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Beyond the Pod: The Role of Pole Sitao in Strengthening Sustainable Agriculture and Rural Livelihoods

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ABSTRACT

Pole sitao, widely known as a staple legume in Southeast Asia, plays an important role in food security, nutrition, and rural livelihoods. This review consolidates existing knowledge on its agronomic traits, nutritional profile, organic farming potential, and socio-economic implications. Drawing from scientific literature, government reports, policy documents, and grey literature, the review adopts a structured narrative synthesis to integrate agronomic, ecological, and market perspectives. Pole sitao is nutritionally rich in protein, vitamins, and minerals, contributing to dietary diversity in developing countries. Its adaptability to diverse agroecological zones underscores its role in nutrition-sensitive and climate-resilient agriculture. However, organic farming adoption faces structural challenges, particularly the limited availability of organically bred seed varieties, market access constraints, and consumer affordability concerns. Comparative evidence suggests organic systems reduce pesticide exposure and enhance secondary plant metabolites, although population-level health benefits remain inconclusive. From a socio-economic perspective, pole sitao offers strong potential for embedding within organic value chains, thereby enhancing competitiveness in domestic and regional markets. Yet, the lack of robust seed systems, regulatory gaps, and uneven consumer access continue to hinder its scalability. Strengthening participatory breeding programs, seed sector reforms, and policy support under the Philippine Organic Agriculture Act of 2010 are identified as critical pathways forward. This review emphasizes the importance of integrating ecological sustainability, economic viability, and social equity to advance pole sitao as both a traditional food crop and a strategic commodity in sustainable agricultural development.

Keywords: Pole sitao, *Vigna unguiculata*, organic farming, seed systems, food security, sustainable agriculture

INTRODUCTION

Pole sitao (*Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc.), locally known as sitaw (Tagalog), hantak (Waray), utong (Ilokano), batong (Cebuano), and latuy (Marinduque), is a viny annual crop valued for its long, succulent pods that range between 30–60 cm (BPI, 2013). The crop is characterized by trifoliate leaves, paired flowers of varying colors, and pods that can be green, dark green, light green, or purple. Due to its fast growth, harvesting is often required every other day, making it a consistent source of income and nutrition.

Beyond its agronomic attributes, pole sitao holds cultural significance as a staple ingredient in Filipino cuisine, featuring prominently in dishes such as adobong sitaw and pinakbet, which are deeply tied to regional food traditions. Economically, the crop supports smallholder farmers by providing year-round market opportunities, particularly in peri-urban and rural communities where daily harvests translate into steady cash flow. Nutritionally, pole sitao contributes to food security by supplying dietary fiber, vitamins A and C, and essential minerals such as calcium and iron, which help address common micronutrient deficiencies. Its accessibility and affordability make it an important component of household diets, especially for low-income families who rely on it as a low-cost but nutrient-rich vegetable source.

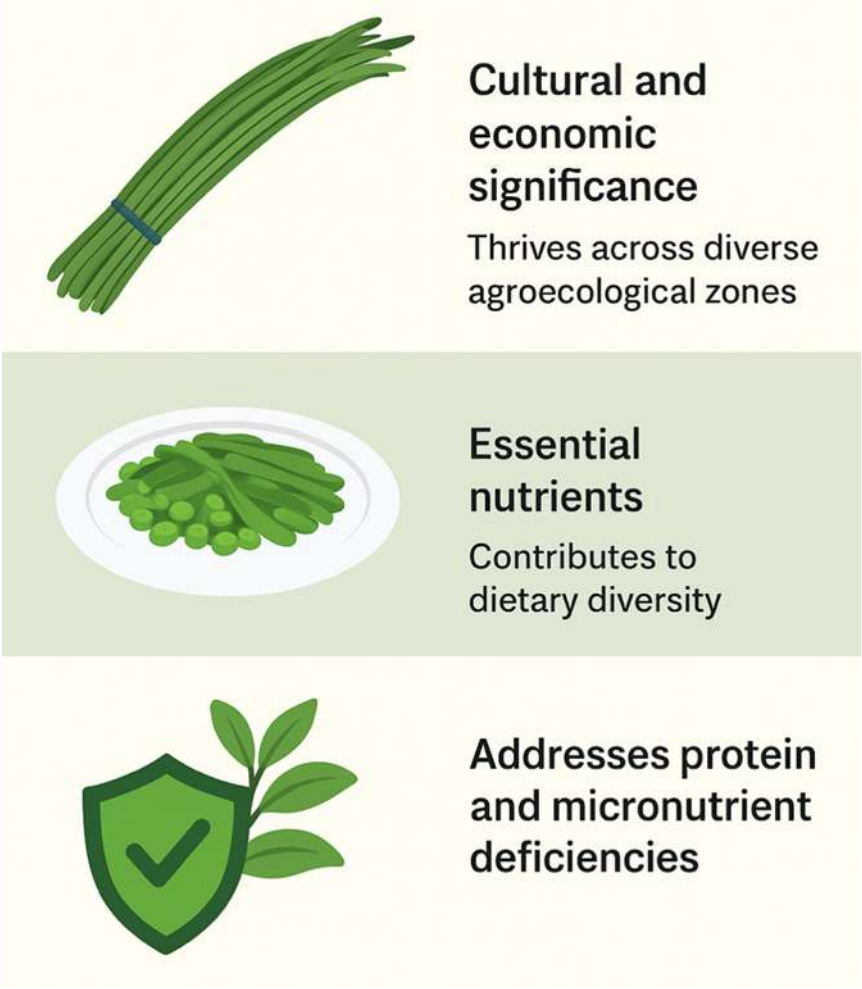

Figure 1: Significance of Pole Sitao in various aspects

Pole sitao plays a prominent role in Asian vegetable production, particularly in Malaysia, Thailand, Indonesia, Taiwan, China, and the Philippines. In the Philippines, it is the most widely produced edible legume, cultivated in home gardens, rice dikes, shaded areas, and commercial farms (BAS, 2010). Central Luzon leads production (32%), followed by Cagayan Valley (15%) and Davao Region (11%). Nutritionally, it is rich in protein, vitamins A and C, thiamin, riboflavin, iron, phosphorous, potassium, folate, magnesium, and manganese (BPI, 2013). The increasing demand for organic vegetables has heightened global interest in crops like pole sitao. Consumer perceptions link organic products with health, safety, and environmental benefits. In response, the Philippines enacted the Organic Agriculture

Act of 2010 (RA 10068), which promotes organic farming to enhance soil fertility, productivity, and public health, while reducing chemical inputs and resource depletion.

Vegetable production in areas like Claveria, Misamis Oriental, and Dalwangan, Bukidnon thrives under favorable climatic conditions, yet organic adoption remains limited (Elmundo et al., 2013). Given rising consumer demand and national organic standards requiring organically produced seeds, there is an urgent need to strengthen organic pole sitao seed systems (Ohagan et al., 2023). Furthermore, elevation and climatic factors significantly influence vegetable growth and productivity, reinforcing the importance of location-specific trials (Rempelos et al., 2023). Hence, this review consolidates existing knowledge on pole sitao production, the importance of organic farming systems, the role of seed industries, nutritional and ecological benefits, and broader economic implications.

METHODS

This article adopts a structured narrative review with elements of a scoping review, designed to consolidate evidence on pole sitao production and its integration into organic farming systems. The protocol emphasized transparency, reproducibility, and completeness of reporting (Nagal et al., 2024). The workflow was aligned with evidence-synthesis conventions such as comprehensive documentation for study identification and selection, while also drawing from environmental evidence standards to accommodate agronomic, policy, and socio-economic sources. A meta-analysis was not undertaken due to heterogeneity in study designs, outcomes, and reporting formats across agronomy, food systems, and policy literature.

Information sources

The information sources consulted for this review encompassed a broad range of materials to ensure both scientific rigor and policy relevance. Government and intergovernmental reports, along with statistical yearbooks, served as primary references. These included documents from the Bureau of Plant Industry, Bureau of Agricultural Statistics, Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development, and the Food and Agriculture Organization, as well as policy and standards documents such as the Philippine Organic Agriculture Act of 2010 and the IFOAM principles. Peer-reviewed journals provided empirical evidence across disciplines including agronomy, horticulture, soil science, food safety, environmental management, and development economics. In addition, production guides, technical notes, and market or industry reports contributed practical insights into crop management and trade dynamics. Academic and institutional repositories were also consulted, yielding theses, dissertations, and conference proceedings that supplemented the evidence base. Finally, credible grey literature with clear policy relevance was included to capture perspectives and data not always available in conventional academic publishing channels.

Search strategy

A multi-database search combined controlled vocabulary and free-text terms. Representative Boolean strings. Searches targeted agricultural databases, agency portals (BPI/BAS/PCAARRD/FAO), and scholarly search engines to capture grey literature. The time window spanned 1990–2025, corresponding with key phases of organic sector expansion and policy adoption. English-language materials and Philippine sources in both English and Filipino were considered. Reference lists of included sources were also screened.

Eligibility criteria

Predefined inclusion and exclusion rules guided study selection (Table 1).

Table 1. Inclusion and exclusion criteria

Dimension	Inclusion	Exclusion
Population/Topic	*Vigna unguiculata* subsp. *sesquipedalis* (pole sitao) and related *Vigna* spp. when relevant to seed systems, markets, biodiversity, or agronomic analogs	Unrelated crops; *Phaseolus* spp. unless addressing global trade or market context
Geography	Global with emphasis on the Philippines and Southeast Asia	Purely temperate systems without translational relevance
Study types	Peer-reviewed empirical studies; experimental trials; agronomic guides; validated statistics; policy/standards documents; reputable market/industry reports	Opinion pieces without data; non-documented sources; studies lacking methodological transparency
Outcomes/Themes	Crop traits and production; organic seed systems; food quality and safety; climate and biodiversity impacts; socio-economic and trade dimensions	Outcomes outside production, environment, or policy relevance
Timeframe & Language	1990–2025; English and Filipino	Outside timeframe unless historically foundational; languages without reliable translation

Study selection

Screening and selection were conducted by a single reviewer. Titles and abstracts were assessed first, followed by full-text reviews against the eligibility criteria in Table 1. Duplicates were removed prior to screening. Reasons for exclusion at the full-text stage (e.g., inadequate methodology, off-topic outcomes) were recorded.

Operational definitions

Key concepts were standardized to ensure consistency:

- Organic agriculture: Defined according to the Philippine Organic Agriculture Act of 2010 emphasizing ecological processes, biodiversity, and nutrient cycling, while excluding synthetic fertilizers, pesticides, GMOs, sewage sludge, and growth regulators (RA 10068, 2010).
- Organic seed/variety suitability: Refers to cultivars selected, bred, or tested under organic or low-input conditions with emphasis on pest tolerance, nutrient efficiency, and local adaptation.
- Food quality and safety: Covers nutrient composition, secondary plant metabolites, nitrate levels, and pesticide residues.
- Climate and biodiversity impacts: Include soil organic matter/carbon content, synthetic nitrogen substitution, species richness and abundance, and resilience to climate extremes.
- Socio-economic and trade: Encompasses production statistics, price premia, seed sector dynamics, and global trade flows (CIAT, 1995).

Data extraction

A standardized extraction template (Table 2) was developed to capture bibliographic information, study context, methodology, and outcomes. Data extraction was carried out by a single reviewer to ensure consistency.

Table 2. Data items captured by thematic domain

Domain	Core variables
Crop characteristics & agronomy	Cultivar/line; location; management; yield; phenology; pest/disease profile; organic vs. conventional inputs
Organic seed systems	Seed origin; breeding context; contamination risks; certification status; varietal performance
Food quality & safety	Macro/micronutrients; secondary metabolites; nitrate levels; pesticide residues; comparators
Climate & biodiversity	Soil carbon/organic matter; N inputs; fossil fuel proxies; species richness and abundance
Socio-economics & trade	Production area/volume; price premia; value-chain actors; trade flows; policy context

Quality appraisal and risk of bias

Each source was carefully appraised according to its study design to ensure methodological rigor and credibility. Experimental trials were examined with particular attention to randomization, replication, appropriate controls, and the reliability of measurement procedures. Observational studies were evaluated based on the robustness of their sampling design (Travero et al., 2025), the extent to which potential confounding factors were addressed, and the strength of their statistical analyses.

Policy and statistical reports were assessed in terms of data provenance, accuracy, and compliance with established statistical standards. Meanwhile, technical guides, including those issued by BPI (2013), were judged for internal consistency and validated through triangulation with empirical data. Throughout the review, potential risks of bias—including selection bias, survivorship bias, and publication bias—were critically noted and accounted for in the synthesis process.

Synthesis approach

A convergent narrative synthesis was employed to integrate and interpret the diverse body of literature (Nagal, 2025). First, within-theme synthesis was conducted to systematically organize the evidence into core domains, namely agronomy, seed systems, food quality and safety, climate and biodiversity, and socio-economic and trade dimensions. This approach ensured that findings were clustered according to their primary thematic relevance, allowing for a more coherent discussion within each field.

Second, cross-theme integration was applied to map potential causal linkages across domains. For instance, the analysis highlighted how constraints in organic seed supply could directly influence food quality outcomes, or how climate adaptation strategies intersect with both biodiversity conservation and socio-economic resilience.

Finally, a comparative analysis was carried out to contrast conventional and organic farming systems. This step underscored knowledge gaps, identified contextual variations, and revealed areas where empirical evidence remains insufficient. Together, these levels of synthesis provided a comprehensive framework for interpreting pole sitao production in relation to its integration into organic farming systems.

Handling heterogeneity and context

Contextual factors such as elevation, climate, soil type, and market access were carefully examined to account for the heterogeneity observed across the reviewed studies. Elevation influences temperature regimes and day length, which in turn affect the growth rate, flowering, and yield stability of pole sitao, particularly when comparing lowland production areas with mid-elevation zones. Climate variables, including rainfall distribution, seasonal variability, and exposure to extreme weather events, directly shape planting calendars, pest and disease incidence, and the reliability of organic input availability. Soil type and fertility status also contribute to yield variability, as sandy or degraded soils may constrain nutrient retention, while loamy or organically enriched soils support higher productivity under organic management systems. In addition, market access—defined by proximity to urban centers, infrastructure quality, and integration into value chains—plays a crucial role in determining farm-level profitability, adoption of organic practices, and the capacity of producers to command price premiums for organic pole sitao.

To situate these contextual influences, Philippine statistics were used to anchor the local interpretation of production patterns, yield trends, and regional market dynamics, providing a baseline for assessing national-level opportunities and constraints. At the same time, global trade data served to position Philippine pole sitao within broader regional and international markets, highlighting competitiveness, export potential, and the implications of global demand for organic vegetables. Together, these local and global perspectives allowed

the synthesis to identify not only environmental and agronomic sources of variability but also the socio-economic structures that shape the sustainability and scalability of pole sitao production in organic farming systems.

Data management and transparency

Bibliographic records and full texts were organized using a reference manager. Screening logs and extraction sheets were archived for transparency. Metadata distinguishing official statistics, technical guides, and peer-reviewed articles were preserved.

Ethical considerations

The review was conducted entirely on the basis of publicly available data and published literature, ensuring that all information sources were accessible and verifiable. Since the study did not involve direct interaction with human participants or experimentation on animals, there were no ethical risks related to human or animal welfare. To maintain scholarly rigor and transparency, all cited materials were preserved and reported without omission, including government reports, peer-reviewed studies, policy documents, technical guides, and grey literature. This approach upholds both the ethical standards of secondary research and the integrity of the evidence base, ensuring that readers and subsequent researchers can fully trace and verify the sources used.

Methodological limitations

Limitations included: (i) reliance on a single reviewer for screening and extraction, which may introduce subjectivity; (ii) language bias toward English and Filipino; (iii) variability in methodological detail across grey literature; (iv) limited comparability between agronomic trials and policy reports; and (v) possible publication bias in nutrient-related studies. These were mitigated by broad source coverage, explicit operational definitions, and cross-theme triangulation.

AGRONOMIC AND NUTRITIONAL PROFILE OF POLE SITAO

Global and Regional Production Trends

Pole sitao holds both cultural and economic significance across Asia, thriving in diverse agroecological zones due to its broad adaptability (BPI, 2013). In the Philippines, its year-round availability has cemented its role as a staple in household diets. Beyond its culinary importance, pole sitao provides essential nutrients that contribute to dietary diversity, helping to address protein and micronutrient deficiencies that remain pressing concerns in developing countries (BPI, 2013). This positions the crop not only as a subsistence food but also as a potential leverage point in nutrition-sensitive agriculture.

Table 3. Nutrient composition of pole sitao pods compared to selected legumes (per 100 g edible portion)

Nutrient	Pole sitao	Mungbean pods	Snap bean	Daily Value % (based on pole sitao)
Protein (g)	3.0	3.2	2.0	6%
Vitamin A (µg)	45	28	35	5%
Vitamin C (mg)	18	14	12	20%
Folate (µg)	62	48	40	15%
Iron (mg)	0.9	1.0	0.8	5%
Magnesium (mg)	44	40	30	10%
Potassium (mg)	240	250	210	7%

Source: BPI (2013); USDA food composition tables (for comparative values).

The relevance of pole sitao within the broader discourse on agrobiodiversity and nutrition can be better understood when viewed alongside research on traditional crop landraces, which consistently demonstrate nutritional diversity and agronomic potential across regions. For instance, in the Himalayan region, traditional maize landraces such as *Chitkanu* exhibited early maturity (107 days) coupled with high zinc,

iron, and potassium concentrations, while the paddy landrace *Lamgudi dhan* showed remarkably high protein content (14.86 g/100 g) (Malhotra et al., 2022). Likewise, evaluations of native maize germplasm across three Indian states revealed nutritionally superior accessions. Among them, *Malan 11* stood out with crude fat content nearly double the standard value (7.06%), while several other varieties achieved protein levels approaching 12% (Langyan et al., 2022). The crop's versatility—consumed as pods, leaves, shoots, or seedlings—further strengthens its role in food security. Additionally, its medicinal applications, such as leaf juice use, highlight ethnobotanical importance.

Other traditional crops also highlight the nutritional resilience embedded in indigenous food systems. Finger millet, for example, contains elevated levels of dietary fiber, minerals, and phytochemicals, while its gluten-free property further enhances its role as a functional food for combating malnutrition (Gebre, 2019). Similarly, enset-based foods, commonly consumed in East Africa, provide high carbohydrate content along with critical minerals such as calcium, potassium, and zinc. They also supply essential amino acids, including lysine and leucine, which are often limiting in staple cereal-based diets (Fanta & Neela, 2019).

These examples underscore the broader value of traditional and underutilized crops, including pole sitao, in enhancing nutritional outcomes while sustaining agrobiodiversity. By combining resilience to local environments with superior nutritional attributes, such crops hold promise for advancing both food security and nutrition-sensitive farming systems, particularly under the increasing pressures of climate change and market-driven dietary shifts.

ORGANIC FARMING AND SEED INDUSTRY DYNAMICS

The sustainability of the vegetable sector is closely tied to the availability and quality of seed systems, which play a central role in shaping crop performance, resilience, and productivity. In organic farming, however, this foundation is weakened by what has been described as a critical "missing link": the limited availability of organically bred varieties. Organic growers are often compelled to rely on conventionally bred hybrids, which are designed for high-input systems and may not perform optimally under organic management. This reliance undermines productivity and adaptability in organic production. Compounding the issue, the risk of GMO contamination—as documented in crops such as eggplant and squash—poses a serious threat to the integrity and certification of organic supply chains (Fig. 2).

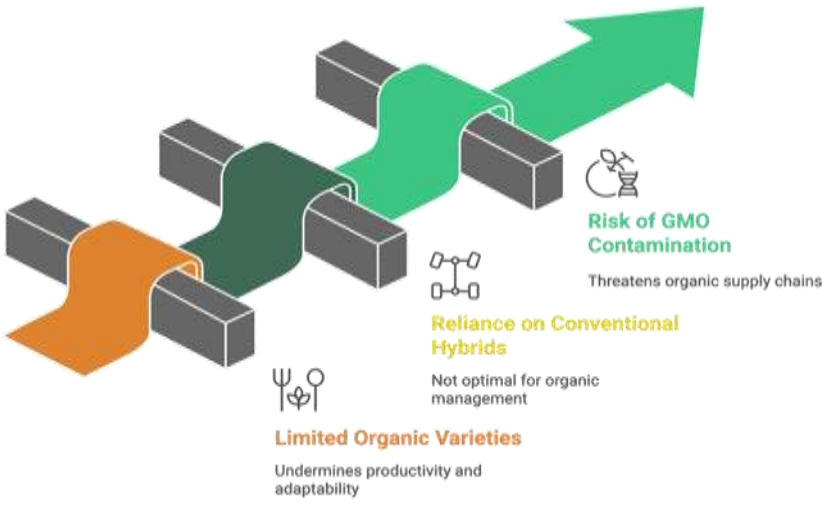

Figure 2: Challenges in Farming Dynamics

One promising response has been the development of collaborative on-farm breeding programs, where public researchers, organic growers, and seed companies work together to design varieties adapted to local agroecological conditions and consumer preferences. Pole sitao, with its wide adaptability, emerges as a strong candidate for such localized breeding programs, which could enhance resilience, reduce dependence on conventional hybrids, and strengthen the organic seed supply.

Research on seed systems within organic agriculture highlights the complex interplay between formal and informal sources. In Italy, for example, organic farmers continue to depend heavily on self-produced seeds and local varieties outside official catalogues, underlining the enduring importance of informal seed networks alongside commercial channels (Bocci et al., 2012). However, the development of an independent organic breeding sector faces structural challenges. Innovative financing mechanisms, such as cross-sector pool funding involving multiple value chain actors, have been proposed to share breeding costs and ensure the long-term availability of organic products (Winter et al., 2021). Beyond economics, organic breeding initiatives must also grapple with social sustainability, balancing economic viability with equitable participation and diverse governance structures (Almekinders & Jongerden, 2002).

The integration of seed and plant health is another emerging area of focus. A dynamic perspective on seed health emphasizes the role of seed vigor and beneficial microbiota in enhancing crop resilience and field performance, suggesting that the continuum from seed to plant health is critical for long-term sustainability in organic systems (Klaedtke et al., 2022).

Globally, studies reveal substantial disparities and challenges in organic seed systems. In Peru, for instance, an overwhelming 90% of seed users remain within informal systems, while only 10% operate under formal, regulated structures. The adoption of quality-declared seeds—where farmers themselves guarantee seed quality—remains limited, reflecting persistent gaps in institutional support (Pinedo-Taco, 2023). India, which accounts for 30% of the world's organic growers, regards organic farming as both a sustainability strategy and a solution to food security challenges. Its commitment is reflected in the allocation of 2.30 million hectares to organic production, yet seed sector development remains uneven (Krithika et al., 2023).

In industrialized contexts, systemic constraints also persist. The European Union faces difficulties in reaching its target of 100% organic seed use by 2036, with specific challenges observed in German organic carrot production. The planned phase-out of derogation systems allowing non-organic seed use risks disrupting supply chains and reducing farm incomes (Winter et al., 2023). Similarly, in the United States, intellectual property restrictions—including patents, plant variety protection certificates, and contractual limitations—have become barriers for small-scale and university-based breeders working on organic crops such as corn. Although the full impact of these contractual restrictions remains difficult to assess due to confidentiality, their role in limiting innovation and seed sovereignty is increasingly recognized (Endres et al., 2023).

Thus, these dynamics reveal a global pattern of structural weaknesses in organic seed systems. While informal seed networks play an indispensable role, especially in the Global South, they often lack institutional support and investment. Meanwhile, formal seed sectors in industrialized nations face regulatory, financial, and intellectual property barriers that constrain innovation and accessibility. For pole sitao, addressing these gaps through localized breeding, participatory research, and balanced policy interventions could serve as a model for strengthening the organic seed industry while advancing both ecological sustainability and farmer autonomy.

FOOD QUALITY, SAFETY, AND CONSUMER PERCEPTIONS

Research comparing organic and conventional foods has generated nuanced findings across nutritional, safety, and consumer domains. Evidence is best understood along three interlinked dimensions: (1) compositional and nutritional differences, (2) food-safety implications, particularly pesticide residues, and (3) downstream health and consumer responses (Table 4).

Table 4. Summary of findings on nutrient content and health impacts of organic vs. conventional produce

Study	Key Finding	Nutrient/Health Aspect
Barański et al. (2014)	No major nutrient difference; organics higher in vitamin C & secondary compounds	Nutritional composition
Brantsæter et al. (2016)	Lower pesticide residues in organic produce	Food safety
Mie et al. (2017)	Organic milk associated with lower eczema risk	Health outcomes
Aschemann-Witzel and Zielke (2015)	Higher prices limit access despite benefits	Socio-economic

Barański et al. (2014) conducted a meta-analysis of 343 studies and reported significant increases in plant secondary metabolites — such as flavonols and anthocyanins — in organic crops. These antioxidant compounds may contribute to potential health benefits. At the same time, no consistent or clinically important advantages were observed for macronutrients or most vitamins across the literature. The meta-analysis also documented lower cadmium concentrations in organic produce. Agronomic practices, including reduced nitrogen fertilization and avoidance of synthetic pesticides, are likely mechanisms driving these differences. However, high heterogeneity in crop type, climate, and analytical methods limits the generalizability of findings, suggesting that such differences represent broad tendencies rather than fixed rules.

Pesticide residues consistently emerge as a key differentiator between organic and conventional produce. Barański et al. (2014) and subsequent studies confirm that organic foods contain fewer detectable residues, thereby reducing consumer exposure. Brantsæter et al. (2017) further emphasized that dietary pesticide exposure is markedly lower among organic consumers, which may be particularly important for children given neurological vulnerability. Still, the translation of reduced exposure into measurable health gains remains uncertain. Limited long-term trials, residual confounding, and gaps in developmental neurotoxicity risk assessments prevent definitive conclusions.

The synthesis by Mie et al. (2017) integrates epidemiological, animal, and mechanistic studies. Observational evidence suggests possible associations between organic consumption and reduced risks of allergic outcomes (e.g., lower eczema prevalence in children consuming organic dairy), modestly lower weight gain trajectories in adults, and higher omega-3 content in organic dairy and meat. However, most human studies rely on self-reported intake and involve consumers with generally healthier lifestyles, raising concerns about residual confounding. As a result, while findings are suggestive, they are not conclusive.

Consumer studies consistently show that perceptions of safety, quality, and health benefits drive organic food purchases more than price considerations. Across regions, freshness, nutritional value, and sustainability are recurring themes. In Europe, for example, Swedish consumers view organic production as more sustainable, with women generally holding more favorable attitudes (Bosona & Gebresenbet, 2018). In Eastern China, health and safety concerns dominate motivations, particularly among educated, higher-income families with children (Xie et al., 2015). Similar health- and environment-based motivations are reported in Northern Thailand (Sangkumchaliang & Huang, 2012) and the

United States, where consumers also seek transparency and traceability (Dove et al., 2020). Nevertheless, affordability remains a major barrier. Price premiums limit adoption, particularly among lower-income households, raising concerns about nutritional inequality if higher costs deter fruit and vegetable consumption altogether. Moreover, despite growing awareness, European consumers continue to express uncertainty about organic production processes (Naspetti & Zanoli, 2009), highlighting the importance of consumer education.

With this, the evidence indicates that organic food systems consistently reduce pesticide exposure and can enhance certain beneficial plant compounds, though clear population-level health benefits remain uncertain. Consumer demand is shaped more by perceptions of quality, safety, and sustainability than by strictly nutritional outcomes. Price and information barriers, however, constrain equitable access and broader adoption. These dynamics underscore the importance of policies that balance consumer education, affordability, and transparent labeling to align organic markets with public-health and sustainability goals.

ECONOMIC, SOCIAL, AND TRADE DIMENSIONS

Pole sitao, a member of the broader Vigna genus, holds both cultural and economic significance across Asia. Historical evidence traces its movement from Central America to Asia and Africa via colonial trade routes, where it became embedded in local diets. Its adaptability, high nutritional value, and integration into daily cuisine make it a promising candidate for both subsistence farming and commercial markets in the Philippines. Positioning pole sitao within organic value chains could further strengthen its competitiveness in regional markets, aligning with the rising consumer demand for health-oriented and sustainably produced foods (Fig. 3).

Figure 3: Global Significance of the Crop

Food legumes, including beans and pulses, play a vital role in global food systems, serving both subsistence and commercial functions. Global dry bean production now exceeds 12 million tons annually, with Brazil and Mexico leading consumption, while China has emerged as a major exporter (CIAT, 1995). In Africa and Central America, beans function as both staple foods and income sources, with women frequently driving production and market sales. Despite this centrality, yield gaps persist: pulse yields average only 0.86 t/ha compared to 3.54 t/ha for cereals (Akibode & Maredia, 2012). While global pulse production has outpaced population growth since the mid-1990s, per

capita consumption has shown a declining trend over the long term (Akibode & Maredia, 2012).

Legumes contribute significantly to nutritional security, supplying protein, fiber, vitamins, and minerals, and are particularly important in plant-based diets due to their amino acid complementation potential (Uebersax, 2006; Siddiq et al., 2021). They are also associated with health benefits, including reducing the risk of metabolic diseases (Siddiq et al., 2021). However, global production faces persistent challenges such as pest and disease pressures, drought stress, and market limitations. Research priorities increasingly focus on improving drought tolerance, yield potential, and consumer acceptance (Luque & Creamer, 2014).

While specific literature on pole sitao remains limited, broader studies of the Vigna genus and related legumes provide valuable context. Cowpea (Vigna unguiculata), for example, was domesticated in sub-Saharan Africa before 2500 BCE and spread globally through ancient and colonial trade networks, reaching Old World production regions by 400 BCE and later expanding during the Columbian Exchange (Herniter et al., 2020). Similar dynamics shaped the global distribution of dry beans (Phaseolus vulgaris), whose production has expanded due to technological innovation and rising demand. Canada, in particular, has leveraged breeding research to establish itself as a leading exporter (Hesami & Yoosefzadeh-Najafabadi, 2025). Soybeans illustrate the scale and complexity of modern legume trade, dominated by Brazil and the United States as exporters and China as the world's largest importer (Oliveira & Lengyel, 2024).

Although research on pole sitao specifically is sparse, its membership in the Vigna genus connects it to a rich history of domestication, trade, and nutritional significance in global food systems. Lessons from broader legume research highlight both opportunities and constraints: strong nutritional benefits and rising global demand contrast with production challenges and declining per capita consumption. For the Philippines, capitalizing on pole sitao's adaptability and embedding it within organic and sustainable value chains offers a pathway to strengthen food security, diversify diets, and capture growing regional markets.

CONCLUSION

Pole sitao remains a vital vegetable crop in Asia, particularly in the Philippines, due to its adaptability, nutritional value, and cultural relevance. However, the shift toward organic farming presents both opportunities and challenges. While organic systems offer benefits in food safety, biodiversity, and climate change mitigation, structural gaps in organic seed systems and higher consumer costs remain critical barriers.

Collaborative breeding, stronger policy support under RA 10068, and targeted farmer capacity-building are needed to realize pole sitao's full potential in organic markets. Integrating ecological sustainability with economic viability ensures that pole sitao contributes not only to food security but also to environmental resilience and rural livelihoods.

Future research should focus on varietal trials across diverse elevations, long-term soil fertility studies under organic systems, and socio-economic analyses of farmer adoption. Such efforts will strengthen the role of pole sitao as both a staple crop and a strategic component of sustainable agricultural development.

Declaration by Authors

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