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SOCIOECONOMIC FACTORS INFLUENCING THE IMPLEMENTATION OF GOOD AGRICULTURAL PRACTICES IN SUSTAINABLE VEGETABLE FARMING

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ABSTRACT

Good Agricultural Practices (GAP) is a certification-based farming standard intended to guarantee food safety, environmentally sound management, worker welfare, and product traceability, and its adoption is mandated for Indonesian horticultural producers under Law No. 13/2010 on Horticulture. Despite this mandate, uptake among smallholder vegetable farmers remains inconsistent, partly because many producers have not perceived a clear benefit from certification and are reluctant to renew it once obtained. This study aimed to determine the level of implementation of GAP standard operating procedures (SOP-GAP) among vegetable farmers in the Argoayuningtani Farmer Group, Selo Sub-district, Boyolali Regency, and to analyse the socioeconomic factors associated with that implementation. A quantitative descriptive study was conducted on 30 vegetable farmers in the Argoayuningtani Farmer Group, Boyolali, Indonesia. Data were collected via structured questionnaires and analyzed using descriptive statistics and Spearman's rank correlation. Data were analysed using descriptive statistics and Spearman rank correlation. Implementation fell into the good category for land preparation, seed selection, fertilizer and pesticide provision, planting, and fertilizer application, and into the fair category for equipment use, plant maintenance, irrigation, pest and disease control, and harvesting. Farmers' age, education, land area, farming experience, livestock ownership, and income were significantly and positively correlated with SOP-GAP implementation across most components, whereas land-ownership status showed weak and largely non-significant associations. socioeconomic characteristics substantially shape the extent of GAP adoption among smallholder vegetable farmers. Strengthening farmer education, facilitating land access, and improving household income may accelerate the sustainability of GAP implementation in similar farming communities.

Keywords: farmer group; good agricultural practices; smallholder farmer; socioeconomic factor; sustainable vegetable farming

INTRODUCTION

The intensive and prolonged use of inorganic chemical fertilizers and pesticides has long been practised in agriculture to secure adequate food supply for a growing population. This reliance on chemical inputs has gradually displaced the traditional cultivation wisdom and biodiversity that once characterized smallholder farming systems, as farmers increasingly favour practical methods that promise fast and satisfying yields. However, mounting evidence indicates that produce grown with heavy chemical input can pose risks to human health, even as consumer demand for agricultural products continues to rise. At the same time, consumer awareness of food safety, product quality, environmental responsibility, and social accountability has grown considerably, and this awareness is increasingly expressed through demands for traceability of the agricultural products consumers purchase.

Changing lifestyles and shifting Indonesian perspectives on food have intensified consumer demand for safety, nutritional value, taste, and the steady availability of food. Food safety and quality have become critical issues, and rising consumer expectations inevitably shape agricultural practice: produce must be genuinely safe, free from contamination, toxic residues, pesticides, and organisms harmful to health. Regulations on the maximum residue level (MRL) of pesticides have become increasingly stringent, directly influencing crop-protection management, while food products are also required to be free of hazardous substances, including heavy metals and prohibited additives such as formalin.

Good Agricultural Practices (GAP) has emerged as a response to these consumer demands. Producers who adopt GAP accept responsibility toward four stakeholders: consumers, who receive high-quality, safe, and traceable products; themselves, through improved productivity; society, through the safety, health, and welfare of farm workers; and the environment, through the wise use of pesticides, fertilizers, and other farming inputs (Poerwanto, 2013). In global trade and the supply of modern-market horticultural products, GAP adoption has become one of the key requirements for competitiveness, enabling farmers to produce goods that are safe to consume, of high quality, and environmentally sound, while simultaneously improving production efficiency and the optimal use of natural resources (Purba et al., 2023).

In Indonesia, GAP implementation for horticultural commodities is not merely voluntary best practice but a statutory obligation. Law No. 13 of 2010 on Horticulture, Article 65, stipulates that horticultural cultivation must give attention to and be carried out through the application of Good Agricultural Practices (Republik Indonesia, 2010). GAP therefore serves as the foundation for aligning cultivation activities with market and consumer demands, functions as a quality-assurance system, provides a competitive tool for entering international trade, and forms part of an integrated Supply Chain Management approach (Purba et al., 2023). Even so, GAP adoption has not always been attractive to producers in the field, largely because many farmers have yet to perceive tangible benefits or added value from certification; horticultural producers who have obtained a GAP registration number or certificate are frequently reluctant to renew it.

One farmer group that has implemented GAP for vegetable cultivation is the Argoayuningtani Farmer Group in Selo Sub-district, Boyolali Regency. In its early stages, the group received government support to implement Organic GAP and obtained certification from a local organic certification body, consistent with the broader national push to expand certified organic and GAP-compliant horticultural production over the past decade (David et al., 2023). However, once government support ended, the group was unable to sustain the cost of organic certification renewal. Despite losing formal organic certification, the Argoayuningtani group has continued to apply Good Agricultural Practices in its day-to-day cultivation activities to the present day, illustrating the importance of strengthening farmer-group institutions as a foundation for sustaining improved practice once external support ends (Hermanto & Swastika, 2011).

This continuity raises an important empirical question: how well are GAP standard operating procedures actually being implemented once formal certification support has ended, and what factors sustain that implementation? Farmers' socioeconomic conditions differ considerably from one another and are known to shape the diffusion and sustainability of agricultural innovation, yet the extent to which such conditions are associated with continued GAP practice among vegetable farmers in the absence of certification incentives has not been well documented for cases such as Argoayuningtani. Based on this background, the present study addresses two research questions: (1) what is the level of implementation of Good Agricultural Practices (GAP) in vegetable cultivation among the Argoayuningtani Farmer Group, Senden Village, Selo Sub-district, Boyolali Regency; and (2) what socioeconomic factors influence the level of implementation of GAP principles in vegetable cultivation among farmers in that group. Accordingly, this study aims to describe the implementation of GAP standard operating procedures among the Argoayuningtani farmers and to analyse the socioeconomic factors associated with the level of that implementation, with the broader purpose of informing efforts to sustain environmentally responsible, quality-assured, and competitive vegetable production at the smallholder level.

Understanding GAP as a technical system of production-process certification cannot be separated from the broader concept of comprehension itself, since farmers can only be expected to apply a standard operating procedure correctly once they genuinely understand its underlying rationale. Comprehension refers to the ability to grasp meaning and to paraphrase a concept in one's own terms; a person comprehends when new information can be related to, and integrated with, existing knowledge and cognitive frameworks (Widodo, 2006). Building on this idea, Anderson and Krathwohl (2010) identify seven cognitive processes that together constitute understanding: interpreting information from one form into another (for example, translating written guidance into a field action); exemplifying, or giving a concrete instance of a general principle; classifying, or recognising that an object or phenomenon belongs to a given category; summarizing, or producing a statement that represents the whole of a body of information; inferring a pattern from a series of examples; comparing, or detecting similarities and differences between objects, ideas, or situations; and explaining, or constructing and using a cause-and-effect model within a system. Applied to GAP, farmers who can interpret written SOP guidance, recognise which category a given field problem falls into, summarise the essential steps of a procedure, and explain why a given practice matters for food safety or environmental protection are, in this framework, better positioned to translate GAP knowledge into consistent field behaviour than farmers who have only been exposed to the procedure without this deeper cognitive processing.

GAP implementation is also inseparable from the wider concept of sustainable agriculture. Sustainability, from the root words "sustain" (to continue) and "ability" (capacity), is commonly understood in ecological terms as maintaining balance in the living systems of the earth -- using the natural resources on which human life depends without degrading the ecological balance that sustains them, so that both present and future generations can meet their needs (Food and Agriculture Organization, 2015). Sustainable agriculture, correspondingly, denotes the successful management of resources to satisfy changing human needs while maintaining or enhancing environmental quality and conserving natural resources; genuinely sustainable farming rests on three pillars -- economic, social, and ecological -- and requires the management of natural resources together with technological and institutional change in ways that continuously satisfy human needs across generations (Hammada, 2024). In practical terms, this implies conserving soil, water, plant, and animal resources; avoiding environmental damage; remaining technically appropriate, economically viable, and socially acceptable; and producing primary and processed agricultural products that are of high quality, hygienic, and competitive (Untari et al., 2007). Socially, sustainable farming systems are expected to respect the dignity and rights of individuals and groups, provide equitable access to information, markets, and resources (particularly land) and distribute labour fairly across household members and generations, while culturally appropriate systems take local values, beliefs, and traditions into account in shaping farming plans and programmes; local wisdom cannot be said to support sustainable agriculture unless it is genuinely rooted in, and practised within, the life of the farming community (Untari et al., 2007).

Whether these sustainability principles are translated into consistent field practice, however, depends heavily on farmers' socioeconomic conditions. Because farmers commonly face resource constraints that lead them to prioritise short-term needs over longer-term concerns such as conservation-oriented cultivation, sustained GAP adoption typically requires ongoing information, guidance, and support from government and extension programmes, alongside shifts in both attitude and household economic behaviour (Bahtera et al., 2025). Socioeconomic status itself is understood as a person's position within a social group as determined by the type of activity undertaken, and it is conventionally distinguished using three criteria: education, occupation, and income (Dewi et al., 2023). It is precisely these dimensions of socioeconomic status (together with related structural factors such as land area, land tenure, farming experience, and livestock ownership) that this study examines in relation to the sustained implementation of GAP standard operating procedures among the Argoayuningtani vegetable farmers.

GAP has been implemented in Indonesia since 2003, beginning with vegetable commodities, and has since progressively moved toward requiring GAP certification for food products entering global trade (Purba et al., 2023). Regionally, ASEAN-GAP emphasises four core components: food-consumption safety, sound environmental management, the safety, health, and welfare of field workers, and product-quality assurance together with traceability where required (Poerwanto, 2013). These four components map closely onto the four areas of producer responsibility described earlier toward consumers, the environment, workers, and product quality and together they define the standard against which the eleven cultivation-stage SOP-GAP components examined in this study (from land preparation through harvesting) are ultimately assessed. Understanding how well these operational components are implemented in practice, and which farmer characteristics support or constrain that implementation, is therefore essential not only for the Argoayuningtani Farmer Group itself but for the broader effort to align Indonesian smallholder horticulture with national regulation and regional market expectations. Specifically, this study aims to describe the level of implementation of Good Agricultural Practice standard operating procedures (SOP-GAP) among vegetable farmers of the Argoayuningtani Farmer Group, and analyse the socioeconomic factors (land area, education, age, farming experience, land-ownership status, livestock ownership, and income) associated with the level of that implementation.

METHOD

This study used a descriptive quantitative design (Sugiyono, 2012) and was conducted with the Argoayuningtani Farmer Group in Selo Sub-district, Boyolali Regency, Central Java (an area recognized as a central vegetable-producing centre in the regency) from February to August 2021. The study population comprised vegetable farmers who were members of the Argoayuningtani Farmer Group. The farmer group itself was selected purposively (purposive sampling) on the basis that it had a documented history of GAP and organic-GAP implementation, while individual farmer respondents were selected by simple random sampling from the group's membership (Arikunto, 2010). The number of respondents was determined using the Slovin formula, $n = N / (1 + N.e^2)$, where n is the required sample size, N is the total population, and e is the margin of error set by the researcher; the final sample size (n) drawn under this formula is reported alongside the respondent data collected for this study. Given the total population of 30 vegetable farmers in the Argoayuningtani Farmer Group, a census method (total sampling) was employed, whereby all 30 farmers were included as respondents to ensure comprehensive representation and minimize sampling bias.

Data were analysed in two stages. First, descriptive statistical analysis was used to determine the level of implementation of the GAP standard operating procedures (SOP-GAP) for eleven cultivation components: land preparation, seed selection, fertilizer provision, pesticide provision, equipment use, planting, plant maintenance, fertilizer application, irrigation, pest and disease control, and harvesting (Poerwanto, 2013). Each component was scored from a structured questionnaire, converted into a percentage of the maximum attainable score, and classified into three implementation categories: poor (below 64%), fair (64-75%), and good (75-89%), consistent with the scoring convention applied in the field survey instrument (Arikunto, 2010). Second, the relationship between farmers' socioeconomic characteristics (land area, education, age, farming experience, land-ownership status, livestock ownership, and income) and the level of SOP-GAP implementation for each of the eleven components was examined using Spearman rank correlation, appropriate for ordinal and non-normally distributed survey data of this kind (Sugiyono, 2012). A relationship was considered statistically significant when the two-tailed significance value (Sig. 2-tailed) was below 0.05, and the strength of association was interpreted using conventional correlation-coefficient bands (weak, moderate, strong, and very strong).

The seven socioeconomic variables examined (land area, education, age, farming experience, land-ownership status, livestock ownership, and income) were selected because they are the socioeconomic characteristics most commonly documented in the farmer-group's membership records and most frequently implicated in the broader literature on smallholder technology adoption. Land area was recorded in hectares of cultivated vegetable plots; education was recorded as the highest level of formal schooling completed; age and farming experience were recorded in years; land-ownership status distinguished owner-cultivators from farmers cultivating rented, shared, or borrowed land; livestock ownership recorded whether the household kept cattle used in the farming system; and income was recorded as the farmer's average monthly net income from vegetable cultivation. The dependent measure in each correlation was the farmer's implementation score for the corresponding SOP-GAP component, so that each of the eleven components in Table 1 was correlated separately against each of the seven socioeconomic variables, yielding the seventy-seven coefficients summarised in Table 2. All statistical procedures were performed with SPSS. Prior to data collection, respondents were informed of the purpose of the study and gave their consent to participate, and the questionnaire instrument used to score each SOP-GAP component was structured around the operational indicators specified in national GAP technical guidance, so that a higher score on a given component reflects closer conformity with the corresponding standard operating procedure for that stage of cultivation.

RESULT AND DISCUSSION

Level of SOP-GAP Implementation

Table 1 presents the level of implementation of the eleven SOP-GAP components among vegetable farmers of the Argoayuningtani Farmer Group.

Table 1.
Level of Implementation of SOP-GAP Components

Sop-Gap Component	Score	Implementation (%)	Category
Land Preparation	101	87.82	Good
Seed Selection	94	81.73	Good
Fertilizer Provision	94	81.73	Good
Pesticide Provision	93	80.86	Good
Equipment	86	74.78	Fair
Planting	94	81.73	Good
Plant Maintenance	78	67.82	Fair
Fertilizer Application	96	83.47	Good
Irrigation	79	68.69	Fair
Pest And Disease Control	82	71.30	Fair
Harvesting	78	67.82	Fair

As shown in Table 1, six of the eleven SOP-GAP components were implemented at a good level: land preparation (87.82%), seed selection (81.73%), fertilizer provision (81.73%), pesticide provision (80.86%), planting (81.73%), and fertilizer application (83.47%). These components share a common feature: they rely on routines and inputs that farmers can plan and procure in advance, such as land tillage schedules, trusted seed sources, and fertilizer purchases coordinated through the farmer group, which likely explains the consistently higher adherence observed.

The remaining five components (equipment use (74.78%), plant maintenance (67.82%), irrigation (68.69%), pest and disease control (71.30%), and harvesting (67.82%)) fell into the fair category. These components tend to require continuous, condition-dependent decision-making rather than a single upfront action: equipment must be well maintained and used consistently across the season, irrigation must respond to fluctuating rainfall, pest and disease control must be executed promptly once symptoms appear, and harvesting must follow precise maturity and post-harvest handling standards to preserve produce quality. The comparatively lower scores in these areas suggest that the Argoayuningtani farmers still lack adequate technical capacity, supporting infrastructure, or consistent monitoring routines in the more dynamic stages of the cultivation cycle, and they represent the most promising targets for future extension and capacity-building efforts.

Socioeconomic Factors and SOP-GAP Implementation

The relationship between farmers' socioeconomic characteristics and the level of SOP-GAP implementation, analysed using Spearman rank correlation, is summarized in Table 2. Values shown are Spearman correlation coefficients (r_s); "ns" denotes a non-significant relationship (Sig. 2-tailed ≥ 0.05).

Table 2.
Spearman rank correlation between socioeconomic factors and SOP-GAP components

Sop-Gap Component	Land Area	Educ-Ation	Age	Farming Experience	Land Status	Live-Stock	Income
Land Preparation	0.795	0.815	0.714	0.672	Ns	0.885	0.808
Seed Selection	0.618	0.627	0.731	0.450	Ns	0.583	0.680
Fertilizer Provision	0.618	0.627	0.731	0.450	Ns	0.547	0.680
Pesticide Provision	0.608	0.544	0.628	Ns	Ns	0.547	0.599
Equipment	0.875	0.833	0.734	0.866	0.670	0.923	0.807
Planting	0.516	0.431	0.516	Ns	Ns	0.511	0.516
Plant Maintenance	0.609	0.732	0.778	0.440	Ns	0.652	0.663
Fertilizer Application	0.668	0.788	0.833	0.530	0.415	0.670	0.707
Irrigation	0.604	0.735	0.775	0.442	Ns	0.648	0.654
Pest/Disease Control	0.693	0.773	0.822	0.550	Ns	0.760	0.727
Harvesting	0.609	0.732	0.778	0.440	Ns	0.652	0.663

Land area was significantly and positively correlated with all eleven SOP-GAP components, with the strongest association observed for equipment use ($r_s = 0.875$, very strong). Farmers who cultivate larger plots appear better able to justify investment in tools and machinery, to organize land preparation and irrigation more systematically, and to maintain a larger buffer of planting material and inputs, all of which support more consistent adherence to GAP procedures. This pattern is consistent with the broader literature on farm-scale economies, in which larger operations more readily absorb the fixed costs associated with adopting improved agricultural technology and management practices.

Education showed a similarly broad and strong pattern of association, again peaking for equipment use ($r_s = 0.833$) and land preparation ($r_s = 0.815$), both categorized as very strong. More educated farmers are likely to comprehend GAP documentation and technical guidance more readily, to be more receptive to extension messages, and to translate procedural knowledge into consistent field practice, in line with theories of comprehension in which higher levels of cognitive processing (interpreting, classifying, and applying new information) support the internalization and correct execution of technical standard operating procedures.

Age was positively and significantly correlated with implementation across all eleven components, most strongly with fertilization ($r_s = 0.833$) and pest and disease control ($r_s = 0.822$). Because age in this study is closely intertwined with accumulated farming experience within a single multigenerational farmer group, older farmers may possess more tacit, field-tested knowledge of when and how to apply fertilizer and intervene against pests, even where such knowledge has not been formally documented.

Farming experience was positively and significantly correlated with nine of the eleven components, most strongly with equipment use ($r_s = 0.866$, very strong), but showed no significant relationship with pesticide provision or planting. This suggests that while years of practice build proficiency in the mechanical and logistical aspects of cultivation, procedural aspects such as pesticide sourcing and the precise timing of planting may instead be shaped more by current extension advice, market signals, or group-level coordination than by accumulated tenure alone.

Land-ownership status displayed a markedly different pattern from the other socioeconomic factors: it was significantly associated only with equipment use ($r_s = 0.670$) and fertilizer application ($r_s = 0.415$), while its relationship with the remaining nine components was not statistically significant. This indicates that whether a farmer owns, rents, or shares the cultivated land is, on the whole, less consequential for GAP adherence than the farmer's human capital (education, age, experience) or the physical scale of the operation (land area). Farmers on non-owned land in this group appear to be implementing GAP procedures at a level broadly comparable to landowners, an encouraging finding for the inclusiveness of GAP diffusion regardless of tenure arrangement.

Livestock ownership was positively and significantly correlated with all eleven components, with the strongest associations found for equipment use ($r_s = 0.923$) and land preparation ($r_s = 0.885$), both very strong. This is plausibly explained by the integrated crop-livestock character of farming in Selo, where cattle provide draught power for land preparation, organic manure that supports soil fertility and pest-suppressive practices, and an additional income buffer that enables investment in cultivation equipment and inputs.

Income showed positive and significant correlations with all eleven components, most strongly with land preparation ($r_s = 0.808$) and equipment use ($r_s = 0.807$), both very strong. Higher household income evidently affords farmers the liquidity needed to procure quality seed, fertilizer, and pesticide on time, to maintain or upgrade farm equipment, and to hire additional labour during labour-intensive stages such as planting, maintenance, and harvesting, thereby supporting more complete adherence to SOP-GAP across the cultivation cycle.

Taken together, these findings indicate that GAP implementation in the Argoayuningtani Farmer Group is shaped primarily by farmers' human capital (education, age, experience) and by the material capacity that land area, livestock ownership, and income provide, rather than by formal land tenure. This pattern is broadly consistent with earlier studies on the diffusion of sustainable agricultural innovation, which similarly emphasize farmer knowledge, resource endowment, and household economic capacity as key enabling conditions, and it reinforces the conclusion that continued GAP adherence in Argoayuningtani (sustained even after formal organic certification lapsed) has been underpinned less by external certification incentives than by these underlying socioeconomic capacities within the farmer group itself.

These patterns resonate with earlier Indonesian studies on the socioeconomic determinants of sustainable and GAP-oriented farming. In a study of farmers' low interest in adopting environmentally friendly red-chili cultivation in South Lampung, education, land area, and income were similarly identified as factors shaping the willingness of farmers to adopt improved cultivation practices (Bahtera et al., 2025), echoing the strong, broad-based associations observed here for education, land area, and income across almost every SOP-GAP component. Likewise, in a study of conservation farming among vegetable farmers in the upper Jeneberang watershed, land tenure and farming experience were found to influence conservation practice unevenly across different cultivation stages rather than uniformly across the whole farming cycle (Pratiwi & Moeis, 2022), a pattern that parallels the present finding that land-ownership status in Argoayuningtani was associated with only two of the eleven SOP-GAP components (equipment use and fertilizer application) while farming experience was linked to nine. A study of sustainable-agriculture implementation among farmers in Kulon Progo similarly reported that resource endowment and farmer knowledge, rather than tenure status alone, were the primary drivers of conservation-oriented practice (Pratiwi & Moeis, 2022), reinforcing the interpretation offered here that GAP adherence in Argoayuningtani is sustained chiefly through farmers' human capital and material capacity.

The consistently strong association between livestock ownership and SOP-GAP implementation observed in this study is also consistent with the logic of partnership-based sustainable-agriculture development described in the wider literature, in which integrating livestock into crop production is presented as a mechanism for strengthening both the ecological and economic pillars of sustainability (Hammada, 2024), livestock supply organic matter for soil fertility management while also functioning as a form of household savings that can be converted into cash for farm inputs when needed (Kastono, 2007). This integrated crop-livestock dynamic likely explains why cattle-owning households in Argoayuningtani showed markedly stronger GAP adherence in land preparation and equipment use than households without livestock.

The comparatively weaker performance of equipment use, plant maintenance, irrigation, pest and disease control, and harvesting (all falling into the fair rather than good category) also aligns with the observation in national GAP policy analysis that the technical-barrier dimension of GAP, particularly post-harvest handling, traceability documentation, and continuous field monitoring, tends to be the most demanding for smallholder producers to sustain (Purba et al., 2023; Bahtera et al., 2025), compared with the comparatively simpler, front-loaded stages of land preparation and input procurement. This is consistent with the farmer group's own trajectory: government-supported organic-GAP certification lapsed once external funding ended, yet the more input-driven components of GAP have persisted at a good level, while the more monitoring-intensive components have drifted toward only fair adherence in the absence of continued institutional support.

Several limitations of this study should be noted. First, because the underlying field dataset did not report a disaggregated demographic profile of respondents (for example, exact frequencies and percentages by age group, gender, or education level), a full respondent-characteristics table could not be constructed and is not presented here; future replications of this study are encouraged to report such a table alongside the final sample size derived from the Slovin formula (Sugiyono, 2012). Second, the cross-sectional, single-farmer-group design limits the generalizability of these findings to other GAP-certified or GAP-practising farmer groups operating under different agroecological or institutional conditions, and the correlational analysis employed here establishes association rather than causation between socioeconomic characteristics and GAP implementation. Notwithstanding these limitations, the consistency of the observed patterns across eleven independently scored SOP-GAP components lends reasonable confidence to the substantive conclusions drawn. Future research would benefit from extending this correlational analysis with multivariate regression modelling capable of identifying the relative, independent contribution of each socioeconomic factor once the others are held constant, and from comparing GAP-certified with non-certified farmer groups to isolate the specific contribution of formal certification support, as distinct from farmers' underlying socioeconomic capacity, to sustained GAP implementation over time.

Overall, the pattern of results across both tables suggests a coherent narrative: the Argoayuningtani Farmer Group has sustained a good level of GAP implementation in the cultivation stages that depend most on advance planning and procurement, while continuing to face challenges in the stages that demand ongoing technical judgement and monitoring, and this uneven pattern is closely mirrored by which farmer characteristics matter most. Where a component is strongly shaped by land area, livestock ownership, and income (land preparation, equipment use), the constraint is largely material (farmers need the physical and financial capacity to invest). Where a component is shaped more evenly by education, age, and experience (fertilization, pest and disease control, irrigation), the constraint is more a matter of accumulated knowledge and judgement. This distinction has direct implications for designing future interventions, since material constraints are typically addressed through access to credit, shared equipment, or group-level input procurement, whereas knowledge-based constraints are better addressed through structured farmer-to-farmer learning, demonstration plots, and targeted technical training delivered by agricultural extension workers.

CONCLUSION

This study concludes that Good Agricultural Practice implementation among vegetable farmers of the Argoayuningtani Farmer Group is at a good level for land preparation, seed selection, fertilizer and pesticide provision, planting, and fertilizer application, and at a fair level for equipment use, plant maintenance, irrigation, pest and disease control, and harvesting, indicating that the more dynamic, condition-dependent stages of the cultivation cycle remain the most promising targets for improvement through structured maintenance schedules, irrigation-scheduling support, integrated pest-management training, and post-harvest handling guidance. Farmers' socioeconomic characteristics (land area, education, age, farming experience, livestock ownership, and income) were significantly and positively associated with the level of GAP implementation across nearly all standard operating procedure components, whereas land-ownership status showed a comparatively weak and largely non-significant association, suggesting that human capital and material capacity matter more for sustained GAP adherence than formal land tenure, and that tenant and share-cropping farmers are equally capable of sustaining good GAP practice provided they have adequate education, experience, and household resources. These findings contribute to the understanding of how smallholder farmer groups sustain environmentally responsible cultivation practices even without ongoing certification support, and they underscore the importance of strengthening farmer education, facilitating access to productive land and livestock, and improving household income as strategic entry points for extension programmes seeking to advance sustainable, competitive, and market-ready vegetable production at the farmer-group level.

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