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Research Article

PEANUT FARMING INCOME, BREAK-EVEN POINTS, AND SENSITIVITY TO ECONOMIC CHANGES IN PONOROGO

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Abstract

Peanut-farming studies in Indonesia commonly report realized income and R/C ratios, but less attention has been given to how far farm performance is from break-even and how coincident adverse changes affect that margin. This study integrates farm-income analysis, production and price break-even points (BEP), margin of safety, and deterministic single- and multi-factor stress tests using 2024 data from 31 purposively selected peanut farmers in Purworejo Village, Ponorogo. Farm records were standardized per hectare per growing season. The sample-average farm generated an R/C ratio of 1.77, while production and price BEPs implied a 43.36% margin of safety. Under a symmetric three-factor scenario in which price and output declined while total cost increased by the same percentage, the zero-income boundary was approximately 18.18%. These thresholds should be interpreted as downside financial resilience of the sample-average farm budget under the stated accounting assumptions, not as a probabilistic forecast or evidence of long-term resilience for all farmers. The contribution of the study lies in combining realized profitability, break-even thresholds, and coincident-shock stress testing in one locally applicable framework, thereby translating farm records into practical benchmarks for production planning, price negotiation, cost control, and extension support.

Keywords: Break-Even Point, Downside Financial Resilience, Farm Income, Peanut, Sensitivity Analysis

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INTRODUCTION

Smallholder farming remains closely connected to rural employment, household cash flow, food availability, and the circulation of money within village economies. The economic condition of a farm household is therefore influenced not only by the amount harvested, but also by the relationship among output price, production cost, timing of sales, and exposure to production risk. These relationships are especially important for seasonal food crops because farmers usually commit cash and labor several months before revenue is realized. When output prices weaken or input prices rise during the production cycle, the realized margin may differ substantially from the margin expected at planting time.

Indonesia's agricultural sector continues to require management approaches that are productive, adaptive, and financially resilient. The 2023 Agricultural Census and subsequent national agricultural mapping emphasize that agricultural potential differs across commodities and locations, and that policy design should recognize local production conditions rather than rely only on national averages (BPS-Statistics Indonesia, 2024, 2025). At the broader agrifood-system level, resilience refers to the capacity to maintain essential functions when shocks affect production, logistics, markets, or household purchasing power (Food and Agriculture Organization of the United Nations [FAO], 2021). For farm-level analysis, this concept can be translated into a practical question: how far can price, output, or cost move in an unfavorable direction before income disappears?

Peanut (Arachis hypogaea L.) is relevant to this question because it links food-crop production with household consumption, local trading, and food-processing activities. Farmers may market peanuts as fresh pods, dried pods, kernels, or raw material for small and medium food enterprises. This range of uses creates commercial opportunities, but it does not eliminate risk. The price received by farmers can vary with harvest timing, moisture content, product quality, local trader demand, and the farmer's bargaining position. Production is also sensitive to seed quality, rainfall distribution, soil condition, pest pressure, labor availability, and the timeliness of crop management.

From a management perspective, peanut farming combines biological production with financial decision-making. Seed, fertilizer, crop protection, hired labor, land preparation, harvesting, and post-harvest handling are committed before the final yield and selling price are known. Empirical evidence indicates that higher technical performance does not automatically produce a stronger financial result when the additional cost is large (Anantha et al., 2021), and that realized profitability can also differ with marketing channels and post-harvest arrangements (Muchtar et al., 2024). Risk-management research further shows that coordinated combinations of technical and commercial responses may be more effective than isolated measures (Birthal et al., 2021). Accordingly, farm performance in this study is assessed not from production alone, but from the joint relationship among output, price, cost, and the financial margin remaining before zero income.

Farm income analysis provides the first layer of evaluation by comparing total revenue with total production cost. A positive value shows that the observed combination of yield and price covered the cost structure recorded for the season. The R/C ratio complements income by expressing how many units of revenue are generated by each unit of cost. These indicators are useful, but they describe the realized position. They do not directly show the minimum yield or minimum price needed to avoid loss, nor do they show how quickly the income position changes when the business environment deteriorates.

Break-even analysis addresses part of this limitation. The production break-even point translates total cost into the minimum physical output required at the observed selling price. The price break-even point translates the same cost into the minimum selling price required at the observed production level. The distance between actual performance and each break-even threshold forms a margin of safety. In farm management, this margin is easier to interpret than a profit figure alone because it indicates the amount of operational room available before the enterprise reaches zero income.

Sensitivity analysis provides a further layer by recalculating performance under specified changes in key variables. Separate scenarios help identify the arithmetic effect of a decline in selling price, a decline in production, or an increase in production cost. Combined scenarios are more demanding because unfavorable changes can occur together. For example, adverse weather can reduce output while simultaneously increasing crop-protection or labor costs, and a concentrated harvest period can lower the selling price. Evaluating only one variable at a time may therefore overstate the downside financial buffer implied by the farm budget when adverse changes occur together.

Empirical evidence from Indonesia generally reports positive peanut-farming income, but the reported magnitudes cannot be interpreted as directly comparable measures of performance. Juniasih et al. (2022), Rawis et al. (2022), Sondakh et al. (2019), and Wowiling et al. (2019) examined location-specific farm income in Buleleng and Minahasa, whereas Ichdayati et al. (2024) showed that planting patterns in West Java were associated with differences in production, selling price, revenue, and income. Muchtar et al. (2024) linked profitability with marketing channels, while Tumbel et al. (2025) examined an eco-enzyme-based production practice. These studies therefore represent different combinations of local production conditions, production technology, and market organization rather than a single homogeneous peanut-farming system.

Such heterogeneity is important for interpreting differences among studies. Farm-income estimates can change not only because farms are more or less productive, but also because cultivated area, product form, season, labor valuation, treatment of family labor and owned land, and the boundary between cash and imputed costs differ across farm budgets. Market conditions also matter: farmers selling through different channels, at different harvest times, or with different product quality may face different farm-gate prices even at similar yield levels. Consequently, a favorable income or R/C ratio in one setting does not necessarily imply the same capacity to withstand a price decline, yield loss, or cost increase in another setting. This limits the value of comparing realized profitability alone and motivates an analysis that separates the observed margin from the farm's distance to its loss boundary.

The research setting in Purworejo Village is important because farmers operate within a localized market and production environment. Their decisions are shaped by the availability and price of inputs, access to labor, agronomic conditions, information from traders, and the strength of farmer institutions. An analysis that converts farm records into concrete thresholds can support decisions that are immediately understandable: the output target that should be protected, the price floor that should be considered in marketing, the maximum cost pressure that can be tolerated, and the priority response when several risks emerge at the same time.

The research gap addressed here is therefore not the absence of peanut-income studies, but the limited use of the same farm budget to connect realized profitability with explicit downside-risk thresholds. The reviewed studies largely establish whether farming was profitable under observed conditions, and some add production-system or marketing comparisons; however, realized income and the R/C ratio remain ex post indicators and do not show how much adverse movement can occur before the farm reaches zero income. This study differs by integrating three complementary layers. First, production and price break-even points translate total cost into minimum operational thresholds. Second, margins of safety measure the distance between actual performance and those thresholds, making the size of the economic buffer directly interpretable. Third, single-factor and combined stress scenarios test how that buffer erodes when price, output, and cost deteriorate separately or simultaneously and identify critical zero-income boundaries. The contribution is thus a risk-informed extension of conventional farm-income analysis that converts accounting results into decision benchmarks for production, marketing, and cost management without claiming probabilistic forecasting.

Accordingly, the study aims to: (1) calculate revenue, total production cost, net income, and the R/C ratio of peanut farming; (2) estimate production and price break-even points and their margins of safety; (3) evaluate net income under separate decreases in selling price and production and increases in total cost; (4) examine combined adverse scenarios; and (5) derive managerial and policy implications for farm planning, marketing, cost control, extension, and future research.

RESEARCH METHOD

Research Design

The study used a descriptive quantitative design to evaluate observed economic performance and downside financial resilience. In this study, downside financial resilience is defined narrowly as the accounting capacity of the sample-average farm budget to remain above zero net income when specified adverse changes are imposed on selling price, production, and total cost. It does not measure longitudinal recovery, adaptive capacity, or the probability of real-world shocks; those broader dimensions of resilience require temporal or probabilistic evidence beyond a one-season dataset (FAO, 2021). The study was conducted in Purworejo Village, Balong District, Ponorogo Regency, Indonesia, during the 2024 peanut-growing season. The location was selected purposively because peanut cultivation was actively undertaken in the area and farm-level information on production, selling price, and production cost was available. The unit of analysis was one hectare of peanut farming for one growing season.

A farm-budget approach was selected because the research objective was to describe the observed financial position and scenario-based downside boundaries rather than estimate a causal production function or long-term resilience. The approach organizes physical output and monetary information into a consistent accounting framework. All values were converted to a per-hectare, per-season basis so that the average result was not distorted by differences in cultivated area. Monetary values are reported in Indonesian rupiah (IDR) at the prices recorded for the study season.

Research Target/Subject

The research subjects were 31 farmers who actively cultivated peanuts in Purworejo Village during the study period. Purposive sampling was used because the number of farmers who met the study requirements and could provide a sufficiently complete production account was limited. Inclusion required that the respondent had managed the crop from land preparation to harvest during the observed season, knew the quantity sold or produced, could report the selling price received, and could identify the principal production expenditures. The sample therefore supports a detailed local assessment but not probability-based statistical generalization to all peanut farmers in Ponorogo.

Research Procedure

The research was conducted in five sequential steps: (1) identifying eligible peanut farmers and verifying their 2024 production records; (2) recording cultivated area, harvested output, selling price, and production-cost components; (3) standardizing observations to a per-hectare, per-growing-season basis; (4) calculating baseline profitability, break-even points, margins of safety, and deterministic adverse-change scenarios; and (5) interpreting the resulting thresholds as farm-management benchmarks while retaining the study's sample and one-season limitations.

Instruments, and Data Collection Techniques

Data collection focused on the realized 2024 growing season. Each record was checked for internal consistency among cultivated area, quantity, selling price, and cost units before standardization. Consequently, the results represent the sample-average financial position during the observed season and should not be interpreted as a multi-year forecast or as evidence that all individual farms have the same profitability or risk buffer.

Data Analysis Technique

Data were analyzed in a staged farm-budget framework. Table 1 defines the operational variables and measurement units. Baseline revenue, total cost, net income, and the R/C ratio were calculated first; production and price break-even points and margins of safety were then derived from the same budget; finally, single-factor and combined deterministic stress tests were applied. This sequence separates observed financial performance from simulated adverse conditions and prevents the scenario thresholds from being interpreted as probabilities of future events.

Table 1. Operational Definitions and Measurement Units

Variable	Operational meaning	Unit
Production (Q)	Harvested peanut output standardized per hectare	kg ha−1 season−1
Selling price (P)	Average farm-gate price received for the marketed output	IDR kg−1
Total revenue (TR)	Gross value of output, calculated as Q × P	IDR ha−1 season−1
Fixed cost (FC)	Cost that does not vary directly with output during the observed season	IDR ha−1 season−1
Variable cost (VC)	Seed, fertilizer, crop protection, labor, and other output-related production expenses	IDR ha−1 season−1
Total cost (TC)	Sum of fixed and variable cost	IDR ha−1 season−1
Net income (π)	Residual after total cost is deducted from total revenue	IDR ha−1 season−1
R/C ratio	Revenue generated per unit of production cost	ratio
BEP production	Minimum output required to cover total cost at the observed price	kg ha−1 season−1
BEP price	Minimum selling price required to cover total cost at the observed output	IDR kg−1
Margin of safety	Percentage distance between actual performance and the corresponding break-even point	percent

Figure 1 summarizes how the variables are connected. The baseline farm budget is calculated first. Break-even and margin-of-safety indicators are then derived from the same baseline, after which separate and combined adverse scenarios are applied. The analytical outputs are finally translated into management benchmarks rather than treated only as accounting results.

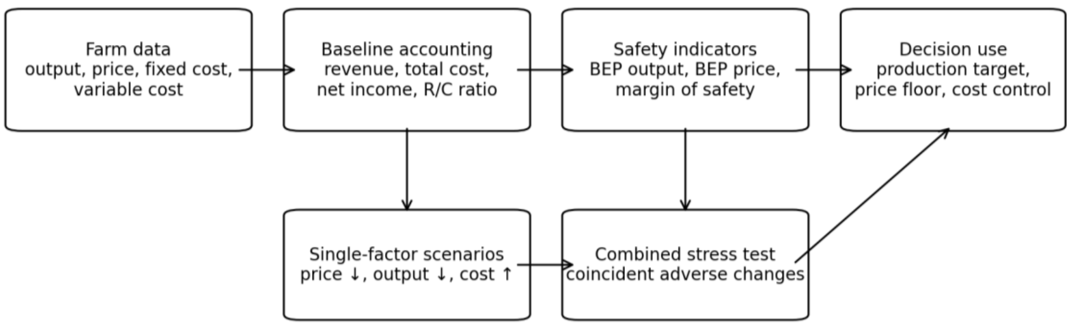

Figure 1. Analytical Framework for Profitability and Downside-Risk Assessment

Income, Efficiency, and Break-Even Calculations

Following established farm-management accounting procedures (Soekartawi, 2016; Suratiyah, 2015), total revenue was calculated by multiplying harvested production by the average farm-gate selling price. Total production cost was obtained from fixed and variable costs, while net income was the difference between total revenue and total cost:

$$TR = Q \times P$$
$$TC = FC + VC$$
$$\pi = TR - TC$$

The R/C ratio was calculated as TR/TC. A ratio greater than one indicates that revenue exceeded production cost during the observed season. To make the result easier to interpret operationally, the study also calculated cost per kilogram (TC/Q), net income per kilogram (π/Q), cost share of revenue (TC/TR), profit margin (π/TR), and return on cost (π/TC). These values are mathematical transformations of the same baseline farm budget and do not introduce new field observations.

The production break-even point was obtained by dividing total cost by the observed selling price. The price break-even point was calculated by dividing total cost by observed production:

$$BEPq = TC / P$$
$$BEPp = TC / Q$$

The production margin of safety was calculated as $[(Q - BEPq)/Q] \times 100\%$, and the price margin of safety as $[(P - BEPp)/P] \times 100\%$. Under the constant-cost and constant-price assumptions of the respective calculations, the two percentages are arithmetically identical. Their practical meanings differ: one is expressed as output room and the other as price room.

Sensitivity Scenarios and Critical Boundaries

Single-factor sensitivity analysis changed one variable while holding the other baseline variables constant. Selling price was reduced by 5%, 10%, and 15%; production was reduced by the same percentages; and total production cost was increased by 5%, 10%, and 15%. The scenarios are deliberately symmetric so that the effect of an equal percentage change can be compared across variables. Because revenue is the product of output and price, an isolated percentage decrease in either variable produces the same numerical revenue change when the other variable remains fixed.

A supplementary combined stress test was added to represent coincident adverse conditions. Three scenario structures were examined: (1) price and output decrease together while cost remains constant; (2) either price or output decreases while total cost increases by the same percentage; and (3) price and output decrease while total cost increases by the same percentage. These are accounting stress tests, not probabilistic forecasts. They show the financial consequence if the specified changes occur; they do not estimate how likely each event is.

Critical boundaries were derived by solving for the adverse change that reduces net income to zero. For a price or output decrease alone, the critical decline equals $1 - TC/TR$. For a total-cost increase alone, it equals $TR/TC - 1$. For an equal price-and-output decline, it equals $1 - \sqrt{(TC/TR)}$. For an equal price decline and cost increase, it equals $(TR - TC)/(TR + TC)$. The three-factor boundary was obtained from $TR(1 - s)^2 = TC(1 + s)$, where s is the symmetric adverse change.

The calculations were performed using unrounded baseline values, while the tables present rounded values for readability. Minor differences between displayed components and recalculated totals can therefore arise from rounding. All scenario results were checked for internal consistency by confirming that net income equaled adjusted revenue minus adjusted total cost and that the reported R/C ratio equaled adjusted revenue divided by adjusted total cost.

RESULTS AND DISCUSSION

Baseline Economic Performance

Average peanut production reached 1,951.07 kg ha−1 per growing season, and the average farm-gate selling price was IDR 17,000 kg−1. Multiplication of these values produced total revenue of IDR 33,168,196 ha−1. Average total production cost was IDR 18,785,930 ha−1, leaving net income of IDR 14,382,266 ha−1. The R/C ratio was 1.77, meaning that each IDR 1.00 of production cost generated approximately IDR 1.77 of revenue during the observed season.

The positive income confirms that the sampled farms covered the recorded production cost and generated a residual for farm households. The result should nevertheless be interpreted as a seasonal business outcome rather than a guaranteed return. Peanut farming requires expenditure before harvest, and the value of the crop is realized only after production and marketing risks have unfolded. The financial attractiveness observed in 2024 therefore depends on the interaction of yield, price, and cost rather than on any one component in isolation.

Table 2. Baseline Economic Performance of Peanut Farming

Component	Unit	Value
Respondents	farmers	31
Production	kg ha−1 season−1	1,951.07
Selling price	IDR kg−1	17,000
Total revenue	IDR ha−1 season−1	33,168,196
Total production cost	IDR ha−1 season−1	18,785,930
Net income	IDR ha−1 season−1	14,382,266
R/C ratio	ratio	1.77

Normalized Profitability and Quality of the Margin

The baseline values become more informative when they are expressed relative to output, revenue, and cost. Total production cost was approximately IDR 9,629 per kilogram, whereas net income was approximately IDR 7,371 per kilogram. The cost share of revenue was 56.64%, leaving a profit margin of 43.36%. Return on cost was 76.56%, which is the percentage form of the surplus above the R/C ratio threshold of one.

These indicators describe the quality of the observed margin from different viewpoints. Cost per kilogram is useful for price negotiation because it approximates the average economic floor under the study's cost definition. Profit per kilogram indicates the contribution of each kilogram to net farm income after average cost. The profit margin shows the proportion of sales retained as income, while return on cost shows the income obtained relative to the resources committed. Farmers and extension workers can select the indicator that best matches the decision being made.

The numerical equality between the profit margin and the price or production margin of safety is not accidental. With revenue defined as Q × P and total cost held constant, income divided by revenue equals the proportional decline in either price or output that would eliminate income. This equivalence provides a useful consistency check: a farm retaining 43.36% of revenue as income can absorb a 43.36% decline in price alone, or output alone, before reaching zero income, provided that total cost does not change.

Table 3. Normalized Profitability Indicators

Indicator	Value	Management interpretation
Average production cost	IDR 9,629 kg−1	Cost required for each kilogram of output
Net income per kilogram	IDR 7,371 kg−1	Residual income associated with each kilogram
Cost share of revenue	56.64%	Proportion of revenue absorbed by production cost

Profit margin	43.36%	Proportion of revenue retained as net income
Return on cost	76.56%	Net income relative to total production cost
R/C ratio	1.77	Revenue generated for each unit of cost

Comparison with Previous Peanut-Farming Studies

The Purworejo sample produced net income of IDR 14.38 million ha−1 season−1 and an R/C ratio of 1.77. This confirms positive realized profitability, consistent with Juniasih et al. (2022), Rawis et al. (2022), Sondakh et al. (2019), and Wowiling et al. (2019), but similarity in the direction of profitability does not imply equivalence in economic performance. For example, Arung et al. (2026) reported average peanut-farm income of approximately IDR 18.47 million ha−1 in Maros. The difference from Purworejo should not be interpreted as a regional ranking because each study reflects a distinct combination of yield, output form, farm-gate price, input use, labor valuation, and cost coverage.

Cost accounting is one major source of cross-study differences. Including imputed family labor, owned-land opportunity cost, depreciation, or only cash expenditure changes both net income and the R/C ratio. Sinabariba et al. (2014) also showed that a farm may be profitable while production-factor use is not economically efficient, whereas Mamoto et al. (2021) demonstrated that margin- and investment-based measures can provide a different view of farm-capital performance. Thus, the Purworejo R/C ratio of 1.77 should be interpreted within its recorded cost structure rather than compared mechanically with ratios from other locations.

Production technology and crop choice provide a second explanation. Ichdayati et al. (2024) found that planting patterns were associated with differences in production, selling price, revenue, and income, while Nur Juan et al. (2026) reported different R/C ratios between peanut varieties. These findings indicate that cross-location profitability gaps can arise before marketing through differences in variety, crop arrangement, yield, and input requirements.

Marketing is a third source of variation. Muchtar et al. (2024) linked peanut profitability to marketing channels, indicating that buyer access, product form, quality, and post-harvest handling can affect the price ultimately received. Within the present dataset, Purworejo's economic profile is characterized by an average yield of 1,951.07 kg ha−1, a farm-gate price of IDR 17,000 kg−1, and total cost of IDR 18.79 million ha−1 season−1. These three observed components jointly explain the reported income and R/C ratio. However, because this study did not estimate causal effects of soil, variety, marketing channel, or individual input use, those factors should be treated as plausible sources of cross-location differences rather than as statistically verified causes in Purworejo.

Break-Even Points and Margins of Safety

The production break-even point was 1,105.05 kg ha−1, so actual output of 1,951.07 kg ha−1 exceeded the accounting threshold by approximately 846.02 kg ha−1 and produced a 43.36% production margin of safety. The price break-even point was approximately IDR 9,629 kg−1, compared with the observed farm-gate price of IDR 17,000 kg−1; the price buffer was therefore about IDR 7,371 kg−1, again equivalent to a 43.36% margin of safety under the baseline assumptions. These values indicate that the sampled farms had substantial room above the zero-income boundary during the observed season, but they should not be interpreted as guaranteed future buffers.

The thresholds are conditional on the cost convention and prices used in the 2024 farm budget. If family labor that was previously unpriced is valued as an economic cost, if hired-labor or input prices rise, or if the expected selling price changes, total cost and the corresponding BEP will also change. Likewise, the BEP price is not a recommended selling price; it is only the price at which the observed production exactly covers the recorded cost. A commercially sustainable target should remain above this boundary to compensate for management effort, working-capital use, production risk, and reinvestment needs.

For farmer decision-making, BEP and margin-of-safety indicators are most useful when they are updated rather than treated as fixed end-of-season calculations. Before planting, expected yield and price can be compared with the baseline thresholds to assess whether the planned cost structure leaves an adequate buffer. During the season, newly incurred input and labor costs can be added to the budget to recalculate the thresholds. Before harvest and sale, updated yield estimates and trader offers can be compared with the revised BEP values; a rapidly narrowing margin can signal the need to protect essential field operations, reduce avoidable expenditure, improve product quality, seek alternative buyers, or coordinate collective marketing. In this way, the indicators function as practical warning points that support the timing of decisions under changing farm and market conditions.

Table 4. Break-Even Thresholds and Economic Safety Margins

Indicator	Actual value	Break-even value	Absolute buffer	Margin of safety
Production	1,951.07 kg ha−1	1,105.05 kg ha−1	846.02 kg ha−1	43.36%
Selling price	IDR 17,000 kg−1	IDR 9,629 kg−1	IDR 7,371 kg−1	43.36%

Table 4 shows that the absolute production and price buffers express the same 43.36% proportional safety margin from two decision perspectives. For farmers, the production buffer is most relevant when monitoring expected yield during the crop cycle, whereas the price buffer is most relevant when evaluating market offers near harvest. Because either threshold moves when costs are revised, the table should be treated as a season-specific reference that can be recalculated as new information becomes available.

Single-Factor Sensitivity

Table 5 presents separate adverse changes of 5%, 10%, and 15%. A decline in selling price and an equal decline in production have the same numerical effect on revenue because only one multiplicative component changes while the other remains at baseline. At a 5% decline, net income falls to IDR 12,723,856 ha−1 and the R/C ratio to 1.68. At a 10% decline, net income is IDR 11,065,446 ha−1 and the R/C ratio 1.59. At a 15% decline, net income remains positive at IDR 9,407,037 ha−1 with an R/C ratio of 1.50.

A cost increase reduces income more slowly than an equal percentage decrease in price or output because the percentage is applied to a smaller base. The baseline cost, IDR 18.79 million, is lower than revenue, IDR 33.17 million. A 15% increase in total cost therefore reduces income by about IDR 2.82 million, while a 15% revenue decline reduces it by about IDR 4.98 million. This arithmetic explains why the farm shows greater tolerance to a proportional cost increase than to a proportional revenue shock.

The comparison does not imply that cost management is less important. Repeated increases in seed, fertilizer, labor, and crop-protection costs can become permanent, whereas a price decline may be temporary. Cost escalation also raises the BEP price and BEP production for subsequent seasons. A farm that absorbs cost growth without updating its production target or selling-price expectation can gradually lose its margin even when each annual increase appears moderate.

Table 5. Sensitivity of Net Income to Single-Factor Adverse Changes

Scenario	Change	Revenue	Total cost	Net income	R/C
Price decrease	5%	31,509,786	18,785,930	12,723,856	1.68
Price decrease	10%	29,851,376	18,785,930	11,065,446	1.59
Price decrease	15%	28,192,967	18,785,930	9,407,037	1.50
Production decrease	5%	31,509,786	18,785,930	12,723,856	1.68
Production decrease	10%	29,851,376	18,785,930	11,065,446	1.59
Production decrease	15%	28,192,967	18,785,930	9,407,037	1.50
Cost increase	5%	33,168,196	19,725,226	13,442,970	1.68

Cost increase	10%	33,168,196	20,664,523	12,503,673	1.61
Cost increase	15%	33,168,196	21,603,820	11,564,376	1.54

The results in Table 5 show that all single-factor shocks tested up to 15% leave the farm above the break-even condition (R/C > 1). Equal percentage declines in price or production reduce income more sharply than an equal percentage increase in total cost because the adverse change is applied to the larger revenue base. Operationally, this ranking suggests that yield and farm-gate price require particularly close monitoring, while cost increases should still be controlled because persistent cost growth raises future BEP thresholds and progressively narrows the safety margin. The table therefore provides the numerical basis for the extended boundary comparison shown in Figure 2.

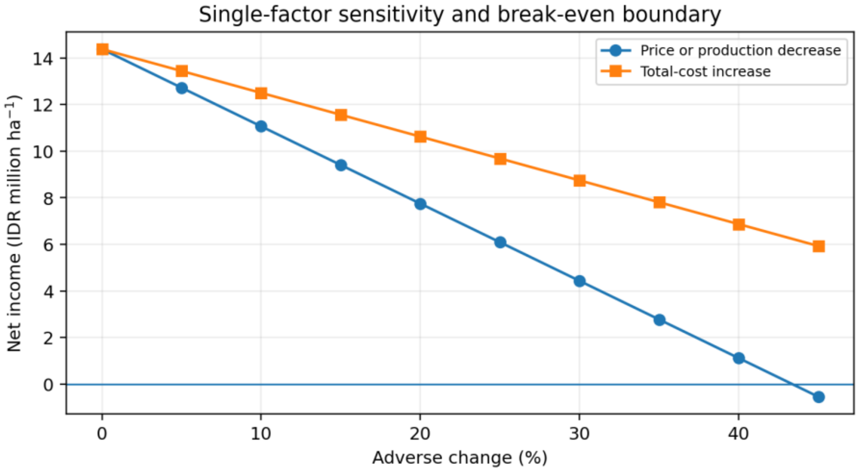

Figure 2. Net Income under Separate Adverse Changes and the Zero-Income Boundary

Figure 2 extends the single-factor changes to illustrate the direction toward the zero-income boundary. The price-or-production line crosses zero at an adverse change of approximately 43.36%. The cost-increase line reaches zero at approximately 76.56%. The wider cost boundary arises from the baseline R/C ratio: total cost would have to rise until it equals revenue, while price or output need only fall until revenue equals the unchanged total cost.

Combined Stress Tests

Single-factor scenarios are transparent, but farms may face several unfavorable changes in the same season. A production decline may be accompanied by additional labor or crop-protection expenditure, and a widespread harvest may coincide with a lower selling price. Combined analysis is therefore useful as a conservative planning tool. It does not claim that the changes are statistically correlated; it asks what happens to the farm budget when they occur together.

When price and output each decline by 5% while cost remains constant, revenue decreases by 9.75%, not 10%, because the factors are multiplied. Net income remains IDR 11.15 million ha−1. At simultaneous 10% declines, income falls to approximately IDR 8.08 million ha−1. At simultaneous 15% declines, income is approximately IDR 5.18 million ha−1. These values are lower than the corresponding single-factor results and demonstrate that the same percentage applied to two revenue components compounds the effect.

The most demanding test reduces both price and output and increases total cost by the same percentage. Under a 5% three-factor shock, the farm still earns approximately IDR 10.21 million ha−1. At 10%, income is approximately IDR 6.20 million ha−1. At 15%, income falls to approximately IDR 2.36 million ha−1, with an R/C ratio close to 1.11. The business remains above break-even, but most of the baseline margin has been lost.

Solving the three-factor equation indicates that net income reaches zero at a symmetric adverse change of approximately 18.18%. This threshold is much lower than the 43.36% single price-or-output boundary and the 76.56% cost boundary. The expanded analysis therefore shows that the downside financial buffer estimated from isolated shocks is larger than the buffer estimated under coincident shocks. This is a deterministic accounting result and should not be interpreted as observed long-term resilience or as the probability that such a combined shock will occur.

Table 6. Combined Adverse-Change Scenarios

Combined scenario	Change	Revenue	Total cost	Net income	R/C
Price ↓ and output ↓	5%	29,934,297	18,785,930	11,148,367	1.59
Price ↓ and output ↓	10%	26,866,239	18,785,930	8,080,309	1.43
Price ↓ and output ↓	15%	23,964,022	18,785,930	5,178,092	1.28
Price/output ↓ and cost ↑	5%	31,509,786	19,725,226	11,784,560	1.60
Price/output ↓ and cost ↑	10%	29,851,376	20,664,523	9,186,853	1.44
Price/output ↓ and cost ↑	15%	28,192,967	21,603,820	6,589,147	1.30
Price ↓, output ↓, cost ↑	5%	29,934,297	19,725,226	10,209,070	1.52
Price ↓, output ↓, cost ↑	10%	26,866,239	20,664,523	6,201,716	1.30
Price ↓, output ↓, cost ↑	15%	23,964,022	21,603,820	2,360,202	1.11

Table 6 demonstrates that the farm's apparent resilience weakens substantially when adverse movements occur together. At a 15% simultaneous decline in price and output, net income falls to about IDR 5.18 million ha−1; when the same 15% shock also includes higher cost, net income falls further to about IDR 2.36 million ha−1 and the R/C ratio approaches 1.11. The contrast with the single-factor results indicates that management decisions should not evaluate price, yield, and cost in isolation when several warning signals emerge in the same season. Figure 3 visualizes this faster erosion of the economic margin under the symmetric three-factor stress test.

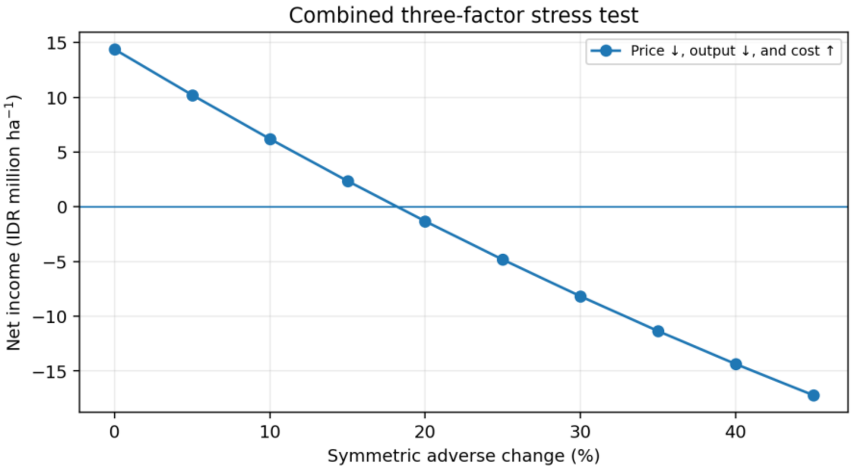

Figure 3. Net Income under a Symmetric Three-Factor Stress Test

Critical Risk Boundaries and Decision Benchmarks

The critical-boundary calculations convert the scenario results into compact management benchmarks. A price decline alone or production decline alone can reach approximately 43.36% before income becomes zero. Total cost can increase by approximately 76.56% before reaching the same boundary, provided revenue remains unchanged. If price and output decline together by an equal percentage, the critical decline falls to approximately 24.74%. If either price or output declines while cost increases by the same percentage, the critical change is approximately 27.68%. When all three adverse changes occur together, the boundary is approximately 18.18%.

These thresholds should be used as warning limits rather than targets. Management action should begin well before a boundary is reached because farm households need a positive return and because the baseline cost may omit opportunity costs that are difficult to value. A prudent internal threshold could therefore be established above the BEP output and BEP price. Farmer groups can use the boundaries to classify conditions as normal, cautionary, or critical and connect each classification with a predefined response.

Table 7. Critical Adverse-Change Boundaries

Risk structure	Risk structure	Risk structure	Risk structure
Selling price decrease only	Selling price decrease only	Selling price decrease only	Selling price decrease only
Production decrease only	Production decrease only	Production decrease only	Production decrease only
Total-cost increase only	Total-cost increase only	Total-cost increase only	Total-cost increase only
Price and production decrease	Price and production decrease	Price and production decrease	Price and production decrease
Price/output decrease plus cost increase	Price/output decrease plus cost increase	Price/output decrease plus cost increase	Price/output decrease plus cost increase
Price and output decrease plus cost increase	Price and output decrease plus cost increase	Price and output decrease plus cost increase	Price and output decrease plus cost increase

Robustness, Scenario Interpretation, and Early-Warning Use

The baseline calculations are internally robust because the principal indicators are linked by accounting identities. Revenue equals production multiplied by price; income equals revenue minus total cost; the R/C ratio equals revenue divided by cost; and the single-factor break-even margin equals the profit margin when cost is fixed. The agreement among these indicators reduces the possibility that the positive result is produced by an isolated calculation error. It also allows extension workers to verify the budget using more than one route.

Scenario results should nevertheless be interpreted within their assumptions. A 10% production decrease in the model reduces revenue by 10% while leaving total cost unchanged. In practice, some harvest and handling costs may decline with output, whereas additional crop-protection or replanting expenses may increase cost before the lower yield becomes known. Similarly, a price decline may alter the quantity stored or the timing of sale. The deterministic scenarios intentionally hold these secondary responses constant so that the direct effect of each primary change can be seen clearly.

The combined stress tests provide a stricter but still simplified representation. Equal percentage changes are used for comparability, although real shocks are rarely equal. One season may involve a 7% price decline, a 12% production decline, and a 4% cost increase. The same formulas can accommodate unequal changes by replacing the common percentage with separate values for price, output, and cost. This makes the framework suitable for updating during the season when field estimates and market information become available.

The analysis is also sensitive to cost coverage. If the recorded total cost excludes the opportunity cost of family labor, owned land, or the farmer's management time, the reported income represents a return to those unpriced resources as well as entrepreneurial surplus. If all opportunity costs are included, the remaining income is closer to economic profit. Future application should therefore state the cost convention consistently. The practical value of the present thresholds lies in their transparency: users can revise total cost and immediately obtain an updated BEP price, BEP output, and safety margin.

An early-warning system can be developed by comparing current estimates with the baseline thresholds. A normal condition exists when expected output and price remain comfortably above the internal target and cost growth is controlled. A caution condition arises when one indicator moves rapidly toward its break-even level. A high-risk condition occurs when two adverse variables move together, while a critical condition is indicated when the combined change approaches the estimated 18.18% three-factor boundary. The categories do not predict failure; they organize the timing and intensity of management responses.

Table 8. Suggested Early-Warning Categories for Farm Management

Category	Financial signal	Recommended management response
Normal	Indicators remain near baseline; R/C well above 1.00	Maintain records, monitor fields and prices, preserve input discipline
Caution	One indicator deteriorates but remains well above its BEP	Update the farm budget, review input use, obtain alternative price information
High risk	Two adverse variables move together and the safety margin narrows	Prioritize essential inputs, protect product quality, coordinate selling through farmer groups
Critical	Combined movement approaches the zero-income boundary	Avoid nonessential expenditure, seek technical and market support, reassess harvest and sales strategy

The early-warning matrix is an applied interpretation rather than a new statistical result. Its purpose is to ensure that the numerical analysis leads to action. The most important principle is timing: interventions are usually less costly when implemented during the caution stage than after production, price, and cost have all moved into the high-risk range.

Managerial Implications for Farmers and Farmer Groups

The first managerial implication concerns production planning. The observed BEP output of 1,105.05 kg ha−1 is the minimum accounting threshold, not the preferred target. Farmers should establish a higher operational target that includes a buffer for normal field variation. Crop calendars, seed selection, plant population, weed control, pest monitoring, and harvest timing should be evaluated in relation to their effect on both yield and cost. The objective is not maximum input use, but a combination that preserves output above the internal safety target at an acceptable cost.

Second, cost management requires reliable farm records. A farmer who records only large cash payments may underestimate the true cost of production, while a farmer who does not separate household and farm cash flow may be unable to identify the cause of a declining margin. A simple seasonal record should list the date, input or activity, quantity, price, labor source, and payment status. At harvest, the record can be converted into cost per kilogram and compared with the price offered by traders.

Third, marketing decisions should be made using both the BEP price and current market information. The break-even price provides a private financial floor, whereas market information indicates whether postponing sale, grading the product, drying it further, or selling collectively may improve the realized price. Collective marketing can reduce small-lot disadvantages, but it requires agreement on quality standards, weighing, payment, and responsibility for post-harvest handling. Muchtar et al. (2024) reinforce the importance of examining marketing channels alongside farm profitability.

Fourth, risk management should combine technical and commercial measures. Birthal et al. (2021) found that combinations of risk-management strategies can provide larger benefits than isolated measures in smallholder agriculture. In the present context, a practical combination may include early pest detection, careful input procurement, staggered production where agronomically appropriate, access to more than one buyer, diversification where locally feasible, and group-based price information. Integrated diversification has also been examined as a strategy for optimizing dry-land farming systems (Wardana et al., 2021). Farm resilience research in Indonesia similarly emphasizes that recovery capacity is shaped by household, management, and institutional conditions (Hidayat et al., 2021; Irham et al., 2021). The combined stress test shows why such coordination matters: a farm can withstand a sizeable isolated change but becomes more vulnerable when yield, price, and cost deteriorate together.

Fifth, farmers should evaluate profitability after each season rather than assume that a profitable year will be repeated. The baseline R/C ratio of 1.77 provides a favorable starting position, but it can change as input prices, labor availability, technology, and market channels change. Recalculation using the same template creates a local time series that is more useful than relying on memory. Over several seasons, the farmer group can identify whether the safety margin is stable, improving, or narrowing.

Implications for Extension and Local Policy

To translate the analysis into extension practice, agricultural extension services can use a simple seasonal farm-budget protocol rather than presenting the indicators only as research results. At the beginning of a season, extension workers and farmer groups can record planned area, expected yield, expected selling price, seed and fertilizer requirements, labor, and other costs to establish an initial BEP output, BEP price, and safety margin. During crop growth, the same worksheet can be updated when input use, labor expenditure, or expected yield changes. Near harvest, current trader offers can be compared with the revised BEP price. This three-stage use pre-season planning, in-season updating, and pre-sale reviewlinks technical recommendations with their financial consequences and is consistent with evidence that best management practices should be evaluated through both productivity and income effects (Anantha et al., 2021).

Cost-recording assistance can be organized as a routine component of farmer-group meetings. A standardized record should separate purchased inputs, hired labor, family labor, land-related charges or opportunity costs where relevant, harvest expenses, and post-harvest costs, so that farmers and extension workers use the same cost convention when recalculating cost per kilogram and break-even thresholds. The objective is not to impose complex bookkeeping, but to create a traceable seasonal record that can show which cost component is driving a narrowing margin. Farmers whose cost growth approaches the caution range can then receive targeted advice on input dosage, procurement timing, labor organization, or avoidable expenditure rather than undifferentiated assistance.

Marketing support can be made equally operational. Extension services or farmer groups can periodically collect local farm-gate price information, compare available offers with the farm's BEP price plus an agreed safety buffer, and identify alternative buyers or collective-selling opportunities when the margin becomes thin. Where collective marketing is feasible, the intervention should specify product-quality standards, weighing procedures, timing of sale, payment arrangements, and responsibility for drying or other post-harvest handling. This mechanism connects the study's price threshold with the marketing-channel considerations emphasized by Muchtar et al. (2024) and reduces the risk that a financially viable crop is sold under unfavorable conditions.

At the local-policy level, the same indicators can support a simple commodity early-warning mechanism using aggregated farm data. Updated estimates of yield, farm-gate price, and major input costs can be compared with the baseline thresholds and classified as normal, cautionary, high risk, or critical. The response can then be matched to the source of pressure: field diagnosis and technical support when expected output approaches the BEP, procurement or cost-management assistance when input costs rise rapidly, and market information or buyer facilitation when the price margin narrows. When several indicators deteriorate together toward the combined critical boundary, extension, market-facilitation, and farmer-organization support should be activated simultaneously. In this form, the analysis provides a transparent mechanism for prioritizing limited local support rather than a justification for uniform assistance and is consistent with the broader emphasis on anticipating and responding to agrifood-system shocks (FAO, 2021).

Limitations and Research Agenda

The study has several limitations. First, it covers 31 purposively selected farmers in one village and one growing season. The results describe the sampled farms and cannot be generalized statistically to all peanut farmers in Ponorogo or Indonesia. Second, the analysis uses average values. It does not show the distribution of income among respondents or whether a minority of farms operated below break-even. Respondent-level analysis would allow estimation of variability, confidence intervals, and the proportion of vulnerable farms.

Third, the sensitivity scenarios are deterministic. They show the consequences of specified changes but not the probability that those changes will occur. Historical time-series data on yield, farm-gate price, and input costs would support probabilistic risk analysis, Monte Carlo simulation, or stochastic dominance assessment. Fourth, the study does not separately estimate the contribution of individual inputs to production, so it cannot identify an economically optimal input level or estimate technical efficiency.

Fifth, the result depends on the cost definition used in the field data. Future research should clearly distinguish cash cost, imputed family labor, owned-land opportunity cost, depreciation, and financing cost. Reporting income over cash cost and income over total economic cost would improve comparability. Product form, moisture content, and sales timing should also be documented because they affect both the physical quantity and price used in the farm budget.

Future studies can extend the analysis in four directions: a multi-season panel to measure stability; respondent-level efficiency and risk analysis; comparison of varieties, planting patterns, and market channels; and value-chain analysis linking farm-gate results with processors and retailers. Such work would clarify whether resilience is created mainly through productivity, cost efficiency, quality-based pricing, institutional coordination, or a combination of these mechanisms.

CONCLUSION

Peanut farming in Purworejo Village was economically profitable during the observed 2024 growing season. Based on 31 purposively selected farmers, average production of 1,951.07 kg ha−1 at IDR 17,000 kg−1 generated revenue of IDR 33,168,196 ha−1, while total production cost of IDR 18,785,930 ha−1 left net income of IDR 14,382,266 ha−1 and an R/C ratio of 1.77. The production and price break-even points were 1,105.05 kg ha−1 and IDR 9,629 kg−1, respectively, corresponding to a 43.36% margin of safety. Separate 15% decreases in price or production and a 15% cost increase did not eliminate profitability, but the combined stress analysis showed that the economic buffer erodes much faster when adverse changes occur together; a symmetric decline in price and output combined with a cost increase reaches the estimated zero-income boundary at approximately 18.18%. These findings support integrated production planning, farm-record keeping, cost control, quality and price management, and collective access to market information. However, the thresholds are site- and season-specific benchmarks rather than general parameters for all peanut farmers in Ponorogo or Indonesia. The evidence comes from one village, one growing season, a small non-probability sample, and average farm-budget values; respondent-level dispersion is not shown, and the deterministic stress tests indicate financial consequences rather than the probability of shocks. Accordingly, the practical contribution is strongest as a transparent local decision-support framework that can be recalculated with current farmer records, prices, and costs. Broader conclusions require multi-season and respondent-level research across production systems and market arrangements

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author used OpenAI ChatGPT to assist with English-language editing, structural alignment with the journal template, numerical consistency checks, scenario calculations, visualization, and document formatting. The author reviewed and edited the manuscript, verified the underlying farm data and calculations, selected and checked the cited sources, and takes full responsibility for the content of the publication.

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AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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