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Production Cost, Selling Price, Harvest Volume, and Land Area as Determinants of Smallholder Vegetable Farmers' Profitability in Garung, Wonosobo: Implications for Rural Livelihoods

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ABSTRACT

Purpose of the study: This study aims to analyse the effect of production cost, selling price, harvest volume, and land area on the profitability of vegetable farmers in Garung District, Wonosobo Regency, Indonesia, using individual farmers as the unit of analysis. Vegetable farming is a key source of cash income for smallholder households in this highland area, where farmers face rising input costs, volatile farm-gate prices, dependence on collectors, and the conversion of farmland to tourism uses.

Methodology: This quantitative explanatory study used a cross-sectional survey of 80 vegetable farmers selected by purposive sampling. Primary data on production cost, farm-gate price, harvest volume, cultivated land, and net profit margin for the latest growing season were collected through structured interviews and analysed with multiple linear regression, classical assumption tests, t-tests, and F-tests in IBM SPSS 31.

Main Findings: Production cost had a negative and significant effect on profitability ($\beta = -0.604$; $p < 0.001$), whereas selling price ($\beta = 0.535$), harvest volume ($\beta = 0.601$), and land area ($\beta = 0.424$) had positive and significant effects ($p < 0.001$). Jointly, the four variables were significant ($F = 62.341$; $p < 0.001$) and explained 75.6% of the variation in farmers' net profit margin.

Novelty/Originality of this study: Unlike earlier studies that used regional secondary data or income in rupiah, this study uses farm-level primary data from highland vegetable farmers and measures profitability as net profit margin, allowing fair comparison across farm sizes. It also links land area to profitability in an area under tourism-driven land conversion, informing farmer-level cost control and farmland protection policy. Socioeconomically, the findings show that the economic sustainability of smallholder vegetable farming depends on reducing dependence on costly external inputs, strengthening farmers' bargaining position in agricultural markets, and securing access to farmland, which together underpin the continuity of farming as a rural livelihood.

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1. INTRODUCTION

Agriculture remains a strategic sector in Indonesia's economy because it supplies food, absorbs a large share of rural labour, and sustains household incomes in villages. Within agriculture, horticulture, and vegetables in particular, offers smallholders short production cycles, high value per unit of land, and year-round demand,

which is why diversification into vegetables is widely regarded as a pathway out of rural poverty [1], [2]. Vegetable farming also supports local economic activity: it creates demand for hired labour, input kiosks, transport and trading services, and the cash earned from frequent harvests helps households meet daily needs, school fees and other expenses [3]. Most of these vegetables are produced by smallholders who cultivate less than two hectares [4]. In Wonosobo Regency, Central Java, vegetable farming is the main livelihood of many households, especially in Garung District, a highland production centre bordering the Dieng Plateau, where potato, cabbage, carrot and other highland vegetables dominate household farming [5], [6].

The central actor in this production system is the individual farmer. Each farmer acts as the manager of the farm: deciding how much land to plant, how much seed, fertiliser, pesticide and labour to use, when to harvest, and to whom and at what price the harvest is sold [1], [7]. Farm success is therefore not measured by output alone but by the ability of each farmer's enterprise to generate profit. Profitability reflects how efficiently an enterprise converts its resources into earnings [7], and a profitable farm is more likely to be sustained across growing seasons. From a rural livelihood perspective, farm profit is the economic base that allows a household to keep farming, reinvest in the next season and absorb shocks, whereas persistent losses push households towards debt, wage labour or the sale of land [8], [9]. Understanding what drives farm profitability is therefore a social as well as a financial question.

Profit theory states that profit is the difference between total revenue and total cost [7]. On the revenue side, a farmer's receipts are the product of the quantity sold and the price received [10]; on the cost side, they depend on the amount and efficiency of inputs and on the scale of the land cultivated [1], [7]. Production cost, selling price, harvest volume and land area are therefore natural candidates for explaining farm profitability. In practice, however, vegetable farmers face rising prices of seed, fertiliser, pesticides and wages. Highland vegetable farming relies heavily on purchased external inputs, so changes in fertiliser prices and subsidy policy are transmitted directly to farmers' costs, while smallholders have little room to pass these costs on to buyers [11], [12]. At the same time, farm-gate prices fluctuate with the season and with farmers' weak bargaining position towards collectors [13], [14]. International evidence also shows that the relationship between farm size and farm performance is not uniform and depends on how land is managed [15], [7].

Farmers' bargaining position is not only a market issue but also a social one. Many smallholders sell to collectors or middlemen who provide transport, quick cash payment and, at times, informal credit before harvest; these ties secure a market outlet but limit farmers' freedom to seek better prices [13], [14]. Limited access to price information, storage and alternative marketing channels leaves farmers as price takers, so part of the value of their harvest is retained by intermediaries. Market access thus shapes how much of the revenue generated on the farm actually remains with farming households.

Garung District illustrates these pressures. Tourism growth around Dieng has encouraged conversion of farmland into villas, homestays, restaurants and other commercial buildings, a process also observed in other Indonesian regions under urban pressure [16], [17]. Such conversion does more than reduce the area planted: it raises land prices and rents, makes it harder for young and tenant farmers to obtain land, and can push some households out of farming into tenancy, wage labour or informal work [9], [17]. Tourism may open new income opportunities, but it also changes the social and economic structure of farming communities and their access to productive resources [18]. Shrinking cultivated land may reduce harvest volume, while input costs rise and selling prices remain volatile. Ideally, farmers in a highland horticultural centre with favourable agro-climatic conditions should earn high returns; in reality, their profitability is threatened by cost increases, price fluctuation, variable harvests and land conversion. This gap between expected and actual conditions motivates the present study.

Previous studies on the determinants of farm income provide mixed evidence. Production cost, land area, production volume and selling price significantly affected the income of rice farmers in Bangkalan [19], whereas in Ngawi land area and selling price were significant but production volume was not [20]. Among vegetable farmers, production cost and selling price significantly affected income in Muna [21], selling price, production cost and land area jointly explained the income of horticultural farmers in East Java [10], and land area, capital and production volume increased the income of vegetable farmers in Bali [22]. Vegetable farming has also been found financially feasible with revenue–cost ratios above one [23]. Selling price and production cost likewise affected chilli farmers' income [24], and land tenure size was the most influential factor for farm profitability in Tasikmalaya [25].

Three gaps emerge from this literature. First, most studies focus on rice, maize or oil palm rather than highland vegetables. Second, most use income in rupiah as the dependent variable, a measure that rises mechanically with farm size and therefore cannot compare the efficiency of small and large farmers; a ratio such as net profit margin is better suited for this purpose [7], [1]. Third, few studies treat the individual farmer as the unit of analysis in an area experiencing tourism-driven land conversion, and most discuss farm income only in financial terms without relating it to the market, land and livelihood conditions of rural households. This study addresses these gaps by using farm-level primary data from vegetable farmers in Garung District and measuring profitability as net profit margin.

The novelty of this study lies in three aspects. It examines highland vegetable farmers, a group that has received less attention than rice farmers; it measures profitability as net profit margin, which allows small and large farms to be compared fairly; and it interprets the determinants of profitability in the context of tourism-driven land conversion around the Dieng Plateau. The study is urgent because rising input costs, volatile prices and shrinking farmland are occurring at the same time in Garung, and farmer-level evidence is needed to design extension, marketing and land-use policies before more productive farmland is lost [16], [17]. Accordingly, the primary objective of this study is to analyse the effect of production cost, selling price, harvest volume and land area on the profitability of vegetable farmers in Garung District, Wonosobo Regency, and to interpret the findings in terms of the economic sustainability of smallholder farming households.

Based on profit theory and previous findings, four hypotheses are proposed. Higher production cost reduces the share of revenue retained as profit [7], [10]; hence H1: production cost has a negative effect on farmers' profitability. A higher price raises revenue from the same harvest without raising cost [10], [21]; hence H2: selling price has a positive effect on profitability. A larger harvest from the same resources raises revenue and lowers unit cost [3], [22]; hence H3: harvest volume has a positive effect on profitability. A larger farm allows economies of scale in equipment, family labour and fixed costs [7], [25]; hence H4: land area has a positive effect on profitability. The research model is shown in Figure 1.

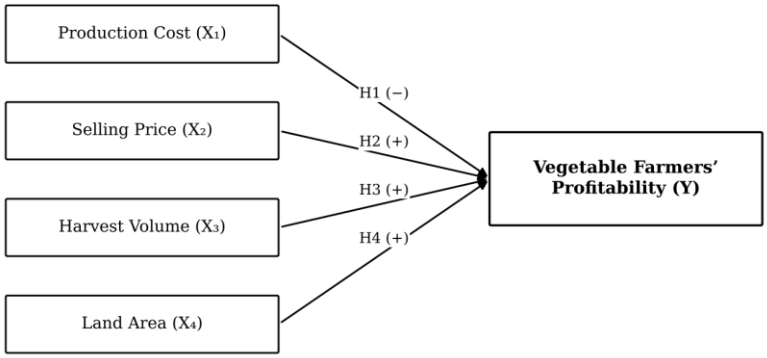

Figure 1. Research model

2. RESEARCH METHOD

2.1. Type of Research

This study used a quantitative approach with an explanatory, cross-sectional survey design [26]. An explanatory design was chosen because the study tests the hypothesised direction of the effects of four farm-level economic variables on profitability, while the cross-sectional design observes all farmers in the same growing season. The unit of analysis was the individual vegetable farmer as farm manager, so that each observation describes one farmer's enterprise during the latest completed growing season. The study was conducted in Garung District, Wonosobo Regency, Central Java, which was selected purposively because it is a highland vegetable centre where most residents farm vegetables and where farmland is under pressure from tourism development.

2.2. Research Subjects

The population comprised all vegetable farmers living and farming in Garung District. Because no complete list of individual farmers was available, the population size was treated as unknown and respondents were selected by purposive sampling [27] using four criteria: (1) residing and cultivating vegetables in Garung District; (2) managing the farm directly as decision-maker on owned, rented or sharecropped land; (3) having harvested and sold at least one complete growing season; and (4) being able to report costs, prices, harvest and revenue and willing to be interviewed. Sample size followed the recommendation that ordinary least squares models should have at least 10–15 observations per independent variable to avoid overfitting [28]. With four independent variables, 80 farmers were interviewed (20 observations per variable), which exceeds this minimum.

2.3. Research Instruments and Data Collection Techniques

The research instrument was a structured questionnaire whose items were derived directly from the operational definitions of the variables in Table 1. Primary data were collected through structured face-to-face interviews using a questionnaire with four parts: farmer identity; cultivated land and tenure; itemised production costs (fixed costs such as land rent, depreciation and land tax, and variable costs such as seed, fertiliser, pesticide,

labour and other operating costs); and harvest volume, quantity sold, average farm-gate price and total revenue. Answers were cross-checked against farm records, input receipts or sales notes where available and screened for internal consistency. Because all variables are factual ratio-scale data rather than perception scores, item validity and reliability tests were not applicable. Secondary data from Statistics Indonesia were used only to describe the study area. The operational definitions are presented in Table 1.

Table 1. Operational definitions of variables

Variable	Operational definition and indicator	Unit
Production cost (X_1)	Total fixed costs (land rent, equipment depreciation, land tax) and variable costs (seed, fertiliser, pesticide, labour, other operating costs) incurred by the farmer in one growing season [7]	IDR/season
Selling price (X_2)	Average farm-gate price received by the farmer for the vegetables sold in one growing season [10]	IDR/kg
Harvest volume (X_3)	Total quantity of vegetables harvested by the farmer in one growing season [3]	kg/season
Land area (X_4)	Area cultivated with vegetables by the farmer in the growing season observed [25]	ha
Profitability (Y)	Net profit margin = (total revenue − total cost) ÷ total revenue × 100% [7]	%

2.4. Data Analysis Techniques

Data were analysed with IBM SPSS Statistics 31. The analysis consisted of descriptive statistics; classical assumption tests, namely the Kolmogorov–Smirnov test with Lilliefors correction for normality of residuals [29], [30], tolerance and variance inflation factor (VIF) for multicollinearity with thresholds of tolerance > 0.10 and VIF < 10 [31], and the Glejser test for heteroscedasticity [32], [33] confirmed by a scatterplot and the Koenker version of the Breusch–Pagan test [34], [35]; and multiple linear regression as specified in Equation (1) [30].

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e \qquad \ldots (1)$$

where Y is net profit margin (%), α is the constant, β_1–β_4 are regression coefficients, X_1 is production cost, X_2 is selling price, X_3 is harvest volume, X_4 is land area, and e is the error term. Hypotheses were tested with the t-test (critical t = 1.992 at $\alpha = 0.05$, df = 75) and the F-test (critical F = 2.494, df = 4; 75), and explanatory power was assessed with the adjusted R^2. Because the data are cross-sectional, autocorrelation testing was not required.

2.5. Research Procedure

The research was carried out in six stages, as shown in Figure 2. (1) Preliminary study: identifying the research problem in Garung District, reviewing the literature and formulating the hypotheses. (2) Instrument preparation: deriving the questionnaire items from the operational definitions of each variable. (3) Sampling: identifying vegetable farmers who met the four purposive criteria. (4) Data collection: conducting structured face-to-face interviews with 80 farmers and cross-checking answers against farm records, receipts or sales notes. (5) Data processing: screening the data for completeness and consistency, calculating total cost, total revenue and net profit margin for each farmer, and entering the data into IBM SPSS 31. (6) Data analysis and reporting: running descriptive statistics, classical assumption tests and multiple linear regression, testing the hypotheses, and interpreting the results.

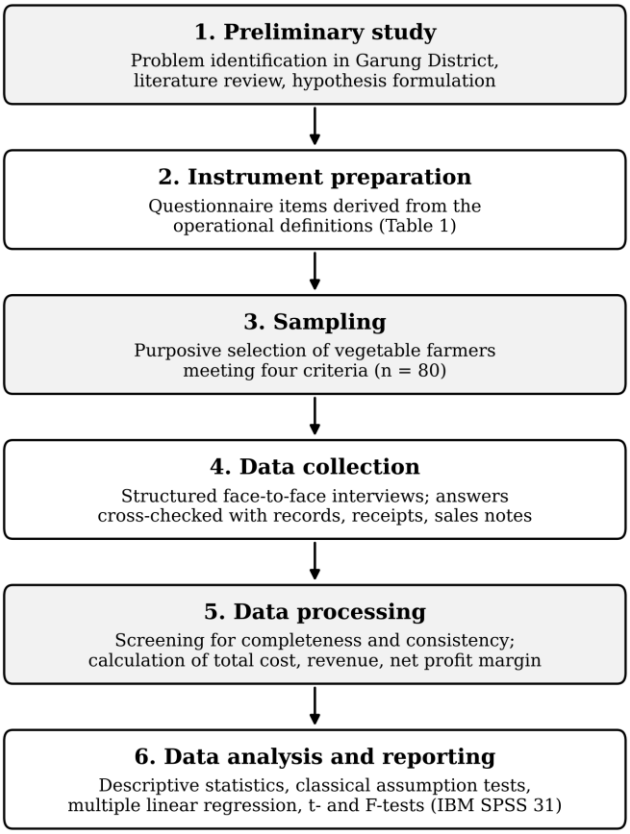

Figure 2. Research procedure flowchart

3. RESULTS AND DISCUSSION

3.1. Respondent Profile and Descriptive Statistics

All 80 questionnaires were complete, so no case was excluded. Most respondents (75.0%) cultivated 0.51–1.00 ha, 13.75% cultivated 0.50 ha or less, and 11.25% cultivated more than 1 ha, indicating that vegetable farming in Garung is dominated by small- to medium-scale farmers. This distribution reflects the wider structure of smallholder agriculture, in which most farms operate less than two hectares [4], so the findings speak mainly to the conditions of small family farms whose livelihoods are closely tied to vegetable farming. The descriptive statistics are shown in Table 2.

Table 2. Descriptive statistics (n = 80)

Variable	N	Minimum	Maximum	Mean	Std. deviation
Production cost (X_1)	80	2,549,823	23,284,707	11,882,887.55	3,935,410.69
Selling price (X_2)	80	4,713	9,000	7,326.44	775.13
Harvest volume (X_3)	80	3,491	14,886	8,328.50	2,303.40
Land area (X_4)	80	0.25	1.21	0.729	0.204
Net profit margin (Y)	80	76.73	96.51	87.001	3.994

Source: primary data processed with IBM SPSS 31 (2026).

Production cost ranged from IDR 2.55 million to IDR 23.28 million per season (mean IDR 11.88 million), reflecting differences in scale and input intensity. Farm-gate prices ranged from IDR 4,713 to IDR 9,000 per kg (mean IDR 7,326), mirroring differences in selling time, quality and marketing channel. Harvest volume averaged 8,328.5 kg per season and cultivated land averaged 0.73 ha. Net profit margin ranged from 76.73% to 96.51% with a mean of 87.00%, meaning that, on average, farmers retained about IDR 87 of profit from every IDR 100 of revenue in the season observed.

3.2. Classical Assumption Tests

The results of the classical assumption tests are summarised in Table 3. The Kolmogorov–Smirnov statistic was 0.086 with an asymptotic significance of 0.200 (> 0.05), so the residuals were normally distributed; the normal P–P plot in Figure 3 also shows residuals lying along the diagonal. All tolerance values exceeded 0.10

and all VIF values were below 10 (highest 1.843), so multicollinearity was absent. The moderate correlation between production cost and land area is expected, since larger farms require more inputs.

Table 3. Results of classical assumption tests

Test	Variable	Result	Criterion	Conclusion
Normality	Kolmogorov–Smirnov (Lilliefors)	Statistic = 0.086; Sig. = 0.200	Sig. > 0.05	Normal
Multicollinearity	Production cost (X_1)	Tolerance = 0.543; VIF = 1.843	Tol. > 0.10; VIF < 10	No multicollinearity
Multicollinearity	Selling price (X_2)	Tolerance = 0.989; VIF = 1.011	Tol. > 0.10; VIF < 10	No multicollinearity
Multicollinearity	Harvest volume (X_3)	Tolerance = 0.886; VIF = 1.128	Tol. > 0.10; VIF < 10	No multicollinearity
Multicollinearity	Land area (X_4)	Tolerance = 0.545; VIF = 1.835	Tol. > 0.10; VIF < 10	No multicollinearity
Heteroscedasticity (Glejser)	Production cost (X_1)	t = 1.187; Sig. = 0.239	Sig. > 0.05	Homoscedastic
Heteroscedasticity (Glejser)	Selling price (X_2)	t = -2.029; Sig. = 0.046	Sig. > 0.05	Marginal
Heteroscedasticity (Glejser)	Harvest volume (X_3)	t = 0.118; Sig. = 0.906	Sig. > 0.05	Homoscedastic
Heteroscedasticity (Glejser)	Land area (X_4)	t = -0.243; Sig. = 0.809	Sig. > 0.05	Homoscedastic
Heteroscedasticity (Koenker–BP)	Whole model	LM = 5.788; Sig. = 0.216	Sig. > 0.05	Homoscedastic

Source: primary data processed with IBM SPSS 31 (2026).

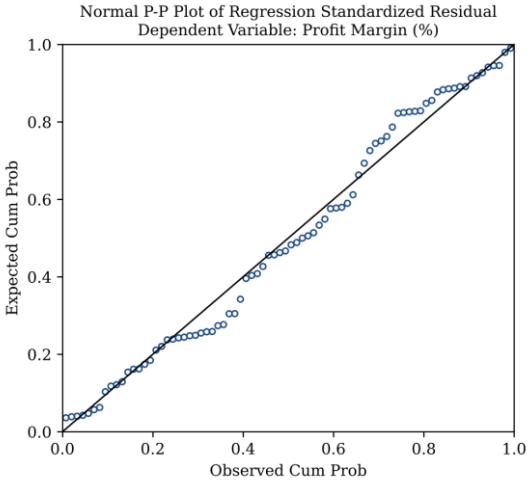

Figure 3. Normal P–P plot of regression standardised residuals

For heteroscedasticity, the Glejser test produced significance values above 0.05 for production cost, harvest volume and land area, while selling price was marginal (p = 0.046). The Koenker–Breusch–Pagan test gave LM = 5.788 (p = 0.216), and the scatterplot in Figure 4 shows residuals spread randomly around zero without a funnel or wave pattern. Taken together, these results indicate no serious heteroscedasticity, although the marginal Glejser result for selling price is acknowledged as a limitation.

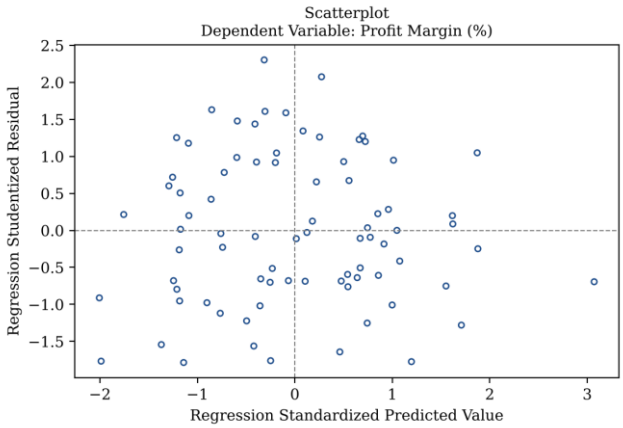

Figure 4. Scatterplot of studentised residuals against standardised predicted values

3.3. Regression Results and Hypothesis Testing

The regression estimates are reported in Table 4, yielding Equation (2).

$$Y = 59.366 - 6.128\times10^{-7}X_1 + 0.002754X_2 + 0.001043X_3 + 8.303X_4 \quad \ldots(2)$$

Table 4. Multiple linear regression and hypothesis test results

Variable	B	Std. error	Beta	t	Sig.	Decision
(Constant)	59.366	2.357	–	25.185	0.000	–
Production cost (X_1)	-6.128E-07	7.651E-08	-0.604	-8.010	0.000	H1 accepted
Selling price (X_2)	2.754E-03	2.877E-04	0.535	9.574	0.000	H2 accepted
Harvest volume (X_3)	1.043E-03	1.023E-04	0.601	10.197	0.000	H3 accepted
Land area (X_4)	8.303	1.471	0.424	5.644	0.000	H4 accepted

Dependent variable: net profit margin (%). $R = 0.877$; $R^2 = 0.769$; adjusted $R^2 = 0.756$; std. error of estimate = 1.971; $F = 62.341$ (Sig. 0.000). Critical t = 1.992; critical F = 2.494 ($\alpha = 0.05$). Source: primary data processed with IBM SPSS 31 (2026).

All four coefficients were significant at the 5% level with the hypothesised signs, so H1–H4 were accepted. Holding other variables constant, an increase in production cost of IDR 1 million per season lowered net profit margin by 0.613 percentage points; an increase in selling price of IDR 1,000 per kg raised it by 2.754 points; an additional 1,000 kg of harvest raised it by 1.043 points; and an additional 0.1 ha of cultivated land raised it by 0.830 points. Based on standardised coefficients, production cost had the largest absolute effect ($\beta = -0.604$), followed closely by harvest volume ($\beta = 0.601$), selling price ($\beta = 0.535$) and land area ($\beta = 0.424$). The F-test ($F = 62.341 > 2.494$; $p < 0.001$) shows that the four variables jointly affected profitability, and the adjusted R^2 of 0.756 indicates that they explained 75.6% of the variation in net profit margin, with the remaining 24.4% attributable to factors outside the model such as crop type, farming experience, seed quality, market access and weather. In socioeconomic terms, these magnitudes are meaningful for small farms: because most respondents cultivate one hectare or less, modest changes in input costs or farm-gate prices translate into noticeable changes in the share of revenue that farming households retain.

3.4. Discussion

The negative effect of production cost confirms profit theory: for a given revenue, every additional rupiah spent on seed, fertiliser, pesticide or labour reduces the share of revenue retained as profit [7]. This direction differs from studies reporting a positive effect of production cost on income [21] but agrees with recent evidence from horticultural farmers in East Java, where production cost reduced farm income [10]. The difference is consistent with the choice of dependent variable: income in rupiah grows with the scale of spending, whereas net profit margin captures how efficiently spending is converted into profit. Socioeconomically, the finding reflects the pressure created by smallholders' dependence on external agricultural inputs. Highland vegetable farming in Garung relies on purchased seed, chemical fertiliser and pesticides whose prices are set outside the village and are influenced by national subsidy and distribution policies [11], [12]. When these prices rise, farmers cannot easily raise their selling prices, so the cost increase is absorbed by the household as a lower margin. Farmers with limited working capital may also obtain inputs on credit from kiosks or collectors, which raises effective costs and ties them to particular buyers [14]. The finding highlights cost efficiency as a key lever for farmers in Garung, for example through recommended fertiliser doses, integrated pest management, partial substitution with on-farm organic inputs and collective purchasing of inputs through farmer groups [1].

Selling price had a positive effect because a higher price raises revenue from the same harvest without increasing cost [10]. This supports earlier evidence among vegetable, chilli and rice farmers [24], [21], [20]. However, the price a farmer receives is not determined by the market alone; it is shaped by the farmer's bargaining position, access to markets and dependence on middlemen. Since vegetable farmers are typically price takers who depend on collectors [13], the wide range of farm-gate prices observed in this study (IDR 4,713–9,000 per kg) suggests that farmers with better market information, larger volumes or alternative buyers obtain better terms than those tied to a single collector. Collective trading arrangements can strengthen farmers' position, but only when they offer prompt payment and include resource-poor farmers [14]. Hence, improving farm-gate prices through group marketing, grading and sorting, access to market price information and staggered planting to avoid selling at peak harvest offers substantial room for raising profitability and for widening the economic opportunities available to smallholders.

Harvest volume had one of the strongest positive effects. Farmers who obtain larger harvests from similar costs and land enjoy lower unit costs and thus higher margins, in line with evidence that higher vegetable output raises the income of rural farming households [3] and with evidence from vegetable and rice farmers [22], [19]. The contrast with the insignificant production effect among rice farmers in Ngawi [20] can be explained by the nature of the crops: rice farmers retain part of their harvest for household consumption, whereas perishable vegetables are almost entirely sold, so additional harvest translates directly into revenue. Production outcomes also

matter for the continuity of farming. A good harvest generates the cash needed to buy inputs for the next season without borrowing, whereas a poor harvest caused by pests, disease or extreme highland weather can leave a farmer unable to cover costs and threaten the continuation of the farm enterprise [5]. Although household welfare was not measured in this study, the result implies that stable and adequate harvests are a precondition for the economic security that rural households derive from vegetable farming. Measures that reduce production risk, such as improved seed, pest management and soil conservation on steep highland slopes [6], therefore support not only profitability but also the sustainability of farming as a livelihood.

Land area also had a positive effect, indicating economies of scale in the use of equipment, family labour and fixed costs [7]. This agrees with the finding that land tenure size is the most influential factor for farm profitability [25] and with the positive effect of land area on farm income [19], [20], [10]. While international studies debate the farm size–productivity relationship and caution about measurement error [15], among Garung farmers, most of whom cultivate less than one hectare, additional land still yields scale benefits. Access to land is therefore central to the sustainability of smallholder vegetable farming. Farmers who own or securely rent sufficient land can spread fixed costs, rotate crops and plan production over several seasons, while those with very small or insecure plots operate with thin margins and are more vulnerable to shocks [8], [9]. Because land is the main productive asset of rural households, its distribution shapes who can continue to earn a livelihood from farming. This finding carries a policy warning: continued conversion of farmland to tourism uses may erode farmers' profitability by shrinking their cultivated area, so protection of productive farmland deserves attention from the local government [16].

The conversion of farmland into tourism facilities may affect agricultural livelihoods in Garung in several ways. Directly, it reduces the area available for cultivation, and this study shows that smaller cultivated areas are associated with lower profitability. Indirectly, rising land values encourage owners to sell or lease land for villas and homestays, increase rents for tenant farmers and make it harder for young people to enter farming [17], [9]. Experience from other Indonesian regions shows that such conversion can turn owner-cultivators into tenants, sharecroppers or wage workers and weaken household food security [9], [17]. At the same time, tourism can provide alternative or complementary income, and some farming households diversify into homestays, food stalls or agritourism [18]. The net effect on the socioeconomic structure of rural communities therefore depends on whether farmers can take part in tourism on fair terms while retaining access to productive land. Spatial planning that protects productive farmland and links tourism development with local agriculture would help keep vegetable farming viable as a livelihood [16].

Overall, the findings are consistent with a growing body of research. The negative effect of production cost and the positive effects of selling price and land area match recent evidence from horticultural farmers in East Java [10]; the positive effects of production volume, land area and selling price are consistent with studies of rice and vegetable farmers in Bangkalan, Ngawi and Bali [19], [20], [22]; and the emphasis on cost efficiency mirrors evidence that improving profit efficiency is an important route to higher household income among smallholder vegetable farms in Nepal [1]. Studies outside Indonesia likewise show that larger vegetable output and commercialisation raise the income of rural households [3], [2], while land size shapes profitability and unit costs in Indonesian farming [25], [7]. The present study extends this evidence by showing that the same determinants hold when profitability is measured as a margin rather than as absolute income.

The implications of this study are both theoretical and practical. Overall, the four variables are largely within the managerial control of farmers or their groups. Theoretically, the study confirms that profit theory holds at the level of individual smallholders and shows that measuring profitability as a margin reveals cost effects that income-based studies may miss. Practically, farmers can improve their margins by recording costs and using inputs efficiently, while farmer groups can strengthen their bargaining position through collective purchasing of inputs, joint marketing and shared price information. For the local government, the findings support strengthening farm-management capacity through extension on cost recording and efficient input use, market information and collective marketing, together with spatial policies that protect productive farmland from conversion. These measures can strengthen the economic base of vegetable-farming households and the continuity of farming as a rural livelihood.

This study has several limitations. First, data relied on farmers' recall for one season, which may contain measurement error and cannot capture seasonal variation. Second, crop types were not distinguished, although costs and prices differ among potato, cabbage, carrot and other vegetables. Third, the Glejser test showed a marginal result for selling price. Fourth, the purposive sample and cross-sectional design limit generalisation beyond Garung and do not allow causal inference over time [26], [27]. Fifth, household welfare, off-farm income and social variables such as farming experience, group membership, tenure status and marketing channel were not included in the model. Future studies could use multi-season panel data, control for crop type, compare alternative profitability measures such as the revenue–cost ratio, apply robust standard errors, and incorporate social and institutional variables to link farm profitability more directly with the livelihoods of rural households.

4. CONCLUSION

This study shows that the profitability of vegetable farmers in Garung District, Wonosobo, is shaped by both the cost and revenue sides of the farm. Production cost has a negative and significant effect on net profit margin, while selling price, harvest volume and land area have positive and significant effects; together they explain 75.6% of the variation in profitability. These results confirm profit theory at the level of the individual farmer and show that measuring profitability as net profit margin can reveal a negative cost effect that income-based studies may overlook. From a socioeconomic perspective, the results indicate that the economic sustainability of smallholder vegetable farming depends on reducing dependence on costly external inputs, strengthening farmers' bargaining position in markets and maintaining access to productive land. Practically, farmers should record costs and use inputs efficiently, farmer groups should strengthen collective purchasing and marketing to improve farm-gate prices, and the local government should support extension services and control the conversion of productive farmland to tourism uses. Further research using multi-season data, crop-specific analysis and additional variables such as farming experience, access to credit and marketing channels is recommended.

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REFERENCES

[1] R. B. Shrestha, H. Bhandari, and S. Pandey, "Profit efficiency of smallholder vegetable farms in Nepal: Implications for improving household income," *Front. Sustain. Food Syst.*, vol. 5, Art. no. 691350, 2022, doi: 10.3389/fsufs.2021.691350.

[2] L. Mdoda and M. Christian, "Smallholder vegetable farmers' commercialization to enhance rural livelihoods in the Eastern Cape province, South Africa," *Afr. J. Sci. Technol. Innov. Dev.*, vol. 14, no. 6, pp. 1667–1676, 2022, doi: 10.1080/20421338.2021.1979172.

[3] R. Mukaila, A. Falola, S.-U. O. Akanbi, A. E. Obetta, L. O. Egwue, and T. L. Onah, "Effects of vegetable production on income and livelihood of rural households in Nigeria," *Mustafa Kemal Univ. J. Agric. Sci.*, vol. 27, no. 2, pp. 213–223, 2022, doi: 10.37908/mkutbd.1067195.

[4] S. K. Lowder, M. V. Sánchez, and R. Bertini, "Which farms feed the world and has farmland become more concentrated?," *World Dev.*, vol. 142, Art. no. 105455, 2021, doi: 10.1016/j.worlddev.2021.105455.

[5] E. Istiyanti and M. I. Prayogo, "Analysis of income and risks of potato farming in the highlands of Wonosobo Regency, Central Java, Indonesia," *E3S Web Conf.*, vol. 682, Art. no. 05004, 2025, doi: 10.1051/e3sconf/202568205004.

[6] A. Pujiwinarko, T. R. Soeprobowati, and Kismartini, "Land management and factors influencing agroforestry adoption on potato farmlands in the Dieng Plateau, Indonesia," *Biodiversitas*, vol. 25, no. 6, pp. 2623–2641, 2024, doi: 10.13057/biodiv/d250633.

[7] V. Y. Ningsih, N. Suryati, and N. Wahyuni, "Farm size, cost structure, and private profitability in smallholder rice farming: Evidence from Musi Rawas Regency," *J. Agrinika: J. Agroteknol. Agribisnis*, vol. 10, no. 2, pp. 265–281, 2026, doi: 10.30737/agrinika.v10i2.7873.

[8] N. Natarajan, A. Newsham, J. Rigg, and D. Suhardiman, "A sustainable livelihoods framework for the 21st century," *World Dev.*, vol. 155, Art. no. 105898, 2022, doi: 10.1016/j.worlddev.2022.105898.

[9] S. Y. 'Aini, G. Kurnia, D. Bachiardi, and A. C. Tridakusumah, "Land conversion and farmer exclusion: Land tenure change and livelihoods transformation in Sukamakmur Village, Karawang Regency," *Sodality: J. Sosiol. Pedesaan*, vol. 12, no. 3, pp. 238–249, 2024, doi: 10.22500/12202448870.

[10] A. E. Hardana, D. L. Maulida, and A. Siswantoro, "Pengaruh harga jual, biaya produksi, luas lahan, dan akses kredit terhadap pendapatan petani hortikultura di Jawa Timur," *J. Ilm. Manaj. Agribisnis*, vol. 14, no. 2, pp. 48–59, 2026, doi: 10.33005/jimaemagri.v14i2.65.

[11] I. M. Fahmid et al., "Study of the impact of increasing the highest retail price of subsidized fertilizer on rice production in Indonesia," *Open Agric.*, vol. 7, no. 1, pp. 348–359, 2022, doi: 10.1515/opag-2022-0087.

[12] Widyastutik, M. Aminah, D. V. Panjaitan, and E. R. Cahyadi, "The role of fertilizer subsidies in rice productivity and profitability: Evidence from Indonesian smallholder farmers," *Signifikan: J. Ilmu Ekon.*, vol. 15, no. 1, pp. 83–108, 2026, doi: 10.15408/sjie.v15i1.50435.

[13] Sumaryanto et al., "Determining drivers of chili farming participation: Insights from Upper Citarum Watershed, Indonesia," *Int. J. Des. Nat. Ecodyn.*, vol. 19, no. 2, pp. 581–590, 2024, doi: 10.18280/ijdne.190224.

[14] D. W. Untari and S. Vellema, "Are collective trading organisations necessarily inclusive of smallholder farmers? A comparative analysis of farmer-led auctions in the Javanese chilli market," *J. Agric. Environ. Ethics*, vol. 35, Art. no. 19, 2022, doi: 10.1007/s10806-022-09891-6.

[15] S. M. Helfand and M. P. H. Taylor, "The inverse relationship between farm size and productivity: Refocusing the debate," *Food Policy*, vol. 99, Art. no. 101977, 2021, doi: 10.1016/j.foodpol.2020.101977.

[16] U. Faoziyah, M. F. Rosyaridho, and R. Panggabean, "Unearthing agricultural land use dynamics in Indonesia: Between food security and policy interventions," *Land*, vol. 13, no. 12, Art. no. 2030, 2024, doi: 10.3390/land13122030.

[17] L. T. Suganda and J. S. Setyono, "From farmland to housing: Assessing the consequences of agricultural land conversion for farmers' welfare and food security," *Forum Geografi*, vol. 40, no. 2, pp. 197–212, 2026, doi: 10.23917/forgeo.12300.

[18] Y. Yusriadi, A. Cahaya, and M. Masriadi, "Tourism and farmers' economic transformation: Lessons from North Toraja," *Front. Sustain. Food Syst.*, vol. 8, Art. no. 1487452, 2024, doi: 10.3389/fsufs.2024.1487452.

[19] D. A. Mohsinah and O. Arisinta, "Pengaruh biaya produksi, luas lahan, jumlah produksi dan harga jual terhadap pendapatan petani padi di Desa Ra'as Kecamatan Klampis Kabupaten Bangkalan," *OIKOS: J. Kajian Pendidik. Ekon. Ilmu Ekon.*, vol. 8, no. 2, pp. 227–236, 2024, doi: 10.23969/oikos.v8i2.16359.

[20] R. P. Ayuningtyas, R. D. O. Sativa, T. Kurniastuti, and Y. Zamrodah, "Pengaruh luas lahan, jumlah produksi, harga jual, dan modal kerja terhadap peningkatan pendapatan petani padi di Kecamatan Gerih Kabupaten Ngawi," *J. Agribisnis Cendekia*, vol. 2, no. 2, pp. 89–97, 2025, doi: 10.32503/jac.v2i2.7459.

[21] W. O. T. Hartini, H. Taan, and D. L. Radji, "Pengaruh biaya produksi dan harga jual terhadap pendapatan petani sayur di Kecamatan Kontukowuna Kabupaten Muna," *El-Mal: J. Kajian Ekon. Bisnis Islam*, vol. 5, no. 7, pp. 3322–3335, 2024, doi: 10.47467/elmal.v5i7.2213.

[22] I. G. A. B. Pradnyawati and W. Cipta, "Pengaruh luas lahan, modal dan jumlah produksi terhadap pendapatan petani sayur di Kecamatan Baturiti," *Ekuitas: J. Pendidik. Ekon.*, vol. 9, no. 1, pp. 93–100, 2021, doi: 10.23887/ekuitas.v9i1.27562.

[23] Nurmaya, L. Harudin, and A. M. Sari, "Analisis kelayakan usaha budidaya tanaman sayuran (Studi kasus: Petani sayuran di Kecamatan Landono)," *J. Agribus. Soc. Econ.*, vol. 5, no. 2, pp. 141–154, 2025, doi: 10.32585/jase.v5i2.7361.

[24] N. Rozaini and S. J. Silaban, "Pengaruh biaya produksi dan harga jual terhadap pendapatan petani cabai merah di Kecamatan Doloksanggul Kabupaten Humbang Hasundutan," *J. Publikasi Sist. Inf. Manaj. Bisnis*, vol. 2, no. 2, pp. 128–141, 2023, doi: 10.55606/jupsim.v2i2.1314.

[25] A. Nugraha and G. Kurnia, "Mendorong keberlanjutan usahatani padi: Tantangan sosial ekonomi di Kabupaten Tasikmalaya," *Agricore: J. Agribisnis Sos. Ekon. Pertan. Unpad*, vol. 9, no. 2, pp. 183–191, 2024, doi: 10.24198/agricore.v9i2.61536.

[26] C. Maier, J. B. Thatcher, V. Grover, and Y. K. Dwivedi, "Cross-sectional research: A critical perspective, use cases, and recommendations for IS research," *Int. J. Inf. Manage.*, vol. 70, Art. no. 102625, 2023, doi: 10.1016/j.ijinfomgt.2023.102625.

[27] M. A. Memon, R. Thurasamy, H. Ting, and J.-H. Cheah, "Purposive sampling: A review and guidelines for quantitative research," *J. Appl. Struct. Equ. Model.*, vol. 9, no. 1, pp. 1–23, 2025, doi: 10.47263/JASEM.9(1)01.

[28] L. Dalicandro, J. A. Harder, D. Mazmanian, and B. Weaver, "How prevalent is overfitting of regression models? A survey of recent articles in three psychology journals," *Quant. Methods Psychol.*, vol. 17, no. 1, pp. 1–6, 2021, doi: 10.20982/tqmp.17.1.p001.

[29] H. W. Lilliefors, "On the Kolmogorov-Smirnov test for normality with mean and variance unknown," *J. Amer. Statist. Assoc.*, vol. 62, no. 318, pp. 399–402, 1967, doi: 10.1080/01621459.1967.10482916.

[30] U. Knief and W. Forstmeier, "Violating the normality assumption may be the lesser of two evils," *Behav. Res. Methods*, vol. 53, no. 6, pp. 2576–2590, 2021, doi: 10.3758/s13428-021-01587-5.

[31] A. Kalnins and K. Praitis Hill, "Additional caution regarding rules of thumb for variance inflation factors: Extending O'Brien to the context of specification error," *Qual. Quant.*, vol. 59, no. S1, pp. 291–314, 2025, doi: 10.1007/s11135-024-01980-0.

[32] H. Glejser, "A new test for heteroskedasticity," *J. Amer. Statist. Assoc.*, vol. 64, no. 325, pp. 316–323, 1969, doi: 10.1080/01621459.1969.10500976.

[33] S. Alıca, Ş. Açıkgöz, R. Dağalp, and Ş. Gökmen, "Comparison of performances of heteroskedasticity tests under measurement error," *Commun. Fac. Sci. Univ. Ank. Ser. A1 Math. Stat.*, vol. 74, no. 2, pp. 333–345, 2025, doi: 10.31801/cfsuasmas.1632865.

[34] T. S. Breusch and A. R. Pagan, "A simple test for heteroscedasticity and random coefficient variation," *Econometrica*, vol. 47, no. 5, pp. 1287–1294, 1979, doi: 10.2307/1911963.

[35] R. Koenker, "A note on studentizing a test for heteroscedasticity," *J. Econometrics*, vol. 17, no. 1, pp. 107–112, 1981, doi: 10.1016/0304-4076(81)90062-2.