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Review Paper

Socio-economic constraints to legume adoption among smallholders

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ABSTRACT

Legumes play a crucial role in sustainable agriculture due to their ability to improve soil fertility, enhance dietary protein intake, and support environmentally sound farming systems. Despite these advantages, adoption of legume crops among smallholder farmers remains limited across many developing regions. This review synthesizes existing literature to examine the socio-economic constraints that shape smallholders' decisions to adopt or avoid legume cultivation. The evidence shows that low and unstable returns, high yield variability, limited access to credit and insurance, and weak market assurance significantly reduce the economic attractiveness of legumes. Institutional factors such as inconsistent procurement, cereal-focused subsidy regimes, and fragmented extension services further discourage adoption. Market-related challenges, including thin local markets, high price volatility, poor storage facilities, and limited processing infrastructure, amplify production risks. Social and behavioural dimensions, including risk aversion, gendered labour roles, and traditional crop preferences, also play a critical role in shaping adoption outcomes. The review highlights that the adoption gap is not primarily due to a lack of awareness or technical feasibility, but rather a result of misaligned economic incentives and institutional support systems. Strengthening market linkages, improving risk management mechanisms, and integrating legumes into broader agricultural planning and policy frameworks are essential for enhancing sustainable legume adoption among smallholders.

Key words: Adoption, Legumes, Markets, Policy, Aisk, Smallholders, Socio-economic constraints, Sustainable development goals

INTRODUCTION

Legume crops occupy a distinctive position in sustainable agricultural systems due to their contribution to soil fertility, dietary diversity, and environmentally sound farming practices. Through biological nitrogen fixation, legumes reduce dependence on synthetic fertilizers while supporting long-term soil health. They also provide a major source of plant-based protein, particularly for low-income populations in developing countries where diets are often cereal-dominated (FAO 2016).

Despite these advantages, adoption of legume crops among smallholder farmers remains limited across many regions. This persistent gap between agronomic potential and farm-level adoption has raised concerns among researchers and policymakers, especially in the context of sustainability and nutrition objectives. Traditional explanations have largely focused on technological constraints such as seed quality or yield performance. However, such perspectives do not fully capture the economic and institutional realities faced by smallholder households (Ekepu and Tirivanhu 2016).

Smallholders make cropping decisions under conditions of uncertainty, where income stability and risk reduction often take precedence over maximizing average returns. In such contexts, crop choices are shaped not only by productivity considerations but also by market access, policy support, and livelihood security. Agricultural policy frameworks that prioritize staple cereals through procurement, subsidies, and investment patterns further influence farmers' perceptions of relative crop attractiveness (Pingali 2015).

The limited adoption of legumes therefore, reflects a broader set of socio-economic constraints rather than a lack of awareness or technical feasibility. Weak market assurance, inconsistent

policy support, and limited risk-management mechanisms reduce the economic viability of legumes at the farm level. These factors interact with household characteristics and social norms to shape adoption outcomes over time (Ojiem *et al.* 2006).

To synthesize the diverse socio-economic factors influencing legume adoption, this review adopts a theoretical framework presented in Fig 1. The framework illustrates how policy and institutional factors, market and value-chain conditions, and household-level characteristics jointly shape farmers' perceptions of risk and income stability, ultimately influencing adoption decisions. By emphasizing feedback effects and behavioural responses, the framework provides a structured basis for reviewing empirical evidence on socio-economic constraints to legume adoption among smallholders (Vilakazi *et al.* 2025).

Against this backdrop, the present review examines the socio-economic constraints affecting legume adoption among smallholder farmers. By synthesizing evidence from empirical studies, policy analyses, and market assessments, the review seeks to move beyond technology-centric explanations and highlight the structural factors influencing farmer decision-making. Understanding these constraints is essential for designing policies and planning strategies that align sustainability goals with the economic realities of smallholder agriculture (Beye *et al.* 2022).

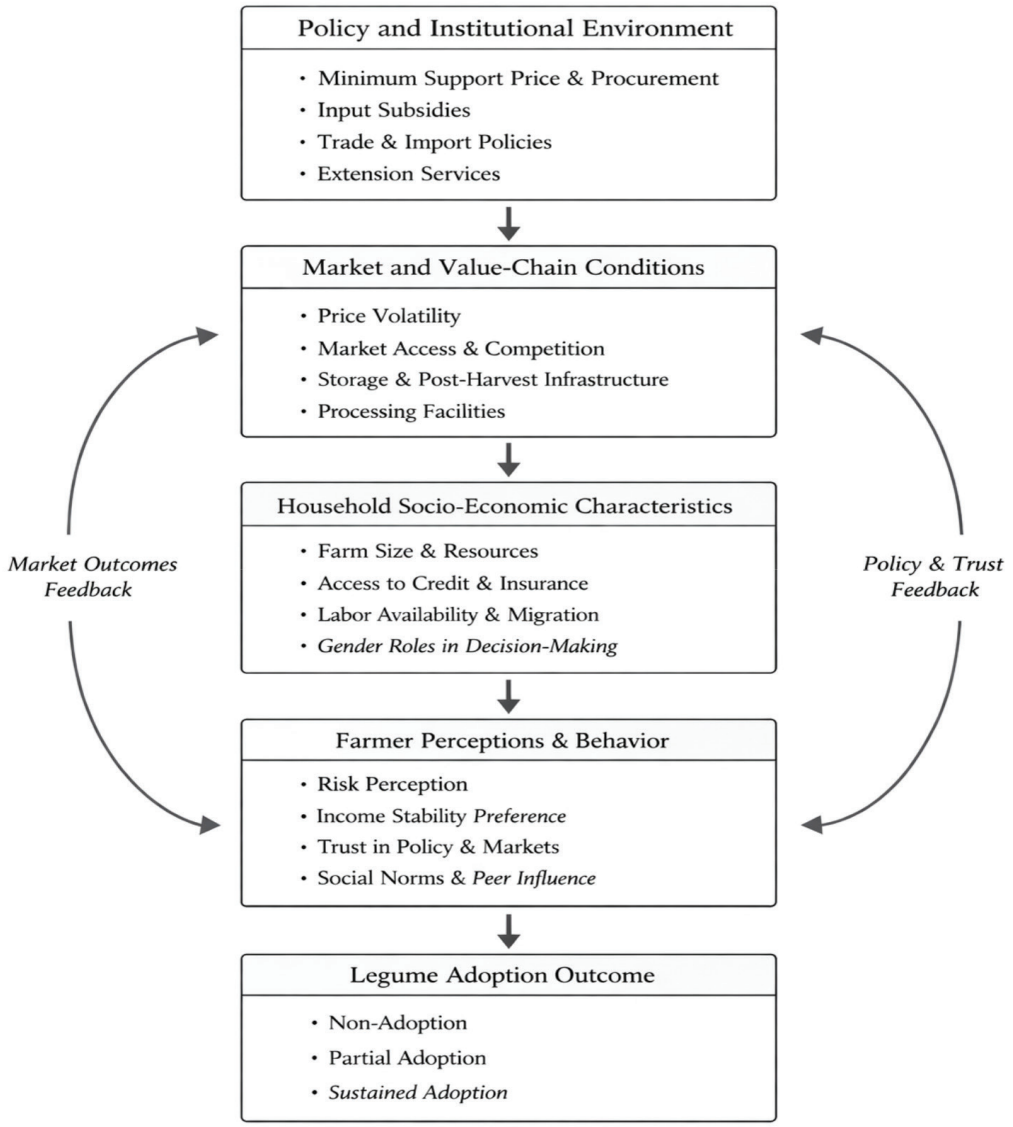

Fig 1. Theoretical framework explaining socio-economic constraints to legume adoption among smallholders.

SOCIO-ECONOMIC CONTEXT OF LEGUME FARMING AMONG SMALLHOLDERS

Smallholder farmers operate within complex socio-economic environments characterized by limited landholdings, high dependence on rainfall, and restricted access to capital and formal institutions. Under such conditions, farm households prioritize stability and risk minimization over maximizing output or profitability. Crop choice decisions are therefore closely linked to livelihood security and the ability to cope with economic shocks rather than to agronomic potential alone (Ellis 2000).

Legume crops are commonly integrated into diversified farming systems rather than cultivated as primary commercial crops. They are often grown as intercrops, rotational crops, or secondary seasonal options alongside cereals. While diversification can enhance resilience, legumes typically receive lower priority in terms of land allocation, input use, and labour investment (Dessalegn *et al.* 2022). This reflects smallholders' preference for crops with established production histories and more predictable outcomes, particularly in environments marked by climatic and market uncertainty (Dercon 2004).

From an economic perspective, smallholders evaluate cropping options based not only on expected returns but also on income stability over time. Legume cultivation is often associated with higher variability in yields due to sensitivity to rainfall fluctuations and pest pressure (Yap *et al.* 2017). In the absence of strong risk-mitigating mechanisms, such variability increases the perceived risk of legumes relative to cereals. Consequently, legumes are frequently allocated to marginal plots or grown on a limited scale, reinforcing low productivity and weak market participation (Birthal and Hazrana 2019).

Access to productive resources further shapes the socio-economic context of legume farming. Many smallholders face constraints in obtaining timely credit, quality seed, and insurance coverage, limiting their capacity to invest in crops perceived as risky. Labour availability also influences crop choices, particularly in households affected by seasonal or permanent migration. Crops requiring careful and timely management may be avoided when labour supply is uncertain, reducing the attractiveness of legumes in such settings (Ellis 2000).

Social norms and accumulated farming experience play an important role in reinforcing these economic considerations. Cropping patterns are often shaped by long-standing practices and collective learning within communities (Mhango *et al.* 2013). Deviating from established systems involves both economic and social risk, which discourages experimentation with alternative crops. As a result, legumes remain embedded in traditional roles within farming systems rather than being fully integrated into commercial production strategies (Dercon 2004).

Overall, the socio-economic context of legume farming among smallholders is defined by risk exposure, resource constraints, and livelihood priorities. These factors interact to limit the scale and intensity of legume cultivation, even when their agronomic and sustainability benefits are widely recognized. Understanding this context is essential for interpreting adoption behaviour and for designing interventions that align legume promotion strategies with smallholders' economic realities.

ECONOMIC CONSTRAINTS AFFECTING LEGUME ADOPTION

Economic considerations play a central role in shaping crop choice decisions among smallholder farmers, and legume adoption is strongly influenced by income risk and uncertainty. Smallholders typically operate under tight financial constraints, where even short-term income losses can have serious implications for household food security and debt obligations. As a result, crop choices are often guided by risk management considerations rather than by average profitability alone (Feder *et al*. 1985; Anderson *et al*. 1977).

Yield variability is one of the most commonly reported economic constraints affecting legume cultivation. Compared to major cereals, legumes are often more sensitive to rainfall variability, pest incidence, and soil moisture stress, particularly in rainfed systems (Mapiye *et al.* 2006). Empirical studies from India show that such variability increases production risk and reduces farmers' willingness to allocate better land and inputs to pulse crops (Birthal and Joshi 2007; Reddy 2009). For smallholders with limited savings or alternative income sources, exposure to yield shocks makes legumes a relatively risky choice.

Smallholder farmers evaluate crop choices not only in terms of average profitability but also in terms of income stability and exposure to risk. Although legume crops can offer competitive

returns, higher yield and price variability often increase perceived income risk (Das and Munshi 2025). This risk–return trade-off plays a central role in shaping legume adoption decisions, particularly among resource-constrained households (Odendo *et al.* 2011). The conceptual relationship between income stability and expected returns influencing legume adoption is illustrated in Fig 2.

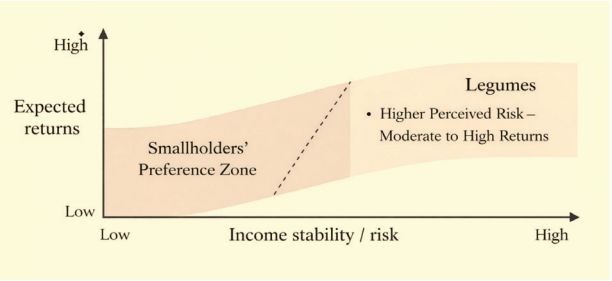

Fig 2. Conceptual representation of risk–return trade-offs influencing legume adoption among smallholders

Price uncertainty further compounds production risk. Pulse prices tend to fluctuate sharply across seasons and years due to supply shocks, weak market integration, and policy interventions. In the absence of effective price stabilization mechanisms, farmers face difficulty in predicting returns from legume cultivation. Evidence suggests that even when average prices are favourable, high variability in realized prices discourages risk-averse farmers from expanding legume area (Birthal and Hazrana 2019). This reinforces the perception that legumes offer unstable income streams compared to cereals with more assured procurement and demand.

Access to financial services is another important economic constraint. Smallholder farmers cultivating legumes often have limited access to formal credit and crop insurance, which restricts their ability to manage production and market risks (Matata *et al.* 2010). Formal lending institutions tend to favour crops with established procurement systems and lower perceived risk, leaving legume growers dependent on informal credit sources with higher costs (Munshi *et al.* 2024). The absence of effective risk-transfer mechanisms increases farmers' exposure to adverse shocks and discourages investment in legume technologies (Anderson 2003; Ward and Singh 2015).

Opportunity costs associated with land and labour allocation also influence adoption decisions. In regions where irrigation or market conditions support high-return crops, allocating land to legumes is often perceived as economically suboptimal. Smallholders typically reserve their best land and labour for crops with predictable returns, relegating legumes to marginal plots. This practice perpetuates low productivity and reinforces the belief that legumes are less profitable, even when this outcome is partly driven by constrained resource allocation (Birthal and Joshi 2007).

Overall, the economic constraints affecting legume adoption reflect rational responses to income instability and risk rather than a lack of awareness or technical knowledge. Smallholder farmers prioritize crops that offer predictable returns and lower exposure to shocks. Addressing these constraints, therefore, requires interventions that improve income stability, reduce yield and price risk, and strengthen access to financial protection mechanisms, rather than focusing solely on increasing average productivity.

INSTITUTIONAL AND POLICY-RELATED CONSTRAINTS

Institutional arrangements and public policy strongly influence crop choice decisions among smallholder farmers, particularly in systems where market risk is high and public support plays a stabilizing role. In the case of legumes, policy frameworks often appear supportive in principle but remain weak or inconsistent in practice, reducing their effectiveness in encouraging adoption.

One of the most frequently discussed policy instruments for pulses is the minimum support price. While MSPs for major pulse crops are announced regularly, procurement remains limited and uneven across regions. Evidence suggests that actual procurement is concentrated in a few states and market centers, leaving a large share of smallholders exposed to open-market price fluctuations (Acharya 2016; Chand 2023). When farmers do not experience MSP operations in their local markets, announced prices lose credibility as a risk-reducing signal. As a result, MSP announcements alone have limited influence on legume area allocation decisions (Snapp and Silim 2002).

Input subsidy structures further shape crop choice incentives. Public expenditure on fertilizers, irrigation, electricity, and procurement infrastructure has historically favoured rice and wheat-based systems. This policy orientation creates an implicit advantage for cereals by lowering their effective cost of production relative to legumes (World Bank 2014). Even when legumes are agro-ecologically suitable, such subsidy biases increase the opportunity cost of allocating land and inputs to

pulse crops. Over time, these structural incentives reinforce cereal-dominated cropping patterns and limit diversification toward legumes (Pingali 2015).

Trade policy interventions also affect legume adoption through their impact on price stability. Pulse markets in India have experienced frequent policy shifts, including changes in import duties, quantitative restrictions, and stock release decisions. While these measures are often intended to stabilize consumer prices, they can depress domestic prices during periods of surplus, transferring price risk to producers (Varma 2019, Roy 2022). For smallholders with limited storage and weak bargaining power, such policy-induced price shocks reduce confidence in legume cultivation (Chianu *et al.* 2011).

Institutional support through extension services remains another constraint. Compared to cereals, legumes receive relatively less attention in public extension programs. Advisory services often focus on input-intensive crops, while guidance on improved pulse varieties, pest management, and post-harvest handling is fragmented or inconsistent (FAO 2016). Weak extension outreach limits farmers' ability to manage production risks effectively and constrains productivity improvements in legume systems.

Finally, coordination across policy domains remains limited. Although legumes contribute to soil health, nutrition security, and climate resilience, agricultural, nutrition, and environmental policies are often designed and implemented independently. The absence of integrated planning means that the broader public benefits of legumes are not adequately reflected in incentive structures or investment priorities (FAO 2016, Pingali 2015).

Overall, institutional and policy-related constraints increase economic uncertainty and weaken incentives for legume adoption among smallholders. Unless policy instruments are implemented credibly, subsidy distortions corrected, and trade and procurement decisions coordinated with producer support, legumes are likely to remain marginal crops despite their recognized sustainability benefits.

MARKET AND VALUE-CHAIN CONSTRAINTS

Market and value-chain conditions strongly influence the economic viability of legume cultivation for smallholder farmers. Even when production risks are manageable, weak market structures often prevent farmers from translating output into stable and remunerative incomes. In the case of legumes, market imperfections frequently amplify both price and income uncertainty.

One of the most persistent constraints is the thin and fragmented nature of pulse markets. In many producing regions, market arrivals are seasonal, and buyers are limited, resulting in low competition at the farm gate (Asfaw *et al.* 2010). Smallholders typically sell their produce to local traders or commission agents soon after harvest due to immediate cash requirements and lack of storage facilities. This weak bargaining position reduces farmers' share in the consumer price and discourages expansion of legume cultivation (Acharya and Agarwal 2011; Birthal *et al*. 2014).

Price volatility further compounds market risk. Empirical evidence shows that pulse prices fluctuate more sharply than those of major cereals, driven by supply shocks, weather variability, and policy interventions related to trade and buffer stocks (Chand 2012; Minot 2014). In the absence of effective price stabilization mechanisms, smallholders bear the brunt of these fluctuations. High inter-year and intra-seasonal price variability makes income from legumes difficult to predict, reducing their attractiveness relative to crops with more stable demand and procurement support (Das *et al.* 2025).

Post-harvest constraints play a critical role in shaping marketing outcomes. Limited access to scientific storage exposes pulse produce to pest infestation and quality deterioration, forcing farmers to engage in distress sales immediately after harvest (FAO 2019). The absence of grading, cleaning, and aggregation facilities further limits farmers' ability to access premium markets or negotiate better prices. As a result, quality differentiation is rarely rewarded at the farm level, weakening incentives for productivity enhancement (Kinyua *et al.* 2023).

Value addition and processing linkages for legumes remain underdeveloped in many regions. Compared to cereals, pulses have fewer organized processing units and weaker backward linkages with producers. Studies on agricultural value chains indicate that limited processing capacity reduces demand stability and restricts opportunities for contract-based or assured marketing arrangements (Reardon *et al*. 2019). Without strong linkages between farmers, processors, and institutional buyers, legume markets remain dominated by informal transactions.

Collective marketing mechanisms, such as farmer-producer organizations, have the potential to improve market access and price realization.

However, their effectiveness in pulse markets has been mixed. Many producer groups lack adequate working capital, storage infrastructure, and direct links with large buyers. Evidence suggests that without complementary investments in infrastructure and market intelligence, collective action alone is insufficient to overcome structural weaknesses in pulse value chains (Negi and Birthal 2018).

Overall, market and value-chain constraints translate production and policy risks into tangible income uncertainty for smallholders. Weak price transmission, limited storage and processing facilities, and fragmented markets reduce the economic incentives for legume adoption. Strengthening pulse value chains through investments in storage, processing, aggregation, and market integration is therefore essential for improving farmer returns and encouraging sustained legume cultivation.

SOCIAL AND BEHAVIOURAL CONSTRAINTS INFLUENCING LEGUME ADOPTION

Social and behavioural factors play a crucial role in shaping crop choice decisions among smallholder farmers, often reinforcing economic and institutional constraints. Even when market conditions improve or policy incentives are introduced, adoption of legumes may remain limited if these interventions do not align with farmers' perceptions, experiences, and social context.

Risk aversion is one of the most consistently documented behavioural traits among smallholder farmers. Households operating close to subsistence levels tend to prioritize loss avoidance over potential gains. In such settings, farmers favour crops with familiar performance and predictable outcomes rather than those perceived as uncertain. Legumes, which are often associated with yield variability and price fluctuations, are therefore treated cautiously. This behaviour reflects rational decision-making under risk rather than resistance to innovation (Anderson 2003; Dercon 2004).

Cropping decisions are also embedded in local traditions and social norms. In many regions, cereal-based cropping systems have evolved over decades through collective experience, reinforced by shared learning and peer influence. Farmers are more likely to follow established patterns that have proven reliable within their communities. Deviating from these norms involves not only economic risk but also social risk, as failure may attract criticism or reduce social standing. Such path dependency slows the diffusion of legume crops, even when their agronomic benefits are widely known (Bandiera and Rasul 2006).

Information access and trust further shape adoption behaviour. Smallholders often rely on informal sources such as neighbouring farmers, traders, or input dealers rather than formal extension services. When information about improved legume varieties, pest management, or marketing opportunities is fragmented or inconsistent, farmers' perceptions remain shaped by past negative experiences. In many cases, isolated crop failures or unfavourable market outcomes continue to influence decision-making long after conditions have changed. Limited trust in institutional advice reinforces reliance on social networks, which can delay adoption of alternative crops.

Gender dynamics add another important dimension to legume adoption. Women frequently contribute a significant share of labour in legume cultivation, particularly in activities such as sowing, weeding, harvesting, and post-harvest processing. However, decision-making authority related to crop choice, input use, and marketing is often concentrated with male household members. This mismatch reduces incentives to invest in improved legume practices and constrains the productivity potential of these crops. Empirical studies show that neglecting gender roles leads to an incomplete understanding of adoption behaviour in smallholder systems (Meinzen-Dick *et al*. 2014; Farnworth *et al*. 2016).

Household labour availability and migration patterns also influence legume cultivation decisions. Seasonal and permanent migration of working-age members reduces the supply of family labour, increasing dependence on hired workers. In such contexts, farmers tend to avoid crops that require timely operations or close supervision. Legumes, which can be sensitive to delayed weeding or harvesting, may therefore be deprioritized in favour of less labour-intensive alternatives.

Overall, social and behavioural constraints interact closely with economic risk, market imperfections, and policy uncertainty. Farmers' decisions reflect accumulated experience, shared knowledge, and household dynamics rather than simple responses to price or technology signals. Addressing these constraints requires interventions that build trust, reduce perceived risk, recognize gender roles, and align extension strategies with

local social contexts. Without attention to these factors, efforts to promote legume adoption are unlikely to achieve sustained impact.

SYNTHESIS OF EVIDENCE AND CROSS-CUTTING INSIGHTS

A synthesis of the reviewed literature shows that low adoption of legumes among smallholder farmers cannot be attributed to a single constraint. Instead, it emerges from the interaction of economic risk, weak institutional support, imperfect markets, and social behaviour. These factors reinforce one another and create a cycle that discourages sustained investment in legume cultivation.

Economic uncertainty forms the core of this cycle. Yield variability, price fluctuations, and limited access to financial protection mechanisms make legumes appear risky relative to cereals. Institutional weaknesses amplify this risk by failing to provide credible price assurance, consistent procurement, or targeted incentives. Market imperfections then translate policy gaps into tangible income losses through distress sales, poor price realization, and limited value addition opportunities.

Social and behavioural factors shape how farmers interpret and respond to these conditions. Risk aversion, traditional cropping norms, and gendered decision-making do not operate independently of economic realities. Rather, they reflect farmers' accumulated experiences with unstable markets and unreliable policy support. This explains why awareness of agronomic benefits alone has not led to widespread adoption of legumes.

An important insight from the literature is that many smallholders do not completely reject legumes. Instead, they adopt them cautiously, allocating marginal land or cultivating them as secondary crops. This partial adoption reflects rational behaviour under uncertainty rather than resistance to change. However, such low-intensity adoption limits productivity gains and reduces the broader sustainability benefits associated with legume-based systems.

The evidence also reveals gaps in existing research. Many studies examine adoption decisions without adequately accounting for market conditions or policy environments. Others focus on yield or profitability without incorporating risk and income stability. Limited attention has been given to gender roles, long-term adoption behaviour, and the interaction between value chains and farm-level decisions. Addressing these gaps is essential for building a more complete understanding of legume adoption dynamics.

POLICY AND PLANNING IMPLICATIONS

The findings of this review suggest that promoting legume adoption requires a shift from technology-centric approaches to risk-sensitive and market-oriented strategies. Input provision and varietal improvement, while important, are insufficient when farmers face unstable returns and weak institutional support.

First, policy frameworks must enhance income predictability for legume growers. This includes strengthening procurement mechanisms, expanding coverage of price stabilization measures, and ensuring timely and transparent market interventions. Support prices need to be backed by credible implementation to influence farmer expectations and planning decisions.

Second, financial risk management tools should be made more accessible for legume cultivation. Crop insurance products tailored to legumes, improved access to affordable credit, and incentives for post-harvest storage can reduce farmers' exposure to both production and price shocks. Such measures are particularly important for smallholders with limited coping capacity.

Third, market and value-chain development should be integrated into legume promotion strategies. Investments in storage, grading, processing, and local aggregation can improve price realization and reduce distress sales. Strengthening farmer collectives and linking them with processors and institutional buyers can create more stable demand for legumes.

Fourth, extension and advisory services need to adopt a broader perspective that combines production guidance with market information and risk management advice. Extension efforts should also be sensitive to gender roles and actively involve women farmers in training and decision-making processes.

Finally, agricultural planning should recognize legumes as strategic crops that contribute to sustainability, nutrition, and livelihood resilience. Aligning agricultural, nutrition, and environmental policies can create coherent incentives that encourage farmers to integrate legumes more fully into their farming systems.

CONCLUSION

This review highlights that the limited adoption of legumes among smallholder farmers is not the result of ignorance or reluctance to adopt sustainable practices. Instead, it reflects rational decision-making under conditions of economic uncertainty, weak institutional support, and imperfect markets. Smallholders prioritize income stability and risk reduction, often at the expense of long-term sustainability benefits. Socio-economic constraints, reinforced by policy inconsistencies, market volatility, and social norms, shape legume adoption outcomes across regions. Addressing these constraints requires coordinated interventions that reduce risk, improve market access, and align policy with on-site farming realities. Promoting legumes as a component of sustainable agriculture will only succeed when farmers perceive them as economically reliable and institutionally supported crops. By shifting the focus from isolated technological solutions to integrated economic and policy frameworks, future strategies can create an enabling environment for sustainable legume adoption among smallholder farmers. Such an approach is essential not only for enhancing farm-level outcomes but also for achieving broader goals related to food security, nutrition, and environmental sustainability.

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