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From production to plate: strengthening legume utilisation in Malawi's food system

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In Malawi, legumes are widely cultivated but not consistently incorporated into routine diets. Drawing on a targeted evidence-informed narrative synthesis of Malawi-specific literature and carefully delimited comparative African evidence, this perspective argues that the gap between production and consumption is best understood as a food-systems problem rather than as a production problem alone. Groundnut (*Arachis hypogaea*), soybean (*Glycine max*), common bean (*Phaseolus vulgaris*), pigeon pea (*Cajanus cajan*), Bambara groundnut (*Vigna subterranea*), and cowpea (*Vigna unguiculata*) differ in food-system role, preparation requirements, nutritional contribution, and level of documentation in Malawi. Grain legume routine use is constrained when harvests leave the household food system through sale, when retained grains remain costly to prepare, when products are poorly aligned with staple-centred meals, and when consumers cannot repeatedly access safe, affordable, recognisable, and trusted legume foods. We identify four linked pathways for strengthening legume utilisation: retention or reacquisition for food, transformation into usable forms, integration into familiar meals, and reliable consumer access. These pathways clarify how agricultural availability can be converted into repeated dietary use and point to a policy agenda that links processing, culinary adaptation, quality assurance, and market development to Malawi's staple-centred diets and evolving food environments.

KEYWORDS

culinary integration, dietary diversity, legume utilisation, preparation burden, product forms, staple integration

1 Introduction

Legumes are important components of healthy and sustainable diets because they provide plant protein, dietary fibre, essential micronutrients, and bioactive compounds while complementing cereal-based diets by improving protein quality and meal nutrient density (Foyer et al., 2016; Mudryj et al., 2014; Rebello et al., 2014). Their relevance is especially pronounced in sub-Saharan Africa, where diets remain heavily reliant on staple cereals, roots and tubers; hence improving diet quality is a central nutrition challenge. In Malawi, this challenge is shaped by the continued dominance of maize-based meals and by constrained dietary diversity amongst many households (Koppmair et al., 2017; Mkwambisi et al., 2023). Protein supply and essential amino acid balance, including lysine and methionine, remain especially limited amongst

poorer households partly because maize-based diets provide protein of limited quality (Muleya et al., 2022). Regular legume use is therefore a plausible route for improving meal quality, but its dietary contribution depends on whether legumes move beyond field production and market availability into foods that households can prepare, afford, trust, and consume repeatedly.

The legumes most consistently documented in Malawi's food system are groundnut or peanut (*Arachis hypogaea*), soybean (*Glycine max*), common bean (*Phaseolus vulgaris*), and pigeon pea (*Cajanus cajan*) (Gama et al., 2018; Tumeo et al., 2017; White and Crawford, 2016; Machinjili et al., 2025). Groundnut is used as flour, peanut butter, roasted or boiled nuts, and ingredients for sauces or relishes (Gama et al., 2018). Soybean is documented mainly through processed or blended forms, including soybean-fortified nsima, complementary foods, flour blends, textured soy pieces, soy milk, and oil (Kalumbi et al., 2019; Mtimuni et al., 2023; Chilungo et al., 2024; Mulenga, 2018). Common bean is a familiar dry grain used in household meals and purchased through urban open markets, while pigeon pea is especially important in southern Malawi as both a household food and a trade crop (Tumeo et al., 2017; Me-Nsope and Nankhuni, 2018; White and Crawford, 2016). Bambara groundnut (*Vigna subterranea*) and cowpea (*Vigna unguiculata*) are nutritionally relevant but less systematically documented in relation to current household food uses, market forms, and regional culinary practice in Malawi (White and Crawford, 2016).

The central policy concern is that legume production gains have not automatically translated into substantial improvements in household diet quality (Gelli et al., 2020; Matita et al., 2021; Matita et al., 2022). Annual legumes in central Malawi have been valued for soil fertility maintenance and food diversity, yet diversification remains shaped by species-specific and household-level constraints (Kamanga et al., 2014; Mhango et al., 2013). Whether an agricultural commodity becomes a routine food depends on market participation, commercialisation, product form, preparation burden, and wider food-environment conditions (Gelli et al., 2020; Koppmair et al., 2017; Matita et al., 2021). Widespread cultivation can therefore coexist with inconsistent household use when harvests are sold, traded, or exported, while the portion that remains in the household is still mainly available as raw grain requiring considerable time, fuel, labour, and culinary effort (Branca et al., 2021; Chinsinga and Matita, 2021; Me-Nsope and Nankhuni, 2018; White and Crawford, 2016).

This article examines why legumes in Malawi, despite being agronomically present, nutritionally valuable, and culturally familiar, are not consistently incorporated into routine diets. It applies a food-systems lens to the conversion of legumes from crops into foods, with attention to retention, processing, market form, culinary integration, and everyday conditions of use. The argument is organised around four linked questions: which legumes are documented in Malawi's food system and how they are used; which household-level barriers constrain repeated use; how food-environment and market conditions shape consumer access; and which production-to-plate pathways can convert agricultural availability into routine consumption.

2 Approach and evidence base

This article was developed as a targeted, evidence-informed narrative synthesis to explain why legumes that are agronomically

present in Malawi do not always become routine foods. To reduce subjectivity, the evidence was organised around four guiding questions: which legumes are documented in Malawi's food system; how they are prepared, processed, marketed, or consumed; which household and food-environment barriers limit routine use; and which conversion points can move legumes from production to repeated dietary use.

The literature base was assembled through targeted searches in Google Scholar, PubMed, Scopus, and Web of Science, supplemented by institutional and development repositories for Malawi-focused reports, theses, and working papers. Search terms combined geographic, commodity, and food-system terms, including Malawi, legume, pulse, groundnut, peanut, soybean, common bean, pigeon pea, Bambara groundnut, cowpea, food use, consumption, dietary diversity, complementary feeding, processing, value chain, market, cooking time, dehulling, aflatoxin, and food safety. Backward and forward citation tracking from key Malawi studies and food-system reports was used to identify additional relevant records.

Evidence was prioritised according to its proximity to the Malawian food system. Malawi-specific studies were used wherever they documented production, food use, preparation, processing, consumer choice, market channels, dietary diversity, complementary feeding, food safety, or policy context. Comparative African evidence was used only where Malawi-specific evidence was limited and only to illustrate transferable mechanisms, such as milling, dehulling, culinary diversification, and consumer-ready product development. Broader pulse and legume nutrition literature was used to support general claims about nutritional relevance and functional value, but not to infer Malawi-specific culinary practice.

The synthesis grouped evidence by commodity and food-system function, distinguishing documented Malawian food uses from evidence on production, trade, processing, preparation burden, consumer choice, food safety, and dietary relevance. Claims were treated as Malawi-specific only when supported by sources that directly examined Malawi. Where such evidence was limited, comparative African literature was used cautiously to identify plausible mechanisms for adaptation rather than to describe current Malawian practice. The final interpretation was built by comparing recurring barriers and enabling conditions across commodities and identifying the conversion points through which legumes are most likely to move from agricultural availability to repeated dietary use. Although not exhaustive, this approach provides a transparent basis for distinguishing evidence-supported claims from gaps requiring ethnoculinary, consumption, processing, and market research.

3 Household-level barriers to routine legume use

In Malawi, many legumes are stored or purchased as dried grains, which means that routine use often begins with sorting, soaking, and prolonged boiling. The preparation burden is especially clear for pigeon pea, where whole seeds cook slowly and dehulling substantially improves cooking feasibility, making processing a practical requirement for repeated use rather than a marginal convenience (Machinjili et al., 2025). Evidence on common bean consumption and complementary feeding in Malawi similarly indicates that convenience, cooking requirements, and preparation demands influence whether

legumes fit into everyday household practice (Tumeo et al., 2017; Geresomo et al., 2017).

These preparation demands are intensified in smallholder settings, where food preparation competes with agricultural work, childcare, fuel collection, and other domestic responsibilities (Anders et al., 2020). Soybean illustrates the importance of product form because its household food role in Malawi is documented much more strongly through processed or blended products than through direct whole-grain cooking (Kalumbi et al., 2019; Mulenga, 2018; White and Crawford, 2016). Nutrition education, dietary counselling, and recipe demonstration have improved dietary diversity and use of nutrient-rich foods, including legumes, but such interventions are more likely to be sustained when they are supported by forms that reduce preparation burden and fit household routines (Katenga-Kaunda et al., 2021; Kuchenbecker et al., 2017).

Household adoption also depends on sensory and practical attributes after preparation, including cooking quality, texture, taste, affordability, and perceived value. Groundnut consumption in Malawi varies by form, with peanut flour and peanut butter amongst the more preferred products (Gama et al., 2018). Common bean demand in Lilongwe is shaped by consumer choice, sourcing patterns, and household purchasing conditions rather than by physical availability alone (Tumeo et al., 2017). These examples indicate that household use depends not only on the presence of legumes, but on whether available forms are practical, familiar, affordable, safe, and easy to prepare repeatedly. Claims about stigma or low-status perceptions of legume grains should be treated cautiously because they are not yet clearly documented in Malawi-specific studies and are better used as comparative insights from broader sub-Saharan African literature (Headey et al., 2023; Noort et al., 2022).

4 Food-environment and market barriers to legume use

Legumes can be widely grown and traded yet still appear infrequently in everyday meals when they reach consumers in forms that are inconvenient or poorly aligned with routine food practices (Gelli et al., 2020; White and Crawford, 2016). In rural Malawi, food-market participation is positively associated with dietary diversity, but the dietary effects of value chains are indirect and mediated rather than automatic (Koppmair et al., 2017; Matita et al., 2021; Gelli et al., 2020). Production or market activity should therefore not be assumed to yield proportional increases in routine legume consumption unless value chains also support food retention, usable product forms, and reliable consumer access.

Malawian grain legumes function simultaneously as foods, cash crops, recycled seed and tradable commodities. Pigeon pea and groundnut are closely linked to commercial and export channels, while soybean has developed important market roles alongside its potential as a human food (Chinsinga and Matita, 2021; Dzanja et al., 2017; Me-Nsope and Nankhuni, 2018; White and Crawford, 2016). Where legumes are cultivated but not routinely eaten, part of the harvest may be absorbed into market channels rather than retained for home consumption. This is nutritionally consequential when household retention, domestic processing, and consumer-ready product development remain weak (Branca et al., 2021; White and Crawford, 2016).

The form in which legumes reach consumers is as important as the channel through which they move. In Malawi, many legumes still reach households mainly as raw grains or minimally transformed ingredients (Gelli et al., 2020; White and Crawford, 2016). Groundnut is consumed as flour, butter, roasted nuts, boiled nuts, and ingredients for sauces or relishes, and these forms shape both preference and frequency of use (Gama et al., 2018). Soybean becomes more usable when incorporated into blended flours, complementary foods, or fortified *nsima* than when left as a whole grain for direct cooking (Kalumbi et al., 2019; Mtimuni et al., 2023; Chilungo et al., 2024). Common bean use in Lilongwe is linked to open-market sourcing and household food choices, while pigeon pea remains less convenient in whole-seed form unless it is dehulled or otherwise processed (Tumeo et al., 2017; Machinjili et al., 2025). Legume utilisation therefore reflects crop-specific differences in processing, market channel, culinary role, and evidence status, as summarised in Table 1.

Food-environment dynamics are likely to become more important as Malawi's food system changes. Malawi's food-system profile points to shifts in food access and consumption (Mkwambisi et al., 2023), while broader work on the nutrition transition indicates that urbanisation and market integration increase the importance of convenience, processing, and time-saving food formats in dietary choice (Popkin, 2017). In this context, legumes that remain available mainly as raw grains face structural disadvantages compared with foods requiring less labour, fuel, and preparation time. Food-environment barriers therefore help explain why the presence of legumes in farming systems and markets does not automatically translate into routine consumption at the plate.

5 Pathways for strengthening legume utilisation

Strengthening legume utilisation in Malawi requires moving beyond production expansion to identify where crops are converted, or fail to be converted, into routine foods. Figure 1 presents a production-to-plate pathway in which dietary impact depends on four linked conversion points: retention or reacquisition for food, transformation into usable forms, integration into familiar meals, and reliable consumer access. These conversion points constitute pathways because they locate where change must occur, identify the mechanism through which agricultural availability becomes food, and clarify the institutional support needed to make repeated consumption possible.

Retention or reacquisition for food is the first conversion point because commercialisation can increase income without ensuring domestic consumption. Pigeon pea, groundnut, and soybean move through commercial processing or trade channels that may weaken direct household food use if consumption is not treated as an explicit objective within value-chain design (Chinsinga and Matita, 2021; Me-Nsope and Nankhuni, 2018; White and Crawford, 2016). Once legumes are retained or reacquired, transformation becomes central because raw crops must become usable food forms before they can enter routine meals. In Malawi, dehulling improves the cooking feasibility of pigeon pea, while hydrothermal treatment and blending make soybean more suitable for *nsima* and other food products (Kalumbi et al., 2019; Machinjili et al., 2025; Mtimuni et al., 2023). Comparative African evidence is useful at this point not as proof of Malawian practice, but because it demonstrates how decentralised milling, flour

TABLE 1 Legumes in Malawi’s food system: documented uses, nutritional framing, and evidence status.

Legume	Malawi-specific food-use evidence, nutritional framing, and evidence status	References supporting the claims
Groundnut/peanut (<i>Arachis hypogaea</i>)	Malawi-specific evidence documents use as peanut flour, peanut butter, roasted or boiled nuts, confectionery, and ingredients for sauces or relishes. The same evidence base also supports attention to aflatoxin and product-quality risks when groundnut products are promoted for wider consumption. Groundnut is nutritionally framed as an energy-dense oilseed legume, although this compositional point should not be read as a separate Malawi dietary-intake estimate.	Gama et al. (2018) ; Matumba et al. (2016) ; Gichohi-Wainaina et al. (2021)
Soybean (<i>Glycine max</i>)	Malawi-specific evidence documents soybean mainly through processed or blended foods, including soybean-fortified <i>nsima</i> , complementary foods, blended flours, textured soy pieces, soy milk, and oil. The cited studies support processed-food use and acceptability; they do not establish routine whole-grain household cooking as a major use pattern.	Kalumbi et al. (2019) ; Mtimuni et al. (2023) ; Chilungo et al. (2024) ; Mulenga (2018) ; White and Crawford (2016)
Common bean (<i>Phaseolus vulgaris</i>)	Malawi-specific evidence documents dry bean use as a purchased household food and meal accompaniment, with demand shaped by sourcing, affordability, consumer choice, and preparation requirements. Evidence on soaking and cooking time further supports the argument that preparation burden affects usability.	Tumeo et al. (2017) ; Munthali et al. (2022) ; Chilungo et al. (2024)
Pigeon pea (<i>Cajanus cajan</i>)	Malawi-specific evidence documents pigeon pea as both a household food and a trade crop, particularly in southern Malawi. Recent Malawi work also supports the claim that whole-seed cooking is demanding and that dehulling and related processing improve feasibility for routine use.	White and Crawford (2016) ; Me-Nsope and Nankhuni (2018) ; Machinjili et al. (2025)
Bambara groundnut (<i>Vigna subterranea</i>)	The Malawi-specific literature located for this synthesis is insufficient to characterise current preparation forms, frequency of consumption, market forms, or contribution to nutrient intake. Bambara groundnut is therefore treated as a documentation gap requiring ethnoculinary mapping rather than being described through regional evidence as if it were established Malawian practice.	White and Crawford (2016)
Cowpea (<i>Vigna unguiculata</i>)	The Malawi-specific literature located for this synthesis is too limited to support strong claims about current household dishes, market forms, or consumption frequency. Comparative West African cowpea dishes are used elsewhere in the manuscript only as examples of possible adaptation and not as direct evidence of Malawian practice.	White and Crawford (2016) ; Madodé et al. (2011) ; Akissoé et al. (2023)
Other less-documented legumes (<i>Mucuna pruriens</i> var. <i>utilis</i> ; <i>Lablab purpureus</i> ; <i>Vigna radiata</i> ; <i>Phaseolus lunatus</i> ; <i>Cicer arietinum</i>)	No strong Malawi-specific household food-use evidence was identified for these legumes in the literature used for this manuscript. They are retained as candidates for future mapping of local names, edible parts, preparation forms, nutrient contribution, seasonality, and market forms.	White and Crawford (2016)

The references column lists sources used to support the claims in each row. Comparative African or global sources are used only to illustrate transferable mechanisms or general nutritional relevance; they are not treated as direct evidence of Malawian culinary practice.

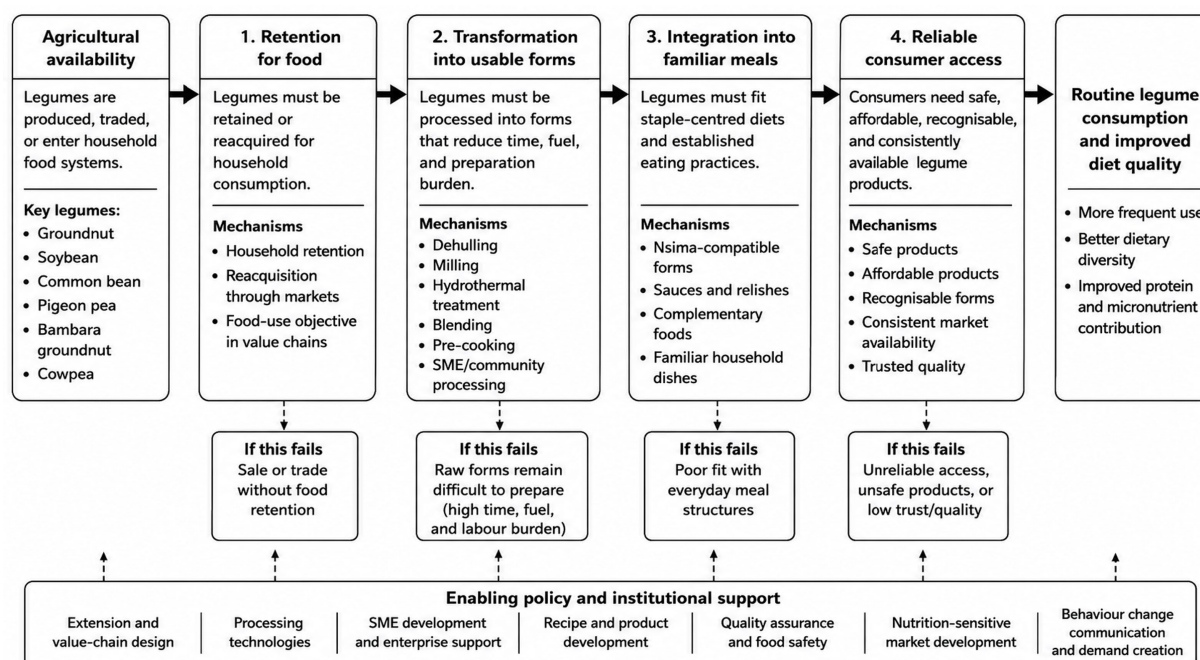


FIGURE 1

Production-to-plate pathway for strengthening legume utilization in Malawi.

production, complementary foods, and diversified recipes can reduce preparation barriers and broaden legume use (Phillips et al., 2003; Madodé et al., 2011; Akissoé et al., 2023).

The remaining conversion points concern dietary fit and repeated access. Legumes are more likely to become routine foods when they are incorporated into staple-centred meal structures rather than promoted as separate dietary additions. In Malawi, soybean-fortified nsima, groundnut forms used in sauces and relishes, and common bean dishes purchased for household meals show how legume use strengthens when it is anchored in familiar meals (Gama et al., 2018; Kalumbi et al., 2019; Tumeo et al., 2017; Mtimuni et al., 2023). Reliable consumer access then determines whether such use can be repeated. Complementary food formulation and SME-produced legume-based flour blends show how consumer-ready forms can support reliability, while groundnut illustrates the additional importance of food safety, product quality, and trust in processing and handling within increasingly commercialised markets (Chilungo et al., 2024; Ndovie et al., 2025; Gichohi-Wainaina et al., 2021; Matumba et al., 2016). Legumes can therefore contribute to diet quality only when they are retained or reacquired for food, transformed into usable forms, integrated into familiar meals, and supplied through reliable channels.

The production-to-plate logic links agricultural availability to routine dietary use through four connected conversion points: retention or reacquisition for food, transformation into usable forms, integration into familiar meals, and reliable consumer access (Figure 1). At each point, legumes may either move closer to repeated consumption or be lost from the pathway through sale without food retention, excessive preparation burden, poor fit with familiar meals, or unreliable access to safe, affordable, and trusted products.

The pathway is further developed in terms of implementation priorities and evidence gaps, including practical bottlenecks, priority actions, commodity areas where Malawi-specific evidence is strongest, and policy or research gaps requiring further attention (Table 2).

6 Strategic priorities for policy and research

The policy significance of this argument lies in how it redefines the problem. In Malawi, legume promotion has largely been valued for soil fertility, diversification, and income generation, all of which remain important (Kamanga et al., 2014; Mhango et al., 2013). Yet production-oriented policy remains incomplete where retention for food, transformation into usable forms, integration into staple-centred meals, and reliable consumer access are weak. The pathway logic in Figure 1 makes these conversion points visible and shows why legume policy should be judged not only by area planted, seed uptake, yield, or marketed volume, but also by whether legumes remain available for household food use, move into usable forms, fit everyday meals, and are consumed often enough to influence diet quality (Gelli et al., 2020; Matchaya and Guthiga, 2023; Mkwambisi et al., 2023).

The practical implication is that legume utilisation requires a linked set of food-system adjustments rather than a single intervention. Retention shifts attention from production and marketed volume to food-use outcomes. Transformation addresses the labour, time, fuel, and cooking burdens that prevent raw legumes from becoming routine foods. Integration ensures that legume products are compatible with Malawi's staple-centred meal patterns, while reliable consumer access links utilisation to safety, affordability, quality, trust, and repeated availability. The policy agenda is therefore to connect agricultural promotion with processing capacity, product development, food safety systems, SME support, behaviour-change communication, and nutrition-sensitive market development.

Research priorities should now move beyond whether legumes are grown to how they are retained, processed, cooked, combined, marketed, and consumed across regions and seasons in Malawi. Groundnut, soybean, common bean, and pigeon pea provide the clearest evidence on how retention, processing, market form, and meal

TABLE 2 Implementation priorities and evidence gaps for legume utilisation in Malawi.

Conversion pathway	Analytical issue in Malawi	Priority implementation actions	Evidence focus and remaining gap
Retention or reacquisition for food	Commercialisation can move legumes out of the household food system before they contribute to diets, especially where crops are treated primarily as cash or trade commodities.	Build food-use objectives into legume value-chain programmes, extension messages, school and community nutrition programmes, and market-development strategies. Promote household retention, planned sale-and-repurchase, and nutrition-sensitive use of income from legume sales.	Evidence is strongest for pigeon pea, groundnut, and soybean. More evidence is needed on the share of each legume retained, sold, reacquired, or consumed across seasons, regions, and wealth groups.
Transformation into usable forms	Many legumes reach households as raw grain, requiring time, fuel, labour, soaking, boiling, dehulling, milling, or specialised preparation skills before they can become routine foods.	Support decentralised dehulling, milling, pre-cooking, hydrothermal treatment, flour blending, textured products, and SME or community-level processing that reduce preparation burden and increase convenience.	Evidence is strongest for pigeon pea, soybean, common bean, and groundnut. More evidence is needed on cost, acceptability, shelf stability, nutrient retention, and scalability of community and SME processing models.
Integration into familiar meals	Legumes remain peripheral when they are promoted as separate dietary additions rather than adapted to staple-centred meal patterns and familiar household dishes.	Prioritise nsima-compatible products, sauces, relishes, complementary foods, snacks, blended flours, and other culturally recognisable forms. Recipe and product development should begin from existing Malawian food practices rather than from imported models.	Evidence is strongest for soybean, groundnut, and common bean. Ethnoculinary mapping remains weak for Bambara groundnut, cowpea, and less-documented legumes, including local names, dishes, preparation forms, and regional variation.
Reliable consumer access	Repeated consumption is constrained when legume foods are irregularly available, unaffordable, poorly packaged, unsafe, or insufficiently trusted by consumers.	Strengthen quality assurance, food safety systems, aflatoxin control, product standards, SME support, packaging, labelling, distribution, and behaviour-change communication for safe and affordable consumer-ready legume foods.	Evidence is strongest for groundnut, soybean, and legume-based flour blends. More evidence is needed on consumer trust, willingness to pay, quality signals, safety perceptions, and the market performance of legume-based products.

integration shape routine food use. By contrast, the household uses, preparation repertoires, and consumption frequency of Bambara groundnut, cowpea, and less common legumes remain insufficiently characterised. Ethnoculinary documentation should therefore record scientific and local names, edible parts, seasonal availability, preparation methods, cooking time, product forms, cultural meanings, and nutrient contribution. Comparative experience from West Africa remains useful because it shows how broader processing repertoires and stronger culinary integration can move legumes into routine diets, but the task for Malawi is to adapt that logic to local meal systems, market structures, food preferences, and quality expectations (Madodé et al., 2011; Phillips et al., 2003; Akissoé et al., 2023).

7 Conclusion

Legumes occupy an important but under-realised position within Malawi's food system. They are widely grown, nutritionally valuable, and culturally familiar, yet they remain inconsistently incorporated into routine diets because agricultural presence is repeatedly weakened before it becomes habitual consumption. Some legumes leave the household food system through sale, some remain in raw forms that are

difficult to prepare, some are poorly aligned with staple-centred meals, and some are not available in safe and reliable consumer-ready forms. Production-led policy is therefore incomplete unless it secures retention or reacquisition for food, transformation into usable forms, integration into familiar meals, and reliable consumer access. For Malawi, the practical question is not only how to produce more legumes, but how to ensure that legumes become foods that households can retain, prepare, trust, and consume often enough to improve diet quality.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

Author contributions

AM: Conceptualization, Formal analysis, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing.

LM: Writing – original draft, Writing – review & editing. AG: Writing – review & editing. DN: Data curation, Formal analysis, Writing – review & editing. TN: Writing – original draft. BM: Writing – review & editing.

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Conflict of interest

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