 Seasonal production patterns

The baseline results showed that summer crop production is universal across all districts, with 100% of households participating in summer agriculture. This confirms that livelihoods across the study areas are heavily dependent on rainfed farming, making summer production the primary foundation of household food security and rural livelihoods.

Across all districts, maize dominated summer production, often grown alongside groundnut, rice, beans, or sorghum (Table 5.3). This reflects a strong focus on staple food production, combined with limited diversification into legumes and other cereals. The consistency of this pattern across both the Central Region and Southern Region districts suggests that summer production systems are heavily shaped by rainfall patterns and staple food requirements, with relatively limited structural differentiation at baseline.

Table 5.3 Seasonal participation in crop production by district

District	Region (%)	Summer participation (%)	Winter participation	Main summer crops	Main winter crops
Chikwawa	Southern	100	21.6	Maize, sorghum	Green maize, tomato
Dowa	Central	100	51.6	Maize, groundnut	Tomatoes, green maize
Lilongwe	Central	100	58.2	Maize, groundnut	Green maize, tomato
Mangochi	Southern	100	20.0	Maize, rice	Green maize, tomato
Mchinji	Central	100	41.5	Maize, groundnut	Green maize, common bean
Mulanje	Southern	100	22.6	Maize, rice	Tomatoes, green maize
Salima	Central	100	17.1	Maize, beans	Tomatoes, green maize

Source: Authors, WASA Malawi baseline survey, 2024/25.

In contrast to the universal nature of summer farming, winter crop participation varied significantly across districts, revealing important differences in water access, irrigation potential, and dry season production capacity.

Central Region districts, particularly Lilongwe (58.2%), Dowa (51.6%), and Mchinji (41.5%), reported relatively high winter participation. This suggests stronger access to water sources, existing irrigation practices, or environmental conditions that support dry season cultivation. These findings align with earlier evidence showing greater use of wetlands, shallow wells, and other water sources in some of these districts.

Southern districts such as Chikwawa (21.6%), Mangochi (20.0%), and Mulanje (22.6%) reported more moderate participation levels, while Salima recorded the lowest winter participation at 17.1%. These patterns suggest that dry season production was constrained in many locations by limited water access, infrastructure gaps, and broader production risks.

A simple participation-based cropping intensity proxy, calculated as the sum of summer and winter participation rates, ranged from 117.1 in Salima to 158.2 in Lilongwe, with Dowa (151.6) and Mchinji (141.5) also above the district average.

This confirms that Central Region districts combine near-universal summer cultivation with substantially higher second-season use of the same land, while Southern Region districts and Salima cultivate land more sparsely across the year. This measure approximates land use intensity from participation rates alone; a full cropping intensity index based on cropped area per season per plot was not available from the current dataset.

Winter production was largely concentrated in green maize and tomato, with occasional production of common bean. This reflects a combination of food security priorities and market opportunities, as these crops provide both household consumption benefits and income generation potential during dry periods.

From a scaling perspective, districts with high winter participation may indicate areas where farmers are already demonstrating demand for dry season production and where improvements in water efficiency, governance, and market access could strengthen existing systems. However, these districts should not automatically be treated as the only scaling priorities, as lower participation districts may reflect deeper unmet demand caused by infrastructure, financing, or hydrological constraints.

The dominance of green maize and tomato also highlights opportunities to strengthen value chains, reduce postharvest losses, and improve water productivity within crops that farmers are already producing. More broadly, the findings emphasize that expanding resilience in these farming systems will require improving the reliability and sustainability of existing water access systems rather than adopting entirely new production models.

Chapter 6. Technology Adoption

6.1 Soil health and agronomic practices

The findings in this section reveal substantial variation in the adoption of water and soil management practices across districts, with relatively low cost and labor-based technologies dominating. Across all districts, manure application emerged as the most widely adopted practice, particularly in Lilongwe (178 households), Mangochi (150), Mchinji (141), Salima (96), Mulanje (92), and Dowa (79) (Table 6.1). This widespread adoption suggests strong reliance on organic soil fertility management and reflects both limited access to inorganic inputs and growing recognition of declining soil fertility as a major production constraint.

Table 6.1 Number of households adopting select climate smart technologies by district

Technology	Chikwawa	Dowa	Lilongwe	Mangochi	Mchinji	Mulanje	Salima	Total
Agroforestry	4 (3.4%)	15 (16.5%)	39 (19.4%)	21 (11.5%)	32 (17.0%)	8 (7.5%)	13 (11.6%)	132
Cereal legume rotation	1 (0.9%)	11 (12.1%)	18 (9.0%)	8 (4.4%)	20 (10.6%)	2 (1.9%)	8 (7.1%)	68
Contour ridges/bunds	22 (19.0%)	53 (58.2%)	38 (18.9%)	54 (29.5%)	41 (21.8%)	38 (35.8%)	57 (50.9%)	303
Manure application	32 (27.6%)	79 (86.8%)	178 (88.6%)	150 (82.0%)	141 (75.0%)	92 (86.8%)	96 (85.7%)	768
Mulching	15 (12.9%)	11 (12.1%)	17 (8.5%)	30 (16.4%)	24 (12.8%)	11 (10.4%)	19 (17.0%)	127
Other	5 (4.3%)	1 (1.1%)	14 (7.0%)	4 (2.2%)	8 (4.3%)	1 (0.9%)	3 (2.7%)	36
Residue retention	5 (4.3%)	23 (25.3%)	53 (26.4%)	39 (21.3%)	60 (31.9%)	21 (19.8%)	13 (11.6%)	214
Tied ridges	21 (18.1%)	22 (24.2%)	41 (20.4%)	38 (20.8%)	13 (6.9%)	33 (31.1%)	42 (37.5%)	210
Minimum tillage	0 (0%)	1 (1.1%)	1 (0.5%)	2 (1.1%)	1 (0.5%)	0 (0%)	0 (0%)	5

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: The percentage of surveyed households in that district are shown in parentheses (district sample sizes: Chikwawa n=116, Dowa n=91, Lilongwe n=201, Mangochi n=183, Mchinji n=188, Mulanje n=106, Salima n=112). “Other” is a residual category for technologies reported outside the named list; its specific composition is not further disaggregated in this baseline. It comprises climate-smart agricultural technologies reported by respondents that were not classified under the specifically listed technology categories.

On whether households combine practices or adopt a single one, a separate baseline module asked households what new soil, water, and agronomic practices they had introduced in the past five years, distinct from Table 6.1’s measure of current adoption of a fixed technology list. Of 1,027 households responding to this module, 928 (90.4%) reported introducing no new practice in this window, and the mean number of new practices introduced was 0.3 across all households. Among the 99 households that did introduce at least one new practice, the mean rose to 3.6, and 9.1% of all households that introduced two or more practices simultaneously. This suggests that where change occurs, households that make any change tend to bundle several practices together rather than adopting one in isolation, though the low base rate of reported change in this module means this pattern should be read as indicative of behavior among recent adopters rather than as evidence on the prevalence of multipractice adoption across the surveyed population as a whole.

Contour ridges and tied ridges also showed relatively high adoption across multiple districts, reflecting widespread efforts to improve water retention and reduce soil erosion under increasingly variable rainfall conditions. These practices appear particularly prominent in Salima, Mangochi, Dowa, and Chikwawa, where climate stress and soil degradation pressures are especially pronounced.

At the same time, adoption of more transformative or intensification-oriented practices was limited. Minimum tillage was nearly absent across all districts, with only 0–2 adopters recorded. Agroforestry adoption was also relatively low, although uptake was comparatively stronger in Lilongwe (39 households) and Mchinji (32 households). Mulching, residue retention, and cereal legume rotations showed moderate adoption, particularly in Lilongwe and Mchinji, suggesting greater exposure to extension services, previous conservation agriculture programs, or more favorable production conditions in these districts.

By contrast, districts such as Chikwawa and Mulanje showed lower adoption of more diversified practices, with technology uptake concentrated around basic soil and water conservation measures. This may reflect structural constraints including labor shortages, insecure land access, limited extension support, and lower investment capacity.

This distinction is important because it suggests that the primary scaling challenge is often not the introduction of entirely new technologies, but improving the quality, consistency, and integration of practices that farmers are already familiar with. In many areas, adoption appears broad but shallow, with households implementing individual practices rather than integrated packages that generate stronger resilience outcomes.

The near absence of minimum tillage, cereal legume rotation, and broader agroforestry systems also highlights important structural constraints. These practices often require longer planning horizons, stronger tenure security, sustained labor investments, and more effective extension systems. Without addressing these underlying constraints, adoption of more complex practices may be limited.

From a scaling perspective, districts such as Lilongwe and Mchinji, where broader technology diversification is already emerging, may provide useful learning environments for understanding how integrated practices can be strengthened. In contrast, districts such as Chikwawa and Mulanje may require more gradual scaling pathways that address basic productivity constraints before expecting broader adoption of more complex technologies.

The findings highlight that technology adoption across project areas is already underway, but often at relatively low levels of integration and intensity. The central challenge is therefore how to strengthen existing adoption pathways in ways that improve resilience, productivity, and long-term sustainability.

6.2 Seed, fertilizer, and input technologies

Table 6.2 shows widespread adoption of hybrid maize seed across all districts, indicating substantial engagement with improved seed technologies prior to large scale WASA implementation. Hybrid seed use ranged from 68.4% of plots in Chikwawa to as high as 92.7% in Dowa. High adoption was also observed in Mchinji (84.1%), Salima (79.0%), Mangochi (78.8%), Lilongwe (76.6%), and Mulanje (71.1%).

This pattern suggests that maize productivity constraints in these districts are not primarily driven by lack of access to improved seed technologies. Instead, other structural constraints appear more binding, including unreliable water access, declining soil fertility, labor limitations, and climate variability. Even in districts facing high livelihood stress, such as Chikwawa and Mangochi, more than two-thirds of maize plots are planted with hybrid varieties.

Table 6.2 Adoption of hybrid and recycled maize seeds by district

District	Hybrid seed	Local seed	Total plots	Hybrid (%)	Local (%)
Chikwawa	39	18	57	68.4	31.6
Dowa	102	8	110	92.7	7.3
Lilongwe	164	50	214	76.6	23.4
Mangochi	152	41	193	78.8	21.2
Mchinji	169	32	201	84.1	15.9
Mulanje	81	33	114	71.1	28.9
Salima	98	26	124	79.0	21.0

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Hybrid seed and local seed are counts of maize plots planted with each seed type; total plots is their sum (the total number of maize plots surveyed in that district). Hybrid (%) and local (%) are each seed type's share of total plots.

Despite high hybrid seed adoption, local and recycled seed are an important component of maize production, particularly in Chikwawa (31.6%), Mulanje (28.9%), and Lilongwe (23.4%). The continued use of recycled seed may reflect a combination of cost constraints, risk management behavior, and adaptation to highly uncertain production environments.

In areas where abnormal seasons are frequent and returns on purchased inputs are uncertain, households may rationally rely on recycled seed to reduce financial exposure. This reflects a pragmatic household strategy rather than a simple resistance to improved technologies.

The coexistence of hybrid and local seed use therefore reflects a dual strategy. Households invest in improved technologies when conditions appear favorable, while maintaining low- cost alternatives as protection against climate and market risks.

The baseline instead highlights an important structural reality. Technology adoption alone does not automatically translate into improved productivity outcomes. This aligns with earlier findings showing substantial yield variability, gender productivity gaps, and significant income losses during abnormal seasons.

The evidence suggests that productivity challenges are increasingly driven by complementary constraints rather than seed access alone. Without reliable water availability, improved soil health, stronger risk management systems, and better market conditions, the productivity potential of hybrid seed may be under-realized.

From a scaling perspective, this suggests that future interventions may be most effective when they strengthen the broader production environment within which existing seed technologies operate, rather than treating seed adoption as a standalone solution.

6.3 Gendered adoption differences

Table 6.3 reveals persistent gender disparities in maize productivity, although the magnitude and direction of these gaps vary considerably across districts. In most districts, male-managed plots recorded higher average maize yields than female-managed plots, with particularly large differences observed in Chikwawa (962 kg/ha in male-managed plots compared to 412 kg/ha in female-managed plots), Mchinji (1,477 kg/ha compared to 906 kg/ha), and Lilongwe (987 kg/ha compared to 757 kg/ha). These yield gaps may have been influenced by unequal access to productive resources, labor availability, land quality, irrigation access, and complementary inputs.

However, the pattern was not uniform across all districts. Female-managed plots outperformed male-managed plots in Mangochi (1,004 kg/ha compared to 779 kg/ha) and Salima (1,063 kg/ha compared to 954 kg/ha), while yields were nearly identical in Mulanje. These results are particularly important because they demonstrate that lower female productivity is avoidable. Where constraints are reduced, production systems are better aligned, or women have greater access to productive resources, female farmers can achieve comparable or even greater outcomes.

Table 6.3 Maize yield (kg/ha) and technology adoption (%) by gender and district

Indicator	Gender	Chikwawa	Dowa	Lilongwe	Mangochi	Mchinji	Mulanje	Salima
Mean yield (kg/ha)	Female	411.7	1,927.2	756.8	1,004.4	906.1	402.3	1,062.8
	Male	961.9	2,294.3	986.8	779.1	1,477.3	406.8	954.4
Fertilizer use (%)	Female	69.2	100.0	71.8	64.6	85.5	44.6	80.0
	Male	56.2	86.7	79.2	72.7	96.8	71.4	87.5
Intercropping (%)	Female	46.2	36.4	27.1	57.3	30.4	91.1	40.0
	Male	68.8	26.7	25.0	31.8	35.5	78.6	33.3
Irrigation (%)	Female	23.1	9.1	2.4	1.0	4.3	7.1	0
	Male	18.8	4.4	0	4.5	3.2	0	4.2
Number of plots	Female	26	22	85	96	69	56	40
	Male	16	45	24	22	31	14	24

Source: Authors, WASA Malawi baseline survey, 2024/25.

Adoption of key production technologies showed more complex gender dynamics than the yield results alone might suggest. Female-managed plots often demonstrated equal or higher uptake of fertilizer and intercropping in several districts. In Chikwawa, for example, female-managed plots reported higher fertilizer use than male-managed plots (69.2% compared to 56.2%). In Mulanje, female farmers reported substantially higher intercropping adoption (91.1% compared to 78.6%). These patterns suggest that women are actively engaging with productivity-enhancing and risk-spreading practices.

Across all districts, soil and water conservation practices were universally adopted by both female and male farmers. This reflects the widespread recognition of soil degradation and water stress as central production challenges rather than gender-differentiated adoption behavior.

Irrigation use was extremely limited among both male and female farmers, although access patterns varied across districts. The low adoption of irrigation technologies aligns with earlier findings on structural water constraints and suggests that irrigation was inaccessible to many households regardless of gender. However, women may face additional financial, institutional, and asset related barriers that are not fully captured by adoption statistics alone.

This distinction is critical. The findings suggest that productivity gaps are often driven less by behavioral differences and more by structural inequalities related to land access, labor constraints, financing, irrigation access, and control over productive resources.

Districts where large yield gaps persist despite relatively strong adoption may require greater attention to structural constraints affecting women farmers. At the same time, districts where female-managed plots already perform strongly may provide useful learning environments for understanding the conditions under which women achieve higher productivity outcomes.

Chapter 7. Productivity Analysis

7.1 Yield patterns

The baseline yield estimates revealed substantial variation in productivity across crops and households, highlighting the uneven performance of existing farming systems (Table 7.1). Maize, the dominant staple crop, recorded a mean yield of 1,387 kg/ha and a median yield of 865 kg/ha among 997 producing households. The large gap between the mean and median, combined with a standard deviation of 1,727 kg/ha, suggests highly uneven production outcomes, where a relatively small number of households produce substantially more than the typical farmer.

This pattern amplifies maize's continued importance in household food security while also highlighting major productivity disparities across farmers. It suggests that access to productive resources, land quality, labor, water availability, and agronomic practices differ significantly across households.

Importantly, these yields are below national benchmarks. Malawi's national maize productivity reached approximately 2.5 t/ha in 2020/21, compared to a national target of 4 t/ha (Government of Malawi 2021). This suggests that even after correcting for land measurement units, WASA households yield were substantially below both national averages and policy ambitions.

Table 7.1 Mean yield by crop (kg/ha)

Crop	Mean	Median	Standard deviation	Number of households
Cassava	1,026	577	1,061	16
Groundnut	681.9	328.5	986.7	142
Maize	1,387.2	864.9	1,726.9	997
Rice	1,110.9	617.8	1,710.5	60
Soybean	610.4	370.7	1,005.9	224
Tobacco	1,552.7	988.4	1,647.4	102

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Yield/ha=Yield/acre×2.471.

Tobacco recorded the highest mean yield at 1,553 kg/ha and a median yield of 988 kg/ha, although production was concentrated among a smaller group of households. The relatively high standard deviation reflects the commercial nature of tobacco production, where yields are strongly influenced by access to land, labor, capital, and agricultural inputs.

Groundnut and soybean, which represent important diversification crops, showed lower average yields at 682 kg/ha and 610 kg/ha, respectively. Their relatively high standard deviations relative to median values suggest inconsistent production outcomes across households. This may reflect variation in seed quality, soil fertility conditions, rainfall reliability, pest management, and broader agronomic practices.

Rice yields also showed considerable variation, with a mean of 1,111 kg/ha and a median of 618 kg/ha, despite relatively limited participation. This probably reflects the highly location-specific nature of rice production and its dependence on water availability and management systems.

Cassava appeared relatively stable compared to other crops, although the small sample size requires cautious interpretation.

The wide dispersion in maize yields is particularly important because it suggests that productivity constraints extend beyond seed adoption. Earlier sections showed relatively high hybrid seed adoption, yet substantial yield variability persists. This indicates that complementary constraints such as water reliability, soil health, labor availability, and climate exposure may be limiting productivity gains.

The findings also reinforce that productivity challenges are highly heterogeneous. Some households are already achieving relatively strong outcomes under existing systems, while many others are trapped in low productivity production cycles. Understanding what explains these differences will be critical for identifying realistic scaling opportunities in later sections.

Rather than assuming that productivity challenges can be solved through a single intervention, the baseline suggests that yield improvements will depend on addressing multiple interacting constraints within existing farming systems. This is consistent with the broader finding that resilience and productivity outcomes are shaped by water access, soil management, asset ownership, and institutional support systems working together.

Mean crop yields varied substantially across districts and crops, reflecting differences in agroecological conditions, production systems, water availability, market orientation, and access to productive inputs (Table 7.2).

Table 7.2 Mean crop yield (kg/ha) by district

District	Rice	Groundnut	Common bean	Soybean	Sweet potato	Tobacco	Maize
Chikwawa	1,214.8	0	0	0	1,482.6	0	709.0
Dowa	0	706.7	541.1	758.6	2,965.2	802.0	2,212.0
Lilongwe	0	467.0	98.8	442.2	2,176.6	424.0	961.0
Mangochi	769.8	388.0	343.5	1,047.7	936.4	0	983.0
Mchinji	300.0	798.0	397.9	654.8	617.8	396.0	1,242.0
Mulanje	481.2	548.6	1,235.5	0	247.1	0	624.0
Salima	2,200.0	341.0	0	284.2	4,242.7	0	1,868.0
Mean (growing districts)	993.2	541.6	523.4	637.5	1809.8	540.7	1,228.4

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Mean was calculated only across districts where the crop was grown; districts showing 0 were not included in the average, since a 0 here indicates the crop was not cultivated rather than a true yield of 0.

Given maize's dominance in household food systems, its yield patterns are particularly important. After adjusting maize land measurements to reflect hectare equivalents where original plot reporting appeared to be in acres, maize yields ranged from 624 kg/ha in Mulanje and 709 kg/ha in Chikwawa to 2,212 kg/ha in Dowa. Salima also performed relatively strongly at 1,868 kg/ha, followed by Mchinji at 1,242 kg/ha, while Lilongwe (961 kg/ha) and Mangochi (983 kg/ha) were the national average. These revised estimates present a more realistic picture of district-level productivity and show that while some districts are approaching national performance levels, significant productivity gaps remain. Malawi's national maize yield averaged approximately 2.5 t/ha in 2020/21, against a national target of 4 t/ha (Government of Malawi 2021). This means that most WASA districts are below the national averages, with Dowa emerging as the closest to national performance levels.

Part of these lower productivity outcomes may also reflect broader disruptions experienced during the 2024/25 agricultural season. Challenges in the implementation of the Affordable Inputs Programme, including delayed fertilizer deliveries, supplier bottlenecks, and incomplete beneficiary coverage, may have constrained timely fertilizer application among many smallholder households. Given Malawi's continued dependence on subsidized fertilizer systems, these disruptions may have contributed to lower yields in some districts, particularly where farmers depend heavily on

seasonal input support. These short-term challenges may have compounded longer term structural constraints related to rainfall variability, soil degradation, weak irrigation systems, and uneven returns to input use.

Rice production was geographically concentrated and highly uneven across districts. The highest rice yields were recorded in Salima (2,200 kg/ha) and Chikwawa (1,215 kg/ha), suggesting comparative advantages linked to irrigation systems, wetlands, or more favorable hydrological conditions. Rice yields were considerably lower in Mangochi (770 kg/ha), Mulanje (481 kg/ha), and Mchinji (300 kg/ha), while there was no rice production in Dowa and Lilongwe. These patterns reinforce the geographically concentrated nature of rice production and its dependence on localized water availability.

Legume productivity also varied considerably across districts. Groundnut yields were highest in Mchinji (798 kg/ha) and Dowa (707 kg/ha), while lower yields were observed in Salima (341 kg/ha) and Mangochi (388 kg/ha). Common bean yields were particularly high in Mulanje (1,236 kg/ha), substantially exceeding yields in other districts and suggesting localized specialization or stronger agronomic conditions, although these values should be interpreted cautiously where sample sizes are small.

Soybean yields peaked in Mangochi (1,048 kg/ha) and were relatively high in Dowa (759 kg/ha) and Mchinji (655 kg/ha), while they were low in Salima (284 kg/ha) and Lilongwe (442 kg/ha). This indicates uneven performance despite broader diversification efforts.

Sweet potato yields were particularly high in Salima (4,243 kg/ha) and Dowa (2,965 kg/ha), reinforcing its role as an important food security crop in districts where production conditions appear favorable. However, much lower yields in Mulanje (247 kg/ha) and Mchinji (618 kg/ha) suggest considerable variation in production systems and management practices.

Tobacco production was concentrated in Dowa (802 kg/ha), Lilongwe (424 kg/ha), and Mchinji (396 kg/ha), and absent in several other districts. This reflects clear geographic specialization and stronger market orientation in select areas. These results reinforce an important baseline finding: productivity systems are highly spatially differentiated, and districts are already developing distinct production profiles based on local comparative advantages, agroecological conditions, and market opportunities.

Districts with a relatively strong performance in water-dependent crops may warrant a closer examination of the institutional, hydrological, and infrastructure conditions supporting those outcomes. Similarly, districts showing stronger legume performance may offer important lessons for diversification, soil fertility improvement, and resilience pathways.

At the same time, persistently low maize yields across many districts, combined with the absence of certain crops in others, point to broader structural constraints related to water access, soil degradation, market access, and production risks. These findings reinforce the broader conclusion that future scaling efforts are likely to be most effective when they build on existing comparative advantages while addressing location specific constraints rather than promoting uniform production models across all districts.

7.2 Technology effects on yield

The analysis revealed persistent gender differences in crop productivity across most districts, although these gaps were not uniform. In districts such as Chikwawa, Mchinji, and Lilongwe, male-managed plots achieved substantially higher yields than female-managed plots, with differences exceeding 500 kg/ha in some cases (Table 7.3). These disparities point to structural constraints that affect women's ability to translate agricultural effort and technology adoption into comparable output gains.

Importantly, this pattern was not universal. In Mangochi and Salima, female-managed plots achieved equivalent or higher yields than male-managed plots, while yields in Mulanje were nearly identical. These outcomes reinforce an important finding of this baseline: lower productivity among female farmers is avoidable. Where production conditions are more favorable or structural barriers are less acute, women can achieve productivity outcomes comparable to or better than those of men.

Differences in fertilizer use do not adequately explain the observed yield gaps. Across several districts, women applied fertilizer at rates comparable to or higher than men, particularly in Dowa, Chikwawa, and Salima. Even where men reported slightly higher fertilizer use, the differences were generally too negligible to explain the large productivity gaps observed in some districts. This suggests that women are not systematically lagging in the uptake of productivity enhancing inputs.

Table 7.3 Gender differences in maize yield (kg/ha) and technology adoption (%) by district

Indicator	Chikwawa	Dowa	Lilongwe	Mangochi	Mchinji	Mulanje	Salima	Mean
Mean yield (kg/ha) – female	411.7	1,927.2	756.8	1,004.4	906.1	402.3	1,062.8	924.5
Mean yield (kg/ha) – male	961.9	2,294.3	986.8	779.1	1,477.3	406.8	954.4	1,122.9
Fertilizer use (%) – female	69.2	100.0	71.8	64.6	85.5	44.6	80.0	73.7
Fertilizer use (%) – male	56.2	86.7	79.2	72.7	96.8	71.4	87.5	78.6
Intercropping (%) – female	46.2	36.4	27.1	57.3	30.4	91.1	40.0	46.9
Intercropping (%) – male	68.8	26.7	25.0	31.8	35.5	78.6	33.3	42.8
Irrigation (%) – female	23.1	9.1	2.4	1.0	4.3	7.1	0	6.7
Irrigation (%) – male	18.8	4.4	0	4.5	3.2	0	4.2	5.0
Female-managed plots	26	22	85	96	69	56	40	56.3
Male-managed plots	16	45	24	22	31	14	24	25.1

Source: Authors, WASA Malawi baseline survey, 2024/25.

In Table 7.3, Welch's t-tests of maize yield (kg/ha) by respondent gender, restricted to individually-managed plots (consistent with the female/male-managed plot counts above), found statistically significant differences in Chikwawa ($p = 0.041$) and Mchinji ($p = 0.027$). Differences in the remaining five districts were not statistically significant at conventional levels ($p > 0.10$), meaning the apparent gaps in mean yield could plausibly reflect sampling variation rather than a systematic gender difference in those districts.

Women demonstrated strong engagement with agroecological practices, particularly intercropping. In Mangochi and Mulanje, female-managed plots reported substantially higher intercropping rates than male-managed plots, highlighting women's role in adopting risk management and soil health practices under climate stress. These patterns suggest that women are often actively investing in resilience-enhancing practices, even where productivity outcomes remain constrained.

Soil and water conservation practices were adopted across all districts by both men and women. This reflects widespread awareness of soil degradation and water stress challenges and suggests that these practices are already socially accepted within farming systems. The baseline instead shows that adoption exists, but often at varying levels of quality, intensity, and integration.

In contrast, irrigation access was very limited for both genders and continues to represent a major productivity constraint. In most districts, irrigation rates were below 10%, with women often facing even greater exclusion than men. Limited control over water contributes to persistent yield gaps, greater climate vulnerability, and unstable seasonal incomes. Earlier chapters also showed broader household-level deficits in irrigation assets, reinforcing the structural nature of this constraint.

Female farmers managed a substantial share of agricultural production, often overseeing more plots than men in districts such as Mangochi, Lilongwe, and Chikwawa. Despite this high level of responsibility, their yields were frequently lower due to broader structural disadvantages rather than lesser effort or weaker adoption behavior.

The findings highlight that technology adoption alone does not automatically translate into productivity gains. Productivity outcomes are shaped by how technologies interact with water access, land quality, labor availability, financing, and broader structural inequalities. Understanding these constraints is essential for identifying where future scaling efforts can generate more equitable and sustainable productivity outcomes.

7.3 Gender gaps in technology adoption and yields

Figure 7.1 compares gender differences in maize yields alongside gender gaps in fertilizer use, intercropping, and irrigation across districts. Positive bar values indicate higher adoption rates among male farmers, while negative values indicate higher adoption among female farmers. The two-line graphs represent average maize yields for female-managed and male-managed plots respectively. This combined framework allows a clearer assessment of whether productivity gaps are consistently associated with differences in technology adoption.

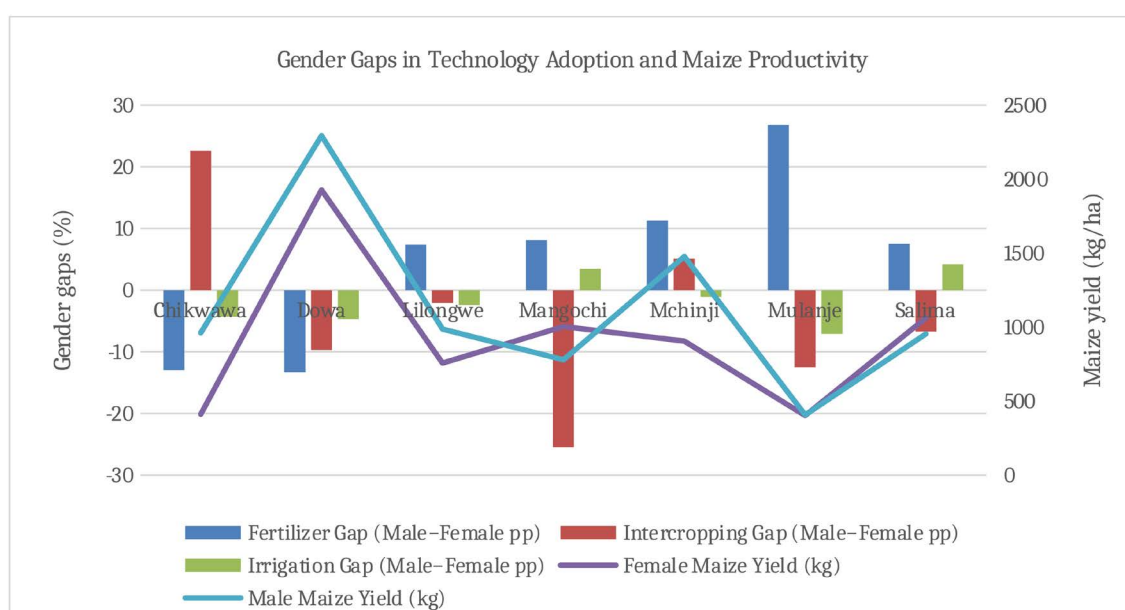


Figure 7.1 Gender gaps in technology adoption and maize productivity

Note: Values above 0 indicate male-dominated outcomes, while values below 0 indicate female-dominated outcomes.

Across several districts, women demonstrated equal or higher fertilizer adoption relative to men. In Chikwawa and Dowa, female farmers reported substantially higher fertilizer use than male farmers, while differences in Lilongwe were relatively small. This reinforces earlier findings that female farmers are not systematically excluded from basic productivity enhancing inputs. However, these relatively equitable patterns of fertilizer use do not consistently translate into equal yield outcomes. In Chikwawa and Lilongwe, women showed relatively strong fertilizer adoption yet continued to record lower maize yields than men, suggesting that access to fertilizer alone is insufficient to close productivity gaps when broader structural constraints remain unresolved.

Coming to intercropping patterns, in districts such as Mangochi and Mulanje, women reported significantly higher intercropping rates than men, reflecting greater engagement in risk management, soil fertility improvement, and diversification strategies. In Mangochi, this higher adoption coincided with greater maize yields by women, suggesting

that under certain production conditions these practices may generate positive returns. In Mulanje, however, higher female adoption resulted in yields nearly identical to those of men, demonstrating that adoption does not automatically translate into differentiated productivity gains.

Irrigation access was extremely limited across nearly all districts and showed mixed gender patterns. In some districts women reported slightly higher irrigation access, while in others men retained a modest advantage. More importantly, irrigation rates were very low for both groups across all districts, reinforcing earlier findings that inadequate water control is a major structural constraint affecting productivity.

The figure also highlights important district-level variations. Dowa recorded the highest maize yields for both men and women despite relatively modest technology gaps, suggesting more favorable broader production conditions. In contrast, Chikwawa and Mchinji combined large yield disparities with persistent structural constraints, indicating districts where productivity inequalities may be more deeply entrenched.

The broader implication is that productivity differences are shaped less by simple technology adoption gaps and more by broader structural factors that determine whether technologies generate returns. These include land quality, labor availability, water access, financing constraints, extension support, and wider household resource limitations.

In general, the figure reinforces one of the central findings of this baseline: improving productivity requires moving beyond adoption metrics alone toward addressing the broader structural conditions that determine whether technologies translate into meaningful and equitable productivity gains.

7.4 Regression analysis and interpretation

To move beyond descriptive comparisons, an econometric model was estimated to examine the factors associated with variation in crop productivity at baseline. The dependent variable in the final specification was the natural logarithm of total crop output, allowing coefficient estimates to be interpreted approximately as percentage changes in output. Independent variables included fertilizer use measured in kilograms, irrigation use (a binary variable indicating whether irrigation was used), and plot size measured in hectares. District fixed effects were included to control for location-specific production conditions, although individual district coefficients were omitted from Table 7.4 for brevity.

The regression model intentionally includes a limited set of key explanatory variables and should therefore be interpreted as identifying important factors associated with productivity rather than establishing causal relationships. An expanded specification introduced technology bundling and gender management variables to better reflect the broader analytical findings of this baseline. However, several important determinants of productivity including soil quality, labor availability, market access, extension quality, rainfall variability, and plot-level biophysical conditions were difficult to fully capture using available cross-sectional data. The regression results should therefore be interpreted as complementary to broader district-level, qualitative, and systems analyses presented throughout this report rather than as standalone evidence of intervention priorities. Several additional factors, including seed quality, labor availability, access to extension services, asset ownership, and the adoption of integrated technology bundles, are also likely to influence productivity outcomes. These variables were not included in the final model specification because of data limitations and the need to maintain an economical empirical model. As additional information becomes available through the WASA midline and endline surveys, future analyses will incorporate these variables to provide a more comprehensive assessment of the determinants of agricultural productivity and technology adoption.

Table 7.4 Summary of the regression results

Dependent variable: ln (total crop output)	Coefficient	Standard Error	t-statistic	p-value
Fertilizer use (kg)	0.01	0.00	10.64	<0.001
Irrigation use	0.19	0.14	1.37	0.17
Plot size (ha)	0.27	0.03	8.06	<0.001
Constant	4.68	0.14	33.04	<0.001

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Model specification – OLS regression of ln (total crop output) on fertilizer use (kg), irrigation use (binary), plot size (ha), and district fixed effects (coefficients omitted from the table for brevity). Standard errors are unadjusted; the model is estimated on cross-sectional baseline data and should be read as descriptive of correlates rather than causal effects.

Baseline regression results showed that fertilizer use and plot size were the strongest and most statistically robust correlates of agricultural output. Fertilizer use had a positive and statistically significant coefficient of 0.0051 ($p < 0.001$), suggesting that each additional kilogram of fertilizer applied is associated with approximately a 0.5% increase in output, holding other factors constant.

Plot size also had a strong positive relationship with output. The coefficient of 0.267 ($p < 0.001$) suggests that larger cultivated areas are associated with significantly higher production levels. This may reflect both scale effects and broader structural differences, including better access to land, labor, and complementary assets among larger producers.

Irrigation use was associated with higher output in magnitude, with a coefficient of 0.193, implying that irrigated plots may produce approximately 19% higher output than non-irrigated plots. However, this relationship is not statistically significant ($p = 0.17$), suggesting that irrigation outcomes vary considerably across locations and may depend on water reliability, infrastructure quality, scale of irrigation use, and broader agroecological conditions.

The results reinforce a broader finding emerging throughout this baseline: productivity outcomes are shaped by multiple interacting constraints rather than single technology gaps. While fertilizer use is important, earlier sections showed that many households were already adopting improved seed, conservation practices, and intercropping technologies. The persistence of low yields despite this adoption suggests that productivity improvements will depend on strengthening how these technologies interact with water access, land quality, financing, and broader support systems.

Chapter 8. Food Security

8.1 Household dietary and food consumption outcomes

The food security indicators revealed widespread and severe vulnerability across all districts, with important differences in intensity, resilience capacity, and exposure to shocks (Table 8.1). Household dietary diversity was generally low, with households consuming an average of between 3.5 and 4.2 of the 12 food groups assessed during the reference period. Districts such as Mulanje (3.5), Chikwawa (3.6), and Mchinji (3.6) displayed particularly low dietary diversity, suggesting heavy reliance on a narrow range of staple foods. Even in relatively better performing districts such as Mangochi (4.2) and Dowa (4.1), dietary diversity was below levels typically associated with stable food security, highlighting broader nutritional constraints across the study areas. These findings mirror broader national food security and nutrition challenges. Malawi continues to face high levels of chronic malnutrition, with approximately 37% of children under 5 reported as stunted nationally, while recurrent seasonal food insecurity is a persistent challenge in many rural areas (Government of Malawi 2020a[s17.1]; Government of Malawi 2020b[sm18.1] MVAC 2024). The low dietary diversity observed across WASA districts reflects these wider structural challenges, where diets are heavily concentrated around staple cereals and households struggle to access more diverse and nutritious foods.

Indicators of stress-based coping and shock exposure further underscore the severity of food insecurity. Coping strategy severity scores were extremely high in Chikwawa (189.2) and Mulanje (128.0), far exceeding levels observed in other districts and signalling heavy reliance on negative coping mechanisms such as reducing meal size, skipping meals, selling productive assets, or borrowing food. Correspondingly, the prevalence of food shortage in Chikwawa was 92.0% and in Mulanje 87.6%, indicating that the vast majority of households experience either seasonal or chronic food deficits. These districts also reported very high-income shock exposure, with more than 91% of households [s19.1]affected, reinforcing the close relationship between food insecurity, livelihood instability, and climate related shocks.

Table 8.1 Food security indicators by district

District	Household dietary diversity	Coping strategy severity	Food shortage (%)	Income shock (%)	Households (number)
Chikwawa	3.6	189.2	92.0	95.9	115
Dowa	4.1	22.8	39.6	87.7	91
Lilongwe	3.8	50.8	56.7	88.2	201
Mangochi	4.2	49.9	74.3	91.5	179
Mchinji	3.6	52.1	51.9	89.9	187
Mulanje	3.5	128.0	87.6	95.1	106
Salima	3.7	50.3	56.0	92.1	111
Weighted Mean	3.8	72.6	64.7	91.1	990

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: The coping strategy severity score follows the standard Coping Strategies Index methodology (Maxwell and Caldwell 2008[s20.1]): for each set of food-based coping behaviors, households reported the number of days in the past seven days the behavior was followed (0–7), which was multiplied by a locally assigned severity weight for that behavior and summed up across behaviors. The resulting score has no fixed upper bound; higher values indicate more frequent and more acute coping, and comparisons are meaningful in relative terms across districts rather than against an absolute threshold. Household dietary diversity represents the number of food groups consumed by household members during the reference period; higher scores indicate a more diverse diet.

Other districts experienced slightly lower but still troubling levels of food stress. Mangochi (74.3%), Lilongwe (56.7%), Salima (56.0%), and Mchinji (51.9%) reported food shortages affecting more than half of the households, while income shocks were pervasive across all districts, affecting between 87.7% in Dowa and 92.1% in Salima. Even in Dowa, which

recorded the lowest coping strategy severity score and comparatively lower food shortage, income shocks were widespread, suggesting that stronger market integration does not fully shield households from climate and livelihood volatility.

These findings demonstrate that food insecurity across the study areas is systemic rather than localized, driven by repeated income shocks, climate variability, low productivity, and limited household buffering capacity. The concentration of severe food stress in districts such as Chikwawa and Mulanje highlights areas where vulnerability is particularly acute and where resilience deficits are most pronounced.

Importantly, the persistence of food insecurity even in districts with relatively stronger market participation or higher crop productivity suggests that food security outcomes are shaped by broader interactions between production, income stability, market access, and climate resilience. Earlier chapters showed that many households are already participating in agricultural production and adopting selected technologies, yet food insecurity is widespread.

This strengthens one of the central findings of the baseline: improvements in agricultural production alone may not automatically translate into stronger food security outcomes unless the underlying instability in water access, income generation, and livelihood stability is also addressed.

The baseline therefore provides an important reference point for tracking whether future interventions are associated with improved dietary diversity, lower reliance on negative coping strategies, and reduced food shortages over time, while recognizing that these outcomes are influenced by broader economic and climatic conditions beyond individual interventions alone.

8.2 Sources of food

Across all districts, households relied primarily on a combination of own agricultural production and market purchases as their main sources of food, indicating partial self-provisioning alongside strong exposure to cash income and food price dynamics (Table 8.2). Own production contributed to household food consumption, ranging between 67.8% of households in Chikwawa to 90.9% in Mchinji, underscoring the continued centrality of smallholder agriculture for food access. At the same time, dependence on markets was high across all districts, reaching 94% in Lilongwe, 91.9% in Salima, and approximately 89% in Dowa, Mangochi, and Mchinji.

This dual reliance on own agricultural production and market purchases highlights an important structural feature of rural food systems. Even households that produced food were heavily dependent on cash income to meet consumption needs, particularly during lean seasons, periods of production shortfalls, or when dietary needs extend beyond staple crops.

Social networks also played an important supporting role in household food security. Between 10 and 18% of households across districts reported receiving food from relatives, with the highest reliance observed in Mchinji (18.2%) and Lilongwe (16.4%). These informal support systems help households cope during periods of shortage but may become increasingly fragile when shocks affect entire communities simultaneously.

In contrast, reliance on formal safety nets was limited. Food aid and food for work programs contributed to food access in only a small proportion of households, with slightly higher incidence in Chikwawa and Lilongwe and a minimal presence elsewhere. Other food sources were negligible across all districts, suggesting that households have relatively few alternative buffers when production and income systems fail.

Table 8.2 Main food sources of the households by district

District	Own production (%)	Market purchases (%)	Relatives (%)	Food aid (%)	Food for work(%)	Other sources (%)
Chikwawa	67.8	60.0	12.2	6.1	6.1	0.9
Dowa	86.8	89.0	13.2	0	2.2	0
Lilongwe	87.6	94.0	16.4	3.5	8.0	0
Mangochi	89.4	88.8	15.1	0.6	3.4	0
Mchinji	90.9	88.8	18.2	2.1	4.8	0
Mulanje	76.4	80.2	10.4	1.9	0.9	0
Salima	83.8	91.9	11.7	0	1.8	0.9

Source: Authors, WASA Malawi baseline survey, 2024/25.

The combination of own production and strong market dependence has important implications for resilience under climate stress. While households continue to produce food, their reliance on markets exposes them to income shocks, food price volatility, and seasonal cash shortages. This aligns closely with earlier findings showing high rates of income shocks and widespread food shortages across multiple districts.

In districts such as Chikwawa and Mulanje, where own production was important but food shortages are widespread, disruptions to agricultural production or income streams can quickly translate into reduced food access. Conversely, districts with very high market dependence, such as Lilongwe and Salima, may be particularly vulnerable to income instability and food price fluctuations even when production systems appear relatively diversified.

These findings reinforce an important baseline conclusion: food security challenges are not driven solely by low production. They are also shaped by unstable income flows, seasonal market dependence, limited formal safety nets, and weak household buffering capacity.

The baseline therefore highlights the importance of understanding food security through a broader livelihoods lens that connects production systems, income stability, market access, and climate resilience rather than viewing food availability alone as the primary constraint.

Chapter 9. Markets, Finance, and Extension

9.1 Financial inclusion and credit

The findings revealed severe and widespread financial exclusion across nearly all productive investment categories, confirming that access to finance remains one of the most binding constraints facing farming households (Table 9.1).

Demand for credit was particularly high for core agricultural inputs such as fertilizer (51.5% of households) and seed (40.0%), yet actual access was extremely limited. Only 14.7% of households seeking fertilizer credit could obtain it, while just 11.6% of households seeking seed credit successfully accessed financing. This left credit gaps of 85% (fertilizer) and 88% (seeds) for two of the most basic productivity-enhancing inputs.

These findings suggest that many farmers are willing to invest in productivity-enhancing technologies but are constrained by limited liquidity and weak financial access.

Table 9.1 Financial inclusion by district

Credit type	Farmers requesting credit	Share of households (%)	Credit access rate (%)	Credit gap (%)
Seeds	380	40.0	11.6	88.4
Fertilizer	490	51.5	14.7	85.3
Herbicides/pesticides	165	17.4	1.2	98.8
Farm equipment	220	23.1	0.9	99.1
Livestock investment	244	25.7	2.0	98.0
Irrigation investment	181	19.0	0	100.0
Aquaculture investment	11	1.2	0	100.0
Nonfarm business	284	29.9	9.2	90.8
Land purchase	137	14.4	0	100.0
Food purchase	306	32.2	16.0	84.0

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Farmers requesting credit is a count (total households surveyed = 997); share of households (%) is this count as a share of all surveyed households; credit access rate (%) is the share of those who requested a given credit type and successfully obtained it; credit gap (%) is 100 minus the credit access rate, representing unmet demand among households that requested that credit type.

Credit access was even more constrained for productive assets and long-term investments. Virtually no households were able to access credit for irrigation equipment, land purchase, aquaculture, or farm equipment, with access rates at or near 0 and credit gaps exceeding 99%.

This complete exclusion from medium- and long-term finance limits households' ability to make transformative investments that could reduce exposure to low productivity and high-risk farming systems.

Similarly, access to livestock credit was extremely limited at only 2%, despite more than a quarter of households expressing demand. This strengthens earlier findings that livestock often functions as a coping asset rather than a pathway for productive expansion.

Credit access for non-farm enterprises was slightly higher but limited. Nearly 30% of households sought credit for Credit access nonfarm businesses, yet only 9.2% successfully obtained financing.

Even credit for food purchases, which reflects distress borrowing rather than productive investment, showed a credit gap of 84% (Table 9.1). This suggests that households often struggle to smooth consumption during shocks through formal financial systems.

These financial patterns help explain several constraints identified elsewhere in the baseline. Extremely limited access to irrigation finance aligns with earlier findings on low irrigation adoption. Limited access to equipment finance helps explain weak mechanization levels, while restricted access to seasonal credit contributes to low input intensity and unstable productivity outcomes.

The complete absence of irrigation financing was particularly notable given earlier findings that water access is one of the most important productivity constraints across districts. This suggests that barriers to irrigation expansion are not solely technical or environmental but also strongly financial.

The baseline therefore suggests that future scaling efforts may need to consider how financing barriers interact with water access, technology adoption, and broader livelihood constraints, particularly for poorer households that may struggle to self-finance productive investments.

Gender disaggregated credit data also suggest that financial exclusion affects both female- and male-headed households, particularly for long-term productive investments. However, any stronger gender-specific conclusions should be interpreted alongside the underlying gender data tables to ensure consistency with observed borrowing patterns.

The gender disaggregated credit data showed that financial exclusion affected both female- headed and male-headed households across nearly all investment categories. Demand for credit was consistently high among both groups, yet actual access was extremely limited, particularly for long-term productive investments.

Table 9.2 shows substantial unmet credit needs among both female-headed and male- headed households. Among female-headed households reporting a need for credit, access was particularly limited for fertilizer, seeds, farm equipment, irrigation, and livestock investment. Only 10.2% of those needing fertilizer credit and 8.7% of those needing credit for seeds obtained it, while reported access to credit for irrigation investment, land purchase, and aquaculture investment was zero.

Table 9.2 Gender-credit gap

Credit type	Female-headed households who needed (%)	Female-headed households who got (%)	Female gap (%)	Male-headed households who needed (%)	Male-headed households who got (%)	Male gap (%)
Aquaculture investment	0.4	0	100.0	1.4	0	100.0
Farm equipment	24.4	1.7	98.3	22.7	0.6	99.4
Fertilizer	49.6	10.2	89.8	52.2	16.1	83.9
Food purchases	29.4	17.1	82.9	33.1	15.7	84.3
Herbicides/pesticides	16.8	2.5	97.5	17.5	0.8	99.2
Land purchase	10.5	0	100.0	15.7	0	100.0
Irrigation investment	16.8	0	100.0	19.8	0	100.0
Livestock investment	21.4	2.0	98.0	27.1	2.1	97.9
Nonfarm business	29.0	7.2	92.8	30.2	9.8	90.2
Seeds	38.7	8.7	91.3	40.4	12.5	87.5

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Needed (%) is the share of all female-headed and male-headed households; got (%) and gap (%) are the share of households that reported needing that credit type, consistent with the credit gap convention in Table 9.1 (gap = 100 minus got).

Male-headed households faced acute financing constraints. Among those reporting a need, only 16.1% obtained credit for fertilizer, 12.5% for seeds, 2.1% for livestock investment, and 0.6% for farm equipment, while no credit was obtained for irrigation investment or land purchase. Overall, the results indicate that financial exclusion is widespread among both female-headed and male-headed households, particularly for productive investments.

However, the implications differ. Earlier chapters showed that female farmers often demonstrated strong adoption of fertilizer, intercropping, and soil conservation practices, yet productivity gaps frequently persisted. Limited access to finance for irrigation, equipment, and complementary investments explains why adoption does not always translate into stronger productivity outcomes for women.

The complete absence of irrigation finance for both female- and male-headed households is particularly significant given earlier findings that water access was a major productivity constraint across districts. This suggests that barriers to irrigation expansion are not simply technical, but also deeply financial.

More broadly, the findings reinforce a central conclusion of the baseline: improving agricultural resilience requires an understanding of how financial access interacts with water access, technology adoption, and broader structural inequalities that shape household investment capacity.

9.2 Main credit sources and unmet needs

Table 9.3 shows that formal financial institutions played an almost negligible role in rural credit access across all districts. Commercial banks were virtually nonexistent as a source of credit, with only Mulanje (0.9 %) reporting bank-based borrowing.

Farmer cooperatives and microfinance institutions reached only a very small proportion of households, typically below 1% in most districts. Even where present, such as in Mulanje for cooperatives (2.1%) and Mangochi for microfinance (0.8%), their contribution to household credit needs was extremely limited.

This confirms that most rural households operate largely outside formal and semiformal financial systems despite a strong demand for agricultural and livelihood investment credit.

In the absence of formal finance, households rely primarily on informal credit sources, although even these are limited in scale. Moneylenders were most prominent in Mulanje (2.6%), Salima (1.1%), and Dowa (1.3%), while borrowing from relatives and neighbors played a somewhat larger role in Mulanje (1.3%), Chikwawa (1.0%), and Mangochi (0.8%).

Savings groups emerged as the most consistently used credit channel across districts, reaching 1.6% of households in both Chikwawa and Mangochi, 1.0% in Lilongwe, and between 0.6 and 0.9% elsewhere.

Although savings groups were limited in overall scale, they were more widely accessed than formal financial institutions and appear to represent one of the few functioning financial mechanisms currently available in rural communities.

Table 9.3 Main credit sources by district

District	Bank	Farmer cooperative	Micro finance	Money lender	Other	Relative/ neighbor	Savings group
Chikwawa	0	0	0.6	0.3	0.2	1.0	1.6
Dowa	0	0.4	0	1.3	1.9	0	0.4
Lilongwe	0	0.8	0.6	0.2	0.8	0.3	1.0
Mangochi	0	0	0.8	0.3	0.8	0.8	1.6
Mchinji	0	0.4	0.8	0.5	0.5	0.4	0.7
Mulanje	0.9	2.1	0.2	2.6	0.5	1.3	0.6
Salima	0	0.5	0.2	1.1	0	0.5	0.9

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Figures show the percentage of all surveyed households in each district that used each credit source; households may have used more than one source, so rows do not necessarily add up to the total share of households with any credit access.

The dominance of informal and community-based credit sources, combined with the near absence of banks and microfinance institutions, suggests that financial exclusion is deeply structural rather than temporary across the study areas.

This finding helps explain why households continue to face major barriers to investing in irrigation, farm equipment, improved inputs, and business diversification, despite strong demand for such investments.

The limited but relatively broader presence of savings groups is particularly notable because it highlights the importance of locally-embedded financial mechanisms in contexts where formal financial systems are weak.

More broadly, these findings reinforce an important baseline conclusion: productivity constraints are not solely technical. They are also shaped by weak rural financial systems that limit households' ability to invest in technologies, absorb shocks, and pursue long term livelihood improvements.

9.3 Extension and training access

The findings revealed an important contrast between relatively high awareness of conservation agriculture practices and much weaker access to climate information across several districts (Table 9.4).

Awareness of conservation agriculture was consistently high, ranging from 72.2% in Chikwawa to 83.9% in Mangochi. This suggests that most households are already familiar with core soil and water management practices promoted through previous government, nongovernmental organization (NGO), and development partner interventions.

Conservation agriculture implementation rates were also relatively high in several districts. Mangochi recorded the highest (91.5%), followed by Dowa (88.9%), Lilongwe (81.4%), and Salima (75.6%). These findings reinforce earlier results showing that many households were already practicing basic soil and water conservation measures prior to WASA implementation.

Mchinji presents an important contrast. While conservation agriculture awareness was relatively high at 77%, implementation was 56.1%, suggesting that knowledge does not always translate into adoption. This may reflect labor constraints, limited complementary inputs, or weaker follow up support.

Table 9.4 Extension, training, and climate information access by district

District	Conservation agriculture awareness (%)	Conservation agriculture implemented (%)	Weather information awareness (%)	Weather information used (%)	Main channels
Chikwawa	72.2	65.4	20.0	100.0	Extension officers, lead farmers
Dowa	78.9	88.9	24.6	92.9	Extension officers, lead farmers
Lilongwe	72.9	81.4	9.8	84.6	Extension officers, lead farmers
Mangochi	83.9	91.5	16.1	88.9	Lead farmers, extension officers
Mchinji	77.0	56.1	4.3	33.3	Extension officers, lead farmers
Mulanje	83.3	72.0	43.3	69.2	Extension officers, lead farmers
Salima	73.2	75.6	7.3	100.0	Extension officers, lead farmers

Source: Authors, WASA Malawi baseline survey, 2024/25.

Awareness of weather information services was considerably lower and varied sharply across districts. Mulanje recorded the highest level of awareness (43.3%), while awareness was extremely low in Mchinji (4.3%), Salima (7.3%), and Lilongwe (9.8%). This suggests that while farmers may be familiar with production practices, access to climate forecasting and early warning information was unequal.

Among households that did receive weather information, utilization rates were generally high. In Chikwawa and Salima, all households that received weather information reported using it, while usage rates were also high in Dowa, Lilongwe, and Mangochi. Mchinji again stood out as an outlier, where both awareness and usage were considerably lower.

The dominance of extension officers and lead farmers as the primary communication channels highlights the continued importance of localized advisory systems in translating technical information into farm-level decisions.

At the same time, the relatively low awareness of weather information services suggests that climate advisory systems are underdeveloped relative to the scale of climate risks documented earlier in the baseline.

These findings reinforce an important baseline conclusion: technology awareness alone is not enough. Households also require timely, accessible, and actionable climate information to make effective production decisions under increasingly volatile weather conditions.

Chapter 10. Consortium Partners

10.1 Total LandCare WASA intervention districts

Table 10.1 presents patterns of sustained adoption of soil and land restoration practices, defined as their continuous use for two years or more, across the four districts where Total LandCare operates. The findings provide important insights into which practices households have been able to maintain over time prior to full WASA implementation.

Overall, the results showed that organic fertility management practices dominated long-term restoration efforts, while more structural and system transformative practices exhibited lower levels of sustained adoption. This suggests that households are more likely to maintain practices that are relatively low cost, locally accessible, and compatible with existing labor and resource constraints.

Across all districts, manure or compost application was by far the most consistently sustained practice, with particularly high adoption in Lilongwe (77.3%), followed by Mchinji (57.0%), Salima (54.7%), and Dowa (52.3%). This indicates strong farmer recognition of declining soil fertility and the importance of organic nutrient management in maintaining productivity under rainfed systems.

The high sustained use observed in Lilongwe may reflect stronger historical extension support, greater access to livestock manure, or higher land pressure that necessitates continuous soil nutrient replenishment.

Table 10.1 Percentage of households using selected soil and land restoration practices continuously for two years or more in TLC districts

Restoration practice	Dowa	Lilongwe	Mchinji	Salima
Agroforestry	22.7	11.7	15.4	12.6
Crop rotation	6.8	3.1	12.8	17.9
Manure or compost application	52.3	77.3	57.0	54.7
Mulching / minimum tillage	6.8	3.1	12.1	7.4
Soil bunds or terraces	11.4	4.9	2.7	7.4

Source: Authors, WASA Malawi baseline survey, 2024/25.

Adoption of agroforestry practices showed moderate but uneven levels across districts. Dowa recorded the highest sustained agroforestry use (22.7%), followed by Mchinji (15.4%), Salima (12.6%), and Lilongwe (11.7%). These figures suggest that while agroforestry is emerging as a long-term restoration pathway, a minority practice it. This likely reflects barriers such as delayed returns, labor requirements, and land tenure uncertainty.

The adoption of crop rotation exceeded 10% only in Salima (17.9%) and Mchinji (12.8%), while being relatively limited in Dowa and Lilongwe. Similarly, mulching and minimum tillage showed sustained use mainly in Mchinji (12.1%), with much lower adoption elsewhere. These patterns suggest that conservation practices requiring consistent residue management and long-term behavioral shifts may face practical constraints related to labor availability, competing uses for crop residues, and household risk preferences.

Structural measures such as soil bunds and terraces were also relatively limited across districts, suggesting that practices requiring greater upfront labor or collective coordination may face additional adoption barriers.

As a whole, these findings indicate that farmers are already sustaining certain restoration practices that align with existing livelihood realities, particularly organic fertility management.

At the same time, lower sustained adoption of agroforestry, crop rotation, structural conservation, and conservation agriculture components highlights important constraints affecting long term transformation pathways.

10.2 Irrigation access and governance

Irrigation access was limited across all Total LandCare districts, with most households continuing to rely primarily on rainfed production (Table 10.2). Irrigation use was highest in Lilongwe (43.8%) and Mchinji (40.4%), followed by Dowa (36.3%), while Salima recorded substantially lower irrigation access (11.7%).

These differences may reflect variations in local hydrology, infrastructure availability, historical investments, and access to suitable water sources. Overall, however, the findings indicate that irrigation has not yet reached a scale sufficient to substantially reduce household dependence on rainfall variability. They reflect broader national irrigation challenges. Malawi's national policy documents estimate that the country has irrigation potential of approximately 407,000 ha, yet only about 104,000 to 120,000 ha have historically been developed for irrigation (Government of Malawi 2021; Government of Malawi 2023a). This indicates that large portions of Malawi's irrigation potential is underutilized, leaving most smallholder households heavily dependent on rainfed agriculture. While irrigation access in districts such as Lilongwe and Mchinji appears relatively higher than expected, overall access is insufficient to meaningfully reduce climate related production risks across WASA target areas.

Table 10.2 Irrigation access and governance in TLC districts (%)

Indicator		Dowa	Lilongwe	Mchinji	Salima
Uses irrigation	Yes	36.3	43.8	40.4	11.7
	No	63.7	56.2	59.6	88.3
Shared irrigation scheme	Yes	6.1	20.5	19.7	7.7
	No	93.9	79.5	80.3	92.3
Irrigation rules in place	Yes	0	38.9	53.3	100.0
	No	50.0	27.8	13.3	0
Water shortage experienced	Yes	18.2	25.0	30.3	30.8
	No	27.3	56.8	38.2	46.2
Water conflict experienced	Yes	7.7	12.4	6.4	8.1
	No	92.3	87.6	93.6	91.9

Source: Authors, WASA Malawi baseline survey, 2024/25.

Note: Some indicators may not add up to 100 % due to nonresponses or because questions applied only to households currently using irrigation.

Where there was irrigation, it was predominantly individually managed rather than organized through formal shared schemes. Shared irrigation systems were reported by only 6.1% of households in Dowa, 7.7% in Salima, and approximately 20% in Lilongwe and Mchinji. This suggests that collective irrigation infrastructure is underdeveloped, with many households relying on small scale and often informal irrigation arrangements.

Governance arrangements varied considerably across districts. Salima stood out with universal reporting of irrigation rules among existing users, despite relatively low irrigation participation. In contrast, Dowa reported no formal irrigation rules, while Lilongwe and Mchinji showed partial governance coverage.

These differences suggest that governance systems may emerge unevenly depending on local water pressure, scheme structure, and institutional history rather than through a standardized model.

Water stress within existing irrigation systems was already evident. Between 18 and 31% of households reported experiencing water shortages, with the highest incidence reported in Mchinji (30.3%) and Salima (30.8%), followed by Lilongwe (25.0%).

This suggests that even households with irrigation access may face unreliable water supplies due to seasonal variability, limited storage infrastructure, and competition over available water resources.

Reported water conflicts were relatively low across all districts, affecting fewer than 13% of households. However, their presence, particularly in Lilongwe and Salima, may signal emerging pressure points as irrigation demand increases.

These findings reinforce an important baseline conclusion: irrigation constraints are not limited to infrastructure access alone. They also involve questions of governance, reliability, institutional coordination, sustainable water allocation, and market access. While access to water infrastructure is necessary, farmers are unlikely to invest in irrigation technologies or intensify production where market opportunities are weak, prices are uncertain, or transaction costs are high. Evidence suggests that irrigation performance depends not only on the availability and management of water resources but also on the broader enabling environment that links production to profitable markets. Strengthening market access, value chains, and commercialization opportunities may therefore be as important as investments in irrigation infrastructure itself in ensuring sustainable adoption and long term returns from irrigation development.

10.3 Catholic Relief Services WASA implementation districts

The findings from CRS implementation districts provide important insights into the extent to which nutrition-sensitive agriculture and formal household support systems are already embedded within existing livelihood systems. In summary, the results indicate limited uptake of nutrition-sensitive agricultural practices alongside very low coverage of formal social protection support.

Across all three districts (Chikwawa, Mangochi, and Mulanje), fewer than a third of households reported maintaining home nutrition gardens. Adoption ranged from 26.1% in Chikwawa to 21.2% in Mangochi and fell further to 16.0% in Mulanje. These figures suggest that while nutrition gardens are present, they comprise a relatively small component of household livelihood strategies despite the widespread food insecurity and low dietary diversity documented earlier in the baseline.

Table 10.3 shows that exposure to nutrition related training was limited. Only 24.3% of households in Chikwawa, 22.3% in Mangochi, and 19.8% in Mulanje reported receiving nutrition training. This means that most households lacked structured support related to dietary diversification, nutrient dense food production, and nutrition-sensitive food preparation.

The relatively small difference between nutrition garden adoption and nutrition training coverage may also suggest that some households are engaging in nutrition related production activities without consistent technical guidance, which may limit long-term sustainability and effectiveness.

Table 10.3 Percentage of households reporting nutrition-sensitive agriculture practices, nutrition training, and social protection support in CRS district

Indicator		Chikwawa	Mangochi	Mulanje
Home nutrition garden	Yes	26.1	21.2	16.0
	No	73.9	78.8	84.0
Nutrition training received	Yes	24.3	22.3	19.8
	No	75.7	77.7	80.2
Social protection support	Yes	7.0	11.2	5.7
	No	93.0	88.8	94.3

Source: Authors, WASA Malawi baseline survey, 2024/25.

Access to formal social protection was extremely limited across all CRS districts, ranging from only 5.7% in Mulanje to 11.2% in Mangochi. In Chikwawa, only 7% of households reported receiving any form of social protection assistance.

These findings indicate that most households rely primarily on own production, market purchases, informal transfers, and household coping strategies rather than formal safety net systems when responding to food shortages and income shocks.

This is particularly important given earlier findings showing high food shortages, widespread income shocks, and severe coping behavior in the same districts. Chikwawa and Mulanje continued to emerge as districts where multiple vulnerabilities converge, including low dietary diversity, high food shortages, severe coping intensity, and weak formal support systems.

The findings point to a clear disconnect between the severity of household food insecurity and the reach of nutrition and social protection systems. Nutrition related interventions were relatively limited in scale, while formal safety nets appeared insufficient to function as reliable household buffers during periods of stress.

10.4 Early warning preparedness in CRS districts

The results showed moderate access to early warning information across CRS districts, combined with relatively strong responsiveness among households that received the warnings (Table 10.4).

Access to early warning systems varied across districts, with Mulanje reporting the highest coverage (56.6%), followed by Chikwawa (51.3%), while Mangochi recorded the lowest access (41.3%). These findings indicate that early warning systems are reaching a meaningful share of households, but they also show that between 43 and 59% of households are outside formal warning systems.

This leaves a substantial proportion of households exposed to climate shocks without timely access to risk information.

Table 10.4 Percentage of households receiving early warning information, taking action following warnings, and receiving climate-shock preparedness support in CRS districts

Indicator		Chikwawa	Mangochi	Mulanje
Early warning received	Yes	51.3	41.3	56.6
	No	48.7	58.7	43.4
Action taken after early warning	Yes	83.1	83.8	88.3
	No	16.9	16.2	11.7
Received climate shock preparedness support	Yes	29.6	24.6	25.5
	No	70.4	75.4	74.5

Source: Authors, WASA Malawi baseline survey, 2024/25.

Among households that did receive early warning information, the majority reported taking action in response. Action rates exceeded 83% across all three districts and reach 88.3% in Mulanje.

This suggests that households generally perceived early warning information as credible and useful and were willing to adjust behavior when timely information is available. Such responses may include changing planting decisions, protecting productive assets, conserving food supplies, or adjusting household spending.

The evidence therefore suggests that responsiveness is relatively strong among households that receive early warning information. The more significant challenge appears to be the limited coverage of early warning systems, with only 41.3 to 56.6% of households across the three districts reporting that they received early warning information.

In contrast, access to formal climate shock preparedness support was low across all districts. Fewer than a third of households reported receiving any preparedness support, with coverage ranging from 24.6% in Mangochi to 29.6% in Chikwawa. This indicates that many households relied primarily on self-initiated responses or informal coping strategies rather than structured preparedness mechanisms when anticipating climate shocks.

This finding is particularly important when viewed alongside earlier evidence of high food shortages, widespread income shocks, and severe coping behavior across these districts.

The combination of moderate early warning access, strong behavioral responsiveness, and weak preparedness support suggests that households may receive warning signals but often lack broader institutional support systems that help convert information into stronger resilience outcomes.

Chapter 11. Strategic Targeting

11.1 District typology and strategic targeting framework

The district profile score matrix synthesizes baseline conditions across six critical dimensions: productivity, adoption of climate-smart practices, food security, water access, market access, and inclusion. Scores ranged from 1 (very weak) to 5 (strong) and were used comparatively to highlight relative strengths, constraints, and opportunities across the seven WASA districts (Table 11.1).

These scores are not econometrically estimated indices. Rather, they are composite diagnostic scores derived from evidence presented throughout the baseline assessment, including productivity outcomes, technology adoption patterns, food security indicators, irrigation access, market participation, and gender inclusion dynamics. Their purpose is to simplify complex baseline evidence into an operational planning framework that distinguishes differing district conditions and implementation needs. The resulting typology should therefore be interpreted as a practical planning tool rather than a formal statistical classification.

The ratings were developed through a triangulation of the quantitative household survey with qualitative evidence from the district-level FGDs, consistent with the FGDs' purpose of generating insights that complement the quantitative data and inform project planning. For each dimension, relevant survey indicators and qualitative findings were reviewed together and districts were comparatively rated on an ordinal scale: productivity ratings considered observed yield and production patterns; adoption considered the prevalence and breadth of agricultural and soil and water management practices; food security considered dietary diversity, food shortages, coping behavior, and shock exposure; water access considered irrigation and water-source access together with reported reliability and infrastructure constraints from FGDs; market access considered market participation, commercialization patterns, and locally reported physical and institutional access constraints; and inclusion considered gender differences in access to productive resources, services, and technology adoption. The ratings are therefore comparative, evidence-informed classifications rather than mechanically calculated index scores, and should not be interpreted as absolute performance thresholds.

Since WASA builds on soil and water management practices that consortium partners were already promoting in these districts, the adoption dimension in particular reflects the reach of this prior platform as well as farmers' own practices. The typology therefore helps distinguish districts where existing promotion has taken hold most strongly from those where scaling investment is likely to have the greatest marginal effect.

Table 11.1 Districts' classification matrix

District	Productivity	Adoption	Food security	Water access	Market access	Inclusion
Chikwawa	1	3	1	2	2	1
Mulanje	1	2	1	1	1	1
Mangochi	3	4	2	2	2	5
Salima	3	3	2	1	3	3
Dowa	5	5	2	3	5	3
Lilongwe	3	5	2	3	5	1
Mchinji	3	4	2	3	3	3

Sources: Authors, based on WASA Malawi baseline survey and district-level FGDs, 2024/25.

Note: Red indicates weak performance (1–2), yellow indicates moderate performance (3), and green indicates relatively strong performance (4–5). Scores are comparative within study districts rather than absolute national benchmarks.

The score patterns revealed three broad district typologies reflecting differing levels of vulnerability, productive capacity, market integration, and resilience.

Typology I: Resilience recovery districts

Districts: Chikwawa and Mulanje

Chikwawa and Mulanje consistently recorded the weakest overall profiles across multiple dimensions. Both districts score lowest in productivity and food security, reflecting low yields, widespread food shortages, and severe livelihood stress. Market access and inclusion outcomes were also weak, while water access was constrained.

These patterns align closely with earlier findings showing high exposure to droughts, floods, income shocks, and heavy dependence on casual labor. Although Chikwawa demonstrated moderate adoption of selected agricultural practices, these adoption levels have not translated into stronger outcomes because of serious broader structural constraints. Agricultural systems in both districts were primarily oriented toward livelihood protection and risk management rather than commercial production.

Interventions in these districts should prioritize resilience building through water security investments, soil restoration, climate risk reduction, food security stabilization, and strengthening of basic productive assets.

Typology II: Diversification transition districts

Districts: Salima and Mchinji

Salima and Mchinji occupy an intermediate position, with most indicators clustering around moderate levels. Both districts demonstrated moderate productivity and adoption outcomes, suggesting productive potential, but continue to face important structural constraints related to food security, water access, and market participation.

Food security was poor in both districts, while water access was particularly constrained in Salima. Farming systems showed evidence of diversification, particularly through legumes and mixed production systems, but were vulnerable to climatic and economic shocks. These mixed outcomes suggest districts where productive potential exists but remains constrained by unresolved structural risks.

Interventions should focus on accelerating diversification through irrigation expansion, improved market linkages, value addition opportunities, and climate-smart production systems that enhance resilience while increasing incomes.

Typology III: Market-led growth districts

Districts: Dowa, Lilongwe and Mangochi

Dowa, Lilongwe, and Mangochi displayed comparatively stronger performance across several dimensions, indicating stronger productive foundations and greater market engagement. Dowa recorded the strongest overall profile, scoring high in productivity, adoption, and market access, consistent with earlier evidence showing stronger cash crop integration, relatively higher yields, and lower coping severity.

Lilongwe demonstrated particularly strong market integration and adoption performance, while Mangochi combined relatively diversified production systems with strong inclusion outcomes. Mangochi's high inclusion score reflected stronger female participation in production and technology adoption, while Lilongwe's lower inclusion score highlighted persistent gender and financial barriers despite stronger productive performance.

Although important challenges persist, particularly in food security and water access, these districts demonstrate greater potential for commercialization, agricultural intensification, and scaling of improved technologies.

Interventions should focus on scaling productivity gains, strengthening commercial value chains, expanding irrigation and mechanization, promoting agribusiness development, and improving inclusion outcomes, particularly for women and youth.

Across all typologies, food security and water access emerged as the most consistently weak dimensions, even where productivity and technology adoption performance appeared relatively strong. This confirms one of the central conclusions of the baseline assessment: adoption alone does not automatically translate into resilience. Broader structural constraints related to water reliability, food access, financial inclusion, and household vulnerability continue to shape outcomes across districts.

The typology highlights an important implementation lesson. While all districts require investments that strengthen resilience and productivity, the nature and sequencing of those investments should differ according to local conditions. Some districts were primarily focused on managing survival risks, others are transitioning toward diversification, while others demonstrated stronger foundations for commercial growth. This variation underscores the importance of tailoring technology packages and investment strategies to district-specific realities rather than applying a uniform intervention model across all implementation areas.

11.2 Priority technology packages

Table 11.2 highlights clear district-level differences in potential technology pathways, reflecting variations in cropping systems, land use intensity, climate exposure, water access, and market orientation identified throughout the baseline analysis.

These pathways should not be interpreted as finalized intervention packages. Rather, they represent indicative technology bundles derived from household survey evidence on production systems, asset ownership, climate exposure, water access, and market participation, and were further validated through district-level FGDs involving approximately 20 participants per district (typically 10 women and 10 men, except where otherwise noted). The focus groups provided important operational insights on infrastructure failures, local governance systems, labor constraints, community preferences, and implementation barriers that were not fully captured through household survey data alone. This combined evidence base strengthens the practical relevance of the proposed bundles.

In Chikwawa and Mulanje, maize is dominant while food security pressures are particularly severe. These districts also exhibited high climate vulnerability, weak water access, limited productive assets, and heavy reliance on casual labor. Mulanje additionally showed strong dependence on cassava as a food security crop. These structural conditions suggest farming systems that are currently oriented more toward household survival and risk management than commercial intensification.

The existing production environment in these districts appears more aligned with low-cost technologies focused on improving production stability, reducing climate exposure, protecting household food access, and rebuilding critical water and land management systems that communities identified as damaged or underperforming.

Mangochi, Salima, and Mchinji displayed stronger evidence of crop diversification.

Salima and Mchinji showed particularly strong land allocation toward legumes, while Mangochi demonstrated relatively diversified production systems combined with stronger female participation in production activities. These districts appear to have more diversified agricultural systems, although they continue to face important water, food security, and income constraints.

Dowa and Lilongwe displayed stronger signs of market integration. Both districts allocated substantial land to tobacco alongside maize and legumes, while also demonstrating stronger productivity outcomes, higher adoption levels, and relatively stronger market participation.

Lilongwe also showed relatively stronger asset ownership, broader extension reach, and more diversified income sources compared to several other districts. These characteristics suggest production systems with relatively stronger foundations for productivity expansion, although with important inclusion and water constraints.

Taken together, the baseline shows that districts are not starting from identical production conditions. Some districts are primarily managing survival risks, others are navigating transitions toward diversification, while others demonstrate stronger commercial potential.

This variation supports the importance of aligning future technology choices with district-specific production realities rather than assuming that a uniform package would be appropriate across all implementation areas.

Table 11.2 Recommended technology bundles by district

District	Recommended technology bundle	Baseline rationale	Current lead partner footprint	Implementation considerations
Chikwawa	Flood-resilient maize systems, drought-tolerant legumes, check dams, vetiver stabilization, rehabilitation of damaged irrigation / water systems, household soil moisture conservation	Universal maize dependence, severe food insecurity, high flood and drought exposure, weak water assets, high casual labor dependence, damaged water infrastructure	Catholic Relief Services	Prioritize restoration of water control systems before aggressive productivity expansion; focus on low-cost technologies that stabilize production for vulnerable households; FGD participants highlighted destroyed schemes, flooding, tool shortages, and weak extension support.
Mulanje	Cassava-maize resilient systems, slope stabilization, erosion control, treadle irrigation, tree restoration, soil fertility restoration	Small landholdings, severe food insecurity, annual flooding, erosion, river sedimentation, weak market access	Catholic Relief Services	Focus first on land stabilization and household resilience before commercialization. FGD findings highlighted annual flooding, poor roads, sedimentation, and demand for irrigation equipment.
Mangochi	Maize-legume diversification, selective irrigation expansion, riverbank stabilization, savings-linked input access, horticulture expansion	Diversified systems, stronger female participation, moderate productivity, recurring floods, river instability	Catholic Relief Services	Build on existing irrigation momentum and savings groups while protecting river systems and strengthening resilience to floods.
Salima	Legume intensification, irrigation expansion, climate information services, water harvesting, dry season production	Larger landholdings, strong legume concentration, water stress, seasonal vulnerability	Total LandCare	Strengthen the integration of weather information, irrigation planning, and market-oriented production.
Dowa	Maize-tobacco productivity systems, soil fertility restoration, efficient water use technologies, sustainable intensification	Strong market orientation, high productivity, large tobacco presence, stronger adoption levels	Total LandCare	Protect productivity gains while reducing soil degradation and strengthening long-term sustainability.

Lilongwe	Diversified maize-legume systems, input optimization, scale-appropriate mechanization, irrigation expansion, aggregation support	Strong market integration, stronger asset ownership, diversified incomes, higher adoption	Total LandCare	Mechanization should fit actual farm sizes and financing realities; focus on scaling commercially viable systems.
Mchinji	Legume commercialization, soil fertility restoration, selective irrigation expansion, aggregation and storage systems	High legume concentration, diversified production systems, moderate market potential	Total LandCare	Focus on productivity stabilization, market aggregation, and reducing seasonal water-related risks.

Source: Authors, based on WASA Malawi baseline survey and district-level FGDs, 2024/25.

The district-specific technology pathways reinforce the importance of moving away from uniform technology promotion toward more context-responsive delivery approaches. Although maize is central across nearly all districts, the type of support required differs significantly depending on climate exposure, water access, market orientation, asset ownership, and livelihood vulnerability.

In Chikwawa and Mulanje, the baseline consistently points toward systems where household food security stabilization is a central priority. In these districts, low-cost technologies that improve production stability and reduce climate exposure appear more closely aligned with current household realities.

In Salima, Mchinji, and Mangochi, stronger diversification patterns create opportunities for technologies linked to legumes, soil fertility improvement, and selective water access improvements, although persistent food security and income constraints are important considerations.

Dowa and Lilongwe demonstrated relatively stronger productivity, market participation, and asset ownership, suggesting greater readiness for more complex production systems and bundled innovation models. However, these districts still face major risks related to water reliability, inclusion gaps, and climate exposure.

The partner alignment presented in Table 11.2 reflects current implementation geography and comparative areas of operational presence rather than fixed implementation mandates. These allocations may evolve as implementation learning emerges.

Comprehensively, Table 11.2 should be interpreted as a transitional framework linking baseline diagnostics to potential implementation pathways. It reflects current production realities while recognizing that effective scaling will depend on resolving district-specific readiness constraints identified through both quantitative survey data and qualitative community consultations. Final implementation choices should therefore be adaptive and responsive to evolving field realities, partner learning, and ongoing MELIA evidence generation.

While Table 11.2 identifies long-term technology bundles that appear aligned with prevailing production systems, Table 11.3 highlights a second and equally important implementation reality: several districts face immediate structural constraints that may limit the effectiveness of technology scaling if these issues remain unresolved. These constraints emerged through the integration of household survey findings and district-level FGDs, which provided deeper insights into infrastructure failures, institutional bottlenecks, and operational barriers affecting adoption.

Table 11.3 Immediate readiness constraints and first response priorities

District	Binding constraint (survey evidence)	FGD validation (why this matters)	Immediate implementation priority
Chikwawa	Severe food insecurity, weak water assets, high climate exposure	FGDs reported destroyed water schemes, floods, droughts, livestock damaging conservation structures, and lack of tools	Rehabilitate water systems, flood control structures, check dams, vetiver stabilization
Mulanje	Small landholdings, severe food insecurity, erosion risk	FGDs highlighted annual flooding, sedimentation, poor roads, demand for treadle pumps	Watershed restoration, erosion control, small irrigation expansion
Mangochi	Moderate productivity with water constraints	FGDs showed irrigation potential, savings groups, riverbank degradation	Riverbank stabilization, irrigation strengthening, financial linkage support
Salima	Water constraints despite larger land sizes	FGD findings on water stress and seasonal vulnerability	Water access expansion and climate information integration
Dowa	Soil degradation risks in productive systems	Survey shows strong commercialization but sustainability risks	Soil fertility protection and sustainable intensification
Lilongwe	Scaling constraints in stronger systems	Larger asset base but mechanization/finance constraints	Scale-appropriate mechanization and finance models
Mchinji	Moderate productivity and water variability	Diversification potential but production instability	Irrigation stabilization and aggregation support

Source: Authors, based on WASA Malawi baseline survey and district-level FGDs, 2024/25.

In Chikwawa and Mulanje, evidence suggests that foundational resilience investments may need to precede broader productivity expansion. Both districts face severe food insecurity, recurrent climate shocks, and weak productive infrastructure. Focus group discussions in Chikwawa highlighted destroyed water schemes, repeated flooding, drought exposure, and shortages of basic conservation tools, while communities in Mulanje emphasized annual flooding, sedimentation, erosion, and weak road infrastructure that limits both market access and service delivery. In these districts, immediate investments in water rehabilitation, erosion control, and basic resilience infrastructure are likely to generate greater returns than prematurely scaling more complex productivity packages.

Mangochi presents a different pattern. While production systems are relatively more diversified, FGDs revealed persistent riverbank degradation alongside evidence of local savings groups and emerging irrigation practices. These findings suggest that strengthening physical water infrastructure while improving access to local financing mechanisms may accelerate existing diversification pathways.

In Salima, Dowa, Lilongwe, and Mchinji, the constraints become less about basic survival and more about improving efficiency, sustainability, and scaling readiness. These districts demonstrate stronger production potential but continue to face important barriers related to water reliability, mechanization access, productivity stabilization, and market coordination.

Table 11.3 validates one of the central findings of the baseline: districts are not underperforming because farmers lack awareness of agricultural technologies. In many cases, farmers are already adopting multiple practices. The larger challenge is that structural bottlenecks such as damaged infrastructure, weak service systems, limited financing, and environmental degradation often prevent these technologies from generating sustained productivity gains. Effective implementation will therefore require careful sequencing of investments by addressing foundational readiness constraints before attempting large scale expansion of more advanced technologies.

Chapter 12. Conclusion and Recommendations

The WASA Malawi baseline survey shows that smallholder agricultural systems across the target districts are constrained more by structural limitations than by gaps in technology awareness. Households farm small landholdings under high exposure to droughts, floods, and intraseasonal dry spells, with extremely limited control over water outside the main rainy season. Basic soil and water conservation practices are already widely adopted, but their effectiveness is undermined by degraded soils, weak water re-tention, damaged infrastructure, and limited irrigation access.

Food insecurity is a systemic outcome of these interacting constraints. It is driven by heavy reliance on own production, limited livelihood diversification, and widespread use of distress-coping strategies. Financial exclusion compounds these pressures by limiting households' ability to invest in irrigation, equipment, storage, and other productivity-enhancing technologies.

Gender disparities are similarly structural. Female-managed plots often show comparable or higher adoption of climate-smart practices; yet, productivity gaps persist because women have less access to land, labor, water, finance, and complementary assets. Closing these gaps therefore requires improving access to productive resources and services, not simply promoting technology uptake.

These constraints, however, exist alongside important foundations on which WASA can build. The differentiated district conditions established in Chapter 11, including differences in vulnerability, diversification, water access, market integration, and implementation readiness, provide the basis for sequencing the following recommendations: immediate actions to stabilize production, medium-term actions to strengthen productivity and service capacity, and long-term actions to address structural water, landscape, institutional, and inclusion constraints.

12.1 Immediate priorities: stabilize vulnerable production systems

In Chikwawa and Mulanje, priority should be given to practical, relatively low-cost measures that reduce production volatility: rehabilitating existing small water-access points where feasible; strengthening soil-moisture retention practices already in use; improving access to drought-tolerant maize and legume varieties; and protecting cassava productivity in Mulanje, where it performs an important food-security function. These measures should be accessible to resource-constrained households, including women farmers facing greater financial and labor constraints.

In Mangochi, Salima, Dowa, Lilongwe, and Mchinji, where diversification and market participation provide stronger foundations for production development, immediate efforts should concentrate on improving how existing advisory and extension systems translate climate information into farm-level decisions on planting, soil management, diversification, and seasonal risk management. In Salima and Mchinji specifically, early interventions should build on the existing legume base through better seed access, postharvest handling, and soil-fertility management rather than introducing entirely new production systems.

These priorities provide starting points based on baseline evidence and should be refined through implementation experience.

12.2 Medium-term priorities: strengthen productivity, services, and market integration

In Dowa and Lilongwe, diversified production systems, together with relatively stronger market integration and asset ownership, provide opportunities for testing integrated delivery approaches that combine technology access, financing, extension, and market coordination.

In Mangochi and Mchinji, selective expansion of small-scale water access may become viable where reliable water resources, market opportunities, and local management capacity justify investment. The baseline does not support indiscriminate irrigation expansion; investment should therefore target locations where enabling conditions are sufficiently strong.

In Salima, comparatively strong responsiveness to climate information provides an opportunity to deepen the practical use of weather and climate services for planting decisions and seasonal risk management.

Across Dowa, Mchinji, and Salima, productivity gains should increasingly connect to aggregation, storage, postharvest management, and existing market channels for legumes and selected horticultural crops. The emphasis should be on strengthening existing producer-buyer relationships rather than creating parallel market structures.

12.3 Long-term priorities: address structural constraints

Water reliability is crucial. Investment should go beyond physical infrastructure to strengthen water governance, watershed management, groundwater protection, maintenance arrangements, and irrigation development within sustainable hydrological limits. Infrastructure access alone is not sufficient where water availability, governance, and maintenance are weak.

In the most vulnerable landscapes, particularly Chikwawa and Mulanje, long-term resilience will also require landscape restoration through soil rehabilitation, watershed restoration, erosion control, and ecosystem-based approaches that support both agricultural productivity and environmental resilience.

A second structural priority is integrated service delivery. Households currently access extension, climate information, finance, and markets through channels that do not always reinforce one another. Water and soil investments are more likely to generate sustained returns when paired with extension support, appropriate finance, functioning local institutions, and market access. WASA should therefore increasingly treat these as components of an integrated system rather than isolated interventions.

Long-term system development should also address persistent gender inequalities in access to productive resources and services through more inclusive financing, labor-saving technologies, and stronger participation of women in water governance and market systems.

12.4 Implications for monitoring, learning, and adaptive management

The baseline establishes the reference point against which future WASA monitoring, evaluation and learning should assess change. Monitoring should distinguish between awareness, initial adoption, and sustained use, since high awareness does not necessarily translate into continued implementation or improved outcomes. It should also reflect district-specific pathways rather than judging all districts against the same intermediate outcomes.

Beyond household and production outcomes, monitoring should assess the effectiveness of delivery systems, including extension officers, lead farmers, radio, mobile communication, financial services, and market linkages. This will establish not only whether coverage has increased but also whether these services are contributing to sustained technology use and improved production outcomes. The monitoring framework should support adaptive management as climate conditions, markets, and farmer responses evolve, ensuring that implementation is responsive to district realities rather than converging on a uniform delivery model.

As a baseline assessment, the findings in this report describe conditions that predate WASA implementation and should not be interpreted as evidence of program impacts. As noted in Chapter 11, the adoption levels documented here reflect both the existing consortium platform and farmers' own prior practices. Taken together, the priorities set out above reinforce the central conclusion of the baseline: sustained resilience and productivity gains will depend less on introducing individual technologies than on strengthening the infrastructure, institutions, services, finance, and markets that enable existing technologies to work effectively together.

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