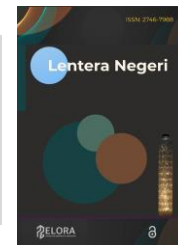




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Job satisfaction as a mediator between work ethic, productivity, and farmer performance: a pls-sem study on patchouli cultivation

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ABSTRACT

Patchouli (*Pogostemon cablin* Benth.) is a strategically important smallholder commodity in Indonesia, which contributes approximately 90% of global patchouli oil production. However, farmer performance in Tompasobaru Satu Village, South Minahasa Regency, remains inconsistent despite relatively high productivity and work ethic, indicating that technical capacity alone may not explain performance outcomes. Grounded in the Porter–Lawler performance–satisfaction model, this study examines job satisfaction as a mediating mechanism linking work ethic and productivity to patchouli farmer performance. A quantitative explanatory design was employed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4. Data were collected through a census of 150 active patchouli farmers using a 32-item, five-point Likert-scale questionnaire adapted from established instruments and pilot-tested on 30 respondents. The measurement model generally met the recommended reliability and validity criteria, although the average variance extracted (AVE) for job satisfaction was marginally below the recommended threshold (0.484). Harman’s single-factor test indicated no dominant common method factor (28.3%). Bootstrapping with 5,000 resamples revealed that work ethic ($\beta = 0.225$) and productivity ($\beta = 0.435$) were positively associated with job satisfaction, which explained 36.6% of its variance. The structural model explained 55.8% of the variance in farmer performance. Job satisfaction partially and complementarily mediated the relationships between productivity and performance (indirect $\beta = 0.125$, $p < 0.001$) and between work ethic and performance (indirect $\beta = 0.065$, $p = 0.031$). Productivity had the strongest total effect on performance ($\beta = 0.446$). This study extends the application of performance–satisfaction theory to self-employed smallholder farmers by conceptualising job satisfaction as a transmission mechanism rather than a moderating factor. The findings highlight the importance of integrating productivity-enhancing interventions with strategies that strengthen farmers’ job satisfaction and psychological well-being to support sustainable performance.



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Introduction

Patchouli (*Pogostemon cablin* Benth.) occupies a strategic position in the Indonesian economy, accounting for approximately 90% of global patchouli oil (*oleum pogostemoni*) production, valued at USD 50 million per year (FAO, 2021). As a fixative in the perfume, cosmetics, and pharmaceutical industries, patchouli oil

represents a critical non-timber smallholder commodity. Indonesia's dominance in global supply makes the performance of its patchouli-farming households a matter of both economic and food-systems importance.

Tompasobaru Satu Village, South Minahasa Regency, North Sulawesi, is a patchouli production centre with 213 hectares under cultivation and 165 farming households, patchouli oil contributing approximately 65% of household income (BPS Kabupaten Minahasa Selatan, 2023). Despite this significance, productivity stands at only 1.8 tonnes of dry leaves per hectare, well below the optimal potential of 2.5 tonnes, and the oil yield of 2.1% falls short of the attainable 3–3.5% (Balittro, 2022). Production has fluctuated markedly 3.8 tonnes (2019), 2.7 tonnes (2020), 3.2 tonnes (2022), and 2.9 tonnes (2023) (Dinas Pertanian Minahasa Selatan, 2023), signalling complex, systemic performance constraints that extend beyond technical input factors.

Prior research at the same site confirmed significant direct effects of productivity, work ethic, and job satisfaction on farmer performance ($R^2 = 0.678$), but examined only direct pathways without testing mediation mechanisms. Field data reveal that 42% of high-productivity farmers demonstrate disproportionately low performance, while 35% of farmers with strong work ethic experience stagnation. These proportions were derived from a preliminary field survey using the same five-interval classification of mean scores adopted in this study (1.00–1.80 very low; 1.81–2.60 low; 2.61–3.40 moderate; 3.41–4.20 high; 4.21–5.00 very high): farmers whose productivity (or work ethic) score fell in the high or very high interval but whose performance score fell in the moderate interval or below were classified as showing disproportionately low performance (or stagnation). The operational definitions and measurement of productivity, work ethic, job satisfaction and farmer performance are set out in the Instrumentation and Operationalisation section (Table 1), and the adequacy of the sample size for mediation analysis is justified in the Population and Sample section. This paradox suggests that psychological mediation, specifically, the role of job satisfaction, may explain the transformation of technical capacity and dispositional effort into actual performance outcomes (Bonifacio et al., 2025; Eliyana et al., 2019; Johari et al., 2019; Katebi et al., 2022; Maniendaran et al., 2025). Job satisfaction was selected as the focal mediator, rather than alternative psychological constructs such as self-efficacy or intrinsic motivation, for three reasons. First, it is the construct that captures farmers' evaluative response to the outcomes of their work (income, facilities, recognition and social relations), which is precisely the link that the Porter–Lawler model places between achieved output and subsequent performance (Judge et al., 2001; Lawler & Porter, 1967). Second, farm-level studies consistently identify satisfaction with work and subjective well-being as the psychological states most sensitive to farm income, working conditions and farm characteristics (Besser & Mann, 2015; Herrera Sabillón et al., 2022; Mzoughi, 2014), and as being associated with higher farm productivity (Ma et al., 2021). Third, self-efficacy and intrinsic motivation are dispositional-motivational states that overlap conceptually with the work ethic construct (discipline, diligence and motivation for improvement), so modelling them as mediators would risk construct redundancy.

Competing structural explanations for the observed performance discrepancies were also considered. Farm-gate price volatility and harvest timing operate largely as common shocks within a single village, because farmers face a broadly similar farm-gate price range and a similar harvest and distillation calendar; on their own, they therefore cannot explain why farmers with comparable productivity and work ethic diverge in performance. Differences in household labour allocation are partly captured by the work ethic construct (consistency of practice and time discipline), whereas market access, credit constraints and extension services were not measured and are acknowledged as untested contextual factors in the Limitations section. These explanations are not dismissed; rather, they motivate treating job satisfaction as a partial, not an exclusive, transmission mechanism, and the model accordingly retains direct paths from productivity and work ethic to performance. Agronomic constraints such as soil quality, pest and disease pressure and post-harvest handling (drying and distillation) act mainly on yield and oil recovery; they are therefore largely embedded in the productivity construct (dry-leaf yield, land use efficiency and adoption of cultivation technology), so their influence on performance is captured through the productivity paths rather than attributed to job satisfaction. The livelihoods literature emphasises that farm outcomes emerge from the interplay of household assets, institutional and market structures and the agency of farming households (Natarajan et al., 2022). Within this interplay, job satisfaction is examined because it is the subjective component that farmers' own effort and output can directly influence, and because it has been shown to vary with farm income and working conditions in farming populations (Herrera Sabillón et al., 2022; Kamaruddin et al., 2018).

The theoretical grounding of this study is anchored in one dominant framework, the performance–satisfaction model of Porter and Lawler, which posits that satisfaction is a consequence of rewarded

achievement rather than its antecedent (Lawler & Porter, 1967). This model specifies the sequence tested here: productive achievement (productivity) and dispositional effort (work ethic) are associated with the rewards farmers experience, these rewards shape job satisfaction, and satisfaction is in turn associated with sustained performance. Other perspectives are used only as subsidiary lenses that explain particular links within this sequence, not as competing frameworks: social exchange theory accounts for the reciprocal, community-based rewards that replace employer rewards in smallholder settings (Cropanzano & Mitchell, 2005; Katebi et al., 2022); self-determination theory explains why output experienced as competent work is rewarding in itself (Ryan & Deci, 2000); and the Ability-Motivation-Opportunity (AMO) framework positions affective states such as job satisfaction as the motivational bridge between capability and performance (Bos-Nehles et al., 2023; Eliyana et al., 2019; Gibson et al., 2020). Together, they imply a dual-pathway model: productivity and work ethic are associated with farmer performance both directly (technical-functional path) and indirectly via job satisfaction (psychological-motivational path). Because job satisfaction is expected to transmit, rather than to condition, the effects of productivity and work ethic, it is specified as a mediator rather than a moderator. The transfer of these organisational frameworks to smallholder agriculture is justified because their core mechanism, the evaluation of the rewards obtained from work and the effect of that evaluation on subsequent effort, does not require the presence of an employer; what changes is the source of the rewards, a boundary condition examined in the Discussion. Self-determination theory and social cognitive theory were considered as alternative primary frameworks but were not adopted, because they explain the origins of motivation (basic need satisfaction and self-efficacy, respectively) rather than the sequence from achieved output to satisfaction to performance that is the focus of this study (Ryan & Deci, 2000).

A critical research gap exists. Existing studies on smallholder farmer performance predominantly examine direct effects using multiple regression, rarely applying SEM-based mediation tests in agricultural contexts (Hair et al., 2021; Zypur et al., 2023). Where mediation has been examined in related settings, it has frequently relied on the causal-steps procedure or the Sobel test, both of which have low statistical power and assume a normally distributed indirect effect (Preacher & Hayes, 2008; Zhao et al., 2010); the present study instead uses bootstrapped specific indirect effects within PLS-SEM (Nitzl et al., 2016). The Indonesian patchouli smallholder population, characterised by limited landholding, informal labour structures, and strong communal cultural values (Mapalus), represents an under-explored context for performance-satisfaction research, which has historically been dominated by formal organisational settings (Herrera Sabillón et al., 2022; Katebi et al., 2022).

This study therefore aims to: (1) examine the effects of work ethic and productivity on job satisfaction among patchouli farmers; (2) examine the direct effects of work ethic, productivity, and job satisfaction on farmer performance; and (3) test the mediating role of job satisfaction in the work ethic-performance and productivity-performance relationships using PLS-SEM. This study makes three contributions to literature. First, it applies performance-satisfaction theory to non-formal, self-employed agricultural workers, a population largely absent from human resource management (HRM) research, and specifies a boundary condition for this application: in the absence of wages, hierarchy and formal appraisal, the rewards that link performance to satisfaction are generated by farm output, market prices and communal relations rather than by an employer. Second, it provides, to the best of the authors' knowledge, the first empirically validated structural mediation model of patchouli farmer performance in Indonesia, filling an evidence gap with implications for smallholder agribusiness policy. Third, it demonstrates the added analytical value of combining PLS-SEM mediation testing with Importance-Performance Map Analysis (IPMA) for deriving actionable intervention priorities in agricultural development contexts.

Method

Research Design and Setting

This study adopted a quantitative explanatory research design, employing Partial Least Squares Structural Equation Modeling (PLS-SEM) as the primary analytical approach. PLS-SEM was selected over CB-SEM for three reasons. First, although the hypothesised relationships are theory-driven, the study has an explicitly predictive objective (identifying which antecedents best predict farmer performance and, whose results are reported in the Structural Model Evaluation and IPMA sections prioritising interventions through PLS predict and IPMA), and PLS-SEM is the recommended approach when prediction is a primary aim alongside explanation (Hair, Matthews, et al., 2017; Hair et al., 2019; Shmueli et al., 2019). Second, established relationships are being tested in a new population, so the analysis combines confirmatory testing of theory-based paths with an assessment of how these constructs behave in a smallholder context. Third, PLS-SEM

allows simultaneous estimation of direct, indirect and total effects with bootstrapped inference that does not require multivariate normality (Hair et al., 2021; Nitzl et al., 2016; Zyphur et al., 2023). Data collection was conducted in Tompasobaru Satu Village, Tompasobaru Sub-district, South Minahasa Regency, North Sulawesi Province, Indonesia, between April and June 2026. The research workflow is summarised in Figure 1.

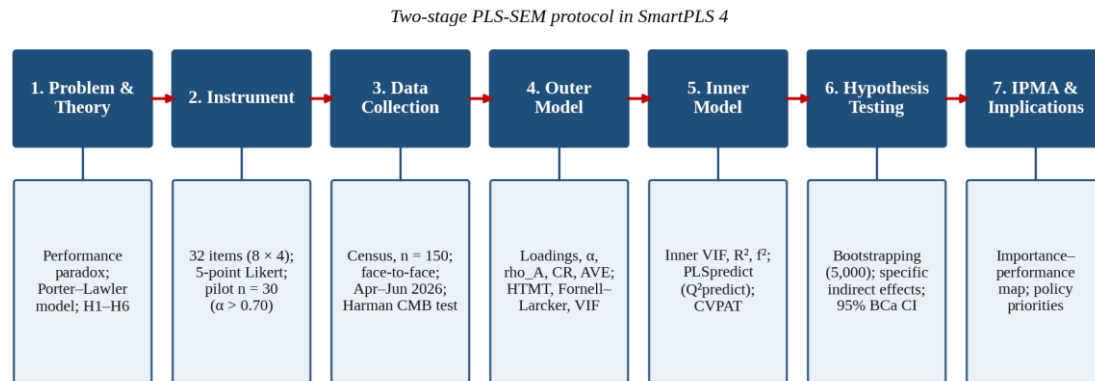


Figure 1. Research design and analytical workflow of the study.

Population and Sample

The target population comprised all 150 active patchouli farming households in Tompasobaru Satu Village. A saturated (census) sampling method was applied, whereby all population members served as respondents, to maximise statistical validity and representativeness given the well-defined and accessible population (Hair et al., 2017). Of the 165 farming households recorded in the village, the 150 households actively cultivating patchouli during the data collection period formed the sampling frame, which was compiled from the farmer-group register of the village agricultural extension office. Saturated sampling was preferred over probability-based alternatives because the population was small, fully listed and geographically accessible: a simple random sample at a 5% margin of error (Slovin's formula) would have yielded only about 110 respondents, below the 123 observations required by the inverse square root method (see below), whereas a census eliminates sampling error for the village population. A structured questionnaire was administered face-to-face with the assistance of trained local enumerators affiliated with the village agricultural extension office (Balai Penyuluhan Pertanian). Of 150 distributed questionnaires, 150 were returned and deemed complete (response rate: 100%), yielding a final analytical sample of $n = 150$. Data quality was screened before analysis in four steps: (1) enumerators checked each questionnaire for completeness on site so that unanswered items could be completed before leaving the household, which resulted in no missing values; (2) response patterns were inspected for straight-lining (identical answers to all items of a construct) and for logically inconsistent answers; (3) univariate outliers were screened using standardised scores ($|z| > 3.29$) and multivariate outliers using the Mahalanobis distance ($p < 0.001$); and (4) the skewness and kurtosis of each indicator were examined. No questionnaire met the exclusion criteria, so all 150 cases were retained. Because no household in the census frame declined to participate, non-response bias did not arise. The complete response rate reflects the census design and face-to-face administration within a small, geographically compact community. Because the enumerators were affiliated with the extension office, respondents may nonetheless have felt pressure to participate or to present their farming practices favourably. To mitigate this, enumerators were trained before fieldwork, participation was voluntary, and respondents were assured of anonymity and confidentiality (see Ethical Considerations); residual social desirability bias cannot be fully excluded and is acknowledged as a limitation.

The adequacy of $n = 150$ was evaluated against four criteria. The 10-times rule requires at least 30 observations, as the largest number of structural paths directed at any construct is three (Hair et al., 2017). An a priori power analysis for the most complex regression in the model (three predictors of Farmer Performance; $f^2 = 0.15$, $\alpha = 0.05$, power = 0.80) requires 77 observations. For the indirect effects, Fritz and MacKinnon (2007) show that bias-corrected bootstrapping requires approximately 71 observations when both mediation paths are medium-sized and approximately 148 when both are small-to-medium; the weakest indirect path in this study (work ethic $\rightarrow$ job satisfaction $\rightarrow$ performance) falls within the latter condition, which $n = 150$ satisfies. Finally, applying the inverse square root method to the smallest estimated structural path ($\beta = 0.225$) yields a minimum of 123 observations (Kock & Hadaya, 2018). The census sample therefore exceeds all four requirements.

Ethical Considerations

The study was conducted in accordance with ethical principles governing research involving human participants. All respondents provided informed verbal consent prior to questionnaire administration. Participation was voluntary and respondents were assured of anonymity and confidentiality of their responses. No sensitive personal or identifying information was collected. This research was conducted under the auspices of the Riset Dasar Unggulan Universitas Sam Ratulangi (RDUU_K1) programme administered by the Research and Community Service Institute (LPPM) of Universitas Sam Ratulangi.

Instrumentation and Operationalisation

Four constructs were measured using reflective scales. Each construct comprised eight indicator items assessed on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Items were adapted from established instruments in the HRM and agricultural performance literature and contextualised for patchouli farming (Gibson et al., 2020; Johari et al., 2019; Katebi et al., 2022; Qureshi, 2024). Specifically, work ethic items were adapted from the work-ethic dimensions (discipline, diligence, consistency and motivation for improvement) described by Qureshi (2024); job satisfaction items from the facets of farm-level satisfaction with work (Besser & Mann, 2015; Herrera Sabillón et al., 2022) and the well-being items of Johari et al. (2019); farmer performance items from the performance dimensions of Gibson et al. (2020); and productivity items from the farm-level indicators of dry-leaf yield, land use efficiency and technology adoption used in patchouli cultivation assessments (Balittro, 2022). Job satisfaction items were contextualised using the facets that farm-level studies identify as salient for farmers' satisfaction with work, namely income, working conditions and facilities, recognition and social relations (Besser & Mann, 2015; Herrera Sabillón et al., 2022), rather than being transferred unchanged from industrial job satisfaction scales. Farmer performance was operationalised as a composite in-role performance construct (harvest quantity, harvest quality, time efficiency and contribution to household welfare); extra-role behaviours such as organisational citizenship behaviour were not measured. The full wording, response scale and source of each of the 32 items are provided in Supplementary Material S1. Table 1 presents the operationalisation of constructs. The equal number of items per construct was a content-coverage decision rather than a statistical one: items were distributed across the facets listed in Table 1 so that every facet was measured by at least two indicators. The adapted items were reviewed for content and wording by agricultural extension staff and the research team before piloting. A separate covariance-based confirmatory factor analysis was not conducted at the adaptation stage; instead, the factor structure was evaluated in the main sample through the PLS-SEM measurement model (outer loadings, AVE, cross-loadings, Fornell-Larcker criterion and HTMT), which performs the confirmatory function in composite-based SEM (Hair et al., 2019).

Table 1. Operationalisation of Research Constructs

Construct	Theoretical Basis	Key Indicators (examples)	No. of Items
Productivity (X1)	Human Capital Theory; RBV	Dry leaf yield per hectare; land use efficiency; adoption of cultivation technology	8
Work Ethic (X2)	Protestant Work Ethic; Job Characteristics Model	Discipline; diligence; motivation for improvement; consistency of practice	8
Job Satisfaction (M)	Two-Factor Theory (Herzberg); AMO Framework	Income satisfaction; social relationships; work facilities; recognition	8
Farmer Performance (Y)	Performance Theory (Gibson et al.)	Harvest quantity; quality; time efficiency; contribution to household welfare	8

A preliminary reliability check using a pilot sample of 30 farmers from an adjacent village confirmed Cronbach's Alpha values above 0.70 for all constructs, validating the instrument's internal consistency prior to full-scale data collection. Pilot respondents were not part of the main sample, and the reliability and validity of all constructs in the main sample are reported in Tables 3 and 4.

Conceptual Model and Hypotheses

The conceptual model (Figure 2) posits Productivity (X1) and Work Ethic (X2) as exogenous constructs influencing Farmer Performance (Y), with Job Satisfaction (M) as the mediating variable. Six hypotheses were tested:

H1: Productivity positively and significantly influences Job Satisfaction.

- H2: Work Ethic positively and significantly influences Job Satisfaction.
H3: Productivity positively and significantly influences Farmer Performance.
H4: Work Ethic positively and significantly influences Farmer Performance.
H5: Job Satisfaction positively and significantly influences Farmer Performance.
H6: Job Satisfaction mediates the effects of Productivity and Work Ethic on Farmer Performance.

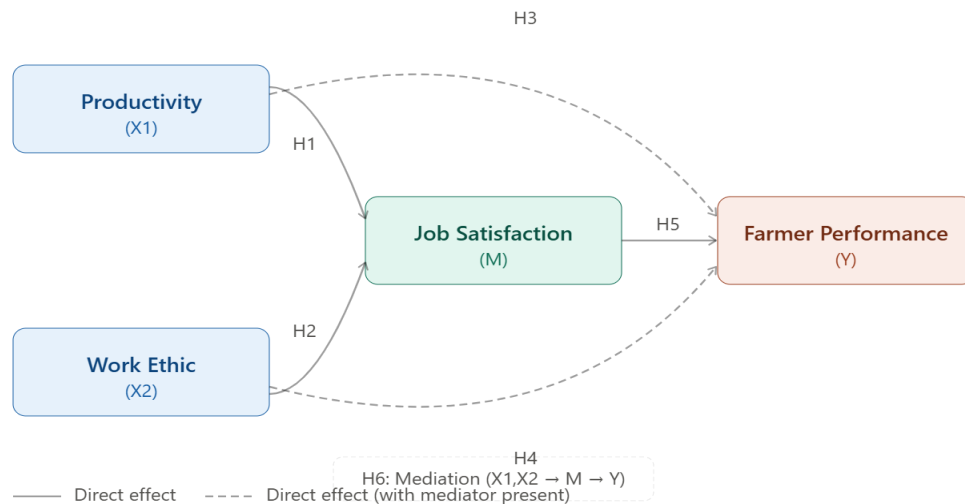


Figure 2. Conceptual model of the mediation mechanism of job satisfaction in patchouli farmer performance. Solid lines = direct paths; dashed lines = direct paths in the presence of the mediator.

Common Method Bias Assessment

Given that all constructs were measured from the same respondents using a self-report questionnaire, common method bias (CMB) was assessed using Harman's single-factor test. An exploratory factor analysis of all 32 items yielded a first common factor explaining 28.3% of the total variance (well below the 50% threshold) suggesting that CMB does not pose a substantial threat to the validity of the findings (Hair et al., 2017). Because Harman's test is a conservative diagnostic, this result is interpreted as indicating the absence of a single dominant method factor rather than as proof that CMB is absent (Podsakoff et al., 2012). Additionally, the procedural separation of predictors and outcomes within the questionnaire layout and the guarantee of respondent anonymity further reduced the likelihood of socially desirable responding.

Analytical Procedure

Model evaluation followed the two-stage protocol recommended by (Hair et al., 2017). Stage 1 Outer Model Evaluation: indicator reliability (outer loadings ≥ 0.60), internal consistency reliability (Cronbach's α , ρ_A , and $CR \geq 0.70$), convergent validity ($AVE \geq 0.50$), discriminant validity assessed via HTMT (< 0.85), cross-loadings, and the Fornell-Larcker criterion, and collinearity (outer VIF < 3.3). Stage 2 Inner Model Evaluation: inner VIF, coefficient of determination (R^2), effect sizes (f^2), predictive relevance ($Q^2_{predict}$) via PLSpredict and Cross-Validated Predictive Ability Test (CVPAT), and Importance-Performance Map Analysis (IPMA). Predictive power was judged by $Q^2_{predict} > 0$ and by the CVPAT comparison of the model's out-of-sample prediction loss against the linear model (LM) and indicator-average benchmarks, which provides an inferential test of the indicator-level RMSE comparison recommended for PLSpredict (Liengaard et al., 2021; Shmueli et al., 2019). Effect sizes (f^2) of 0.02, 0.15 and 0.35 were interpreted as small, medium and large, respectively (Cohen, 1988). Mediation was evaluated via specific indirect effects with bootstrapping (5,000 resamples) and 95% bias-corrected confidence intervals (BCa-CI) following Nitzl et al (2016) and Zhao et al (2010). The causal-steps approach of Baron and Kenny and the Sobel test were not used because they have lower statistical power and assume a normally distributed indirect effect; bootstrapped specific indirect effects are the recommended test of mediation in PLS-SEM (Nitzl et al., 2016; Preacher & Hayes, 2008). The HTMT criterion followed Henseler et al. (2015), predictive assessment followed Shmueli et al. (2019), and IPMA followed Ringle and Sarstedt (2016). For descriptive interpretation, construct mean scores were classified into five equal intervals: 1.00–1.80 (very low), 1.81–2.60 (low), 2.61–3.40 (moderate), 3.41–4.20 (high) and 4.21–5.00 (very high).

Results and Discussion

Respondent Characteristics

The 150 respondents were predominantly in the productive age bracket of 26–45 years (70.0%), with male respondents comprising 66.7% of the sample, reflecting the physically demanding nature of patchouli cultivation. The majority (66.7%) had been cultivating patchouli for fewer than six years, indicating a relatively dynamic and expanding farming community. Most respondents (46.7%) managed plots smaller than 0.5 hectares, characteristic of *usaha tani rakyat* (smallholder household farming) in rural North Sulawesi. These structural characteristics (limited landholding, modest farming experience, and absence of formal employment contracts) confirm that the study population represents a structurally distinct labour context compared to conventional organisational samples in HRM research.

Descriptive Statistics

Table 2 presents descriptive statistics for the four research variables. A substantively important pattern is immediately apparent: while Productivity and Work Ethic were rated in the “High” category, both Job Satisfaction and Farmer Performance fell in the “Moderate” range, with Job Satisfaction recording the lowest mean (3.23) among all variables. This decoupling between high technical and dispositional input (Productivity, Work Ethic) and moderate output (Farmer Performance), accompanied by the lowest-scoring psychological variable (Job Satisfaction), is consistent with, but does not by itself test, the hypothesised mediation structure. Because category labels can mask distributional differences, the full distributions were also inspected: the observed ranges (minimum 1.75–2.00; maximum 4.75–5.00) and standard deviations (0.566–0.690) in Table 2 show that responses were spread across the scale rather than concentrated at either extreme, so the contrast between the high and moderate categories is not an artefact of ceiling or floor effects. Because mean differences across constructs may also reflect differences in item content or response anchoring, the mediation hypothesis is evaluated inferentially through the structural model and bootstrapped indirect effects reported below. The internal consistency of all four multi-item constructs (Cronbach's $\alpha = 0.847$ – 0.899) is reported in Table 3. The theoretical meaning of this decoupling, in relation to the structural vulnerabilities of the study population (small landholdings, informal labour arrangements and weak bargaining power in the commodity chain), is discussed in the Discussion section.

Table 2. Descriptive Statistics of Research Variables (n = 150)

Variable (Code)	Mean	Min	Max	Std. Dev.	Category
Productivity (X1)	3.63	1.75	4.88	0.690	High
Work Ethic (X2)	3.56	1.75	5.00	0.641	High
Job Satisfaction (M)	3.23	2.00	4.75	0.566	Moderate
Farmer Performance (Y)	3.39	1.88	4.88	0.616	Moderate

Within Job Satisfaction, the highest-scoring dimension was inter-farmer social relations (M6, mean = 3.55), reflecting the communal Mapalus cultural values of Minahasa society in which collective mutual assistance governs agricultural activities (BPS Kabupaten Minahasa Selatan, 2023). By contrast, satisfaction with work facilities (M4, mean = 3.01) and income adequacy (M2, mean = 3.03) were lowest, consistent with the structural constraints of small-plot farming and asymmetric commodity market pricing, where farm-gate oil prices (IDR 700,000–900,000/kg) fall substantially below international market levels (IDR 1,200,000–1,500,000/kg).

Measurement Model (Outer Model) Evaluation

Indicator Reliability and Internal Consistency

All 32 indicators yielded outer loadings exceeding the 0.60 minimum threshold (Hair et al., 2017). Seven indicators (X1.3, X2.6, M4, M5, M6, M8, Y2) fell within the 0.60–0.70 range. These were retained because: (a) they represent substantively irreplaceable content dimensions whose removal would compromise construct content validity; (b) their inclusion did not reduce CR below the 0.70 threshold; and (c) their VIF values remained below 2.3, ruling out redundancy as the source of lower loadings. In PLS-SEM, this outer-model assessment of loadings, reliability, convergent validity and discriminant validity performs the confirmatory function that confirmatory factor analysis performs in covariance-based SEM (Hair et al., 2019). Reliability results are summarised in Table 3.

Table 3. Internal Consistency Reliability and Convergent Validity

Construct	Cronbach's α	ρ_A	CR (ρ_c)	AVE
Productivity (X1)	0.899	0.901	0.919	0.587
Work Ethic (X2)	0.891	0.893	0.913	0.567
Job Satisfaction (M)	0.847	0.849	0.882	0.484†
Farmer Performance (Y)	0.873	0.878	0.900	0.532

† AVE marginally below the 0.50 threshold; retained following Fornell and Larcker (1981) given CR = 0.882 >> 0.70, confirmed discriminant validity on all three criteria, and absence of multicollinearity (all outer VIF < 3.3).

Discriminant Validity

Discriminant validity was assessed via three complementary approaches (Table 4). HTMT ratios ranged from 0.577 to 0.745, all below the conservative 0.85 threshold (Hair et al., 2017). Cross-loadings confirmed that each indicator consistently loaded highest on its designated construct. The Fornell–Larcker criterion was fully satisfied: the square root of each construct's AVE (diagonal values in Table 4) exceeded all inter-construct correlations in the corresponding row and column, including for Job Satisfaction ($\sqrt{\text{AVE}} = 0.695 > \text{max off-diagonal correlation of } 0.611$), despite its AVE falling slightly below 0.50.

Table 4. Discriminant Validity: Fornell–Larcker Criterion and HTMT (in parentheses)

Construct	M	X1	X2	Y
Job Satisfaction (M)	0.695	—	—	—
Productivity (X1)	0.580 (0.659)	0.766	—	—
Work Ethic (X2)	0.505 (0.577)	0.641 (0.716)	0.753	—
Farmer Performance (Y)	0.611 (0.706)	0.662 (0.745)	0.623 (0.701)	0.729

Diagonal = $\sqrt{\text{AVE}}$; off-diagonal = inter-construct correlations; HTMT values in parentheses. All HTMT < 0.85 threshold.

Structural Model (Inner Model) Evaluation

Inner VIF values ranged from 1.578 to 1.997, well below the 3.3 threshold, confirming the absence of multicollinearity among predictor constructs. The coefficient of determination (R^2) showed that Work Ethic and Productivity jointly explained 36.6% of the variance in Job Satisfaction ($R^2 = 0.366$; $R^2_{\text{adj}} = 0.358$), while all three predictors jointly explained 55.8% of Farmer Performance variance ($R^2 = 0.558$; $R^2_{\text{adj}} = 0.549$) a moderate-to-strong explanatory power in a smallholder agricultural context. Q^2_{predict} values were positive for both endogenous constructs (Job Satisfaction = 0.339; Farmer Performance = 0.487). CVPAT confirmed statistically significant predictive superiority of the PLS-SEM model over both the Linear Model (overall: Average Loss Difference = -0.0765 ; $t = 8.824$; $p < 0.001$) and the Indicator Average benchmark (overall: Average Loss Difference = -0.1475 ; $t = 5.264$; $p < 0.001$), demonstrating robust out-of-sample predictive validity beyond mere in-sample fit. These PLSpredict and CVPAT results substantiate the predictive objective that motivated the choice of PLS-SEM.

Hypothesis Testing: Direct Effects

Table 5 presents the direct path coefficient results from the bootstrapping procedure. All five direct-effect hypotheses (H1–H5) were supported at $p < 0.05$.

Table 5. Direct Path Coefficients (Bootstrapping, 5,000 Resamples)

Hyp.	Path	β	Std. Error	T-Stat.	p-Value	f^2	Effect Size	Decision
H1	X1 $\rightarrow$ M	0.435	0.079	5.525	< 0.001	0.176	Medium	Supported
H2	X2 $\rightarrow$ M	0.225	0.080	2.796	0.005	0.047	Small	Supported
H3	X1 $\rightarrow$ Y	0.321	0.075	4.310	< 0.001	0.117	Small–Med.	Supported
H4	X2 $\rightarrow$ Y	0.273	0.075	3.661	< 0.001	0.095	Small	Supported
H5	M $\rightarrow$ Y	0.287	0.064	4.510	< 0.001	0.118	Small–Med.	Supported

f^2 effect size categories per Cohen (1988): small = 0.02, medium = 0.15, large = 0.35.

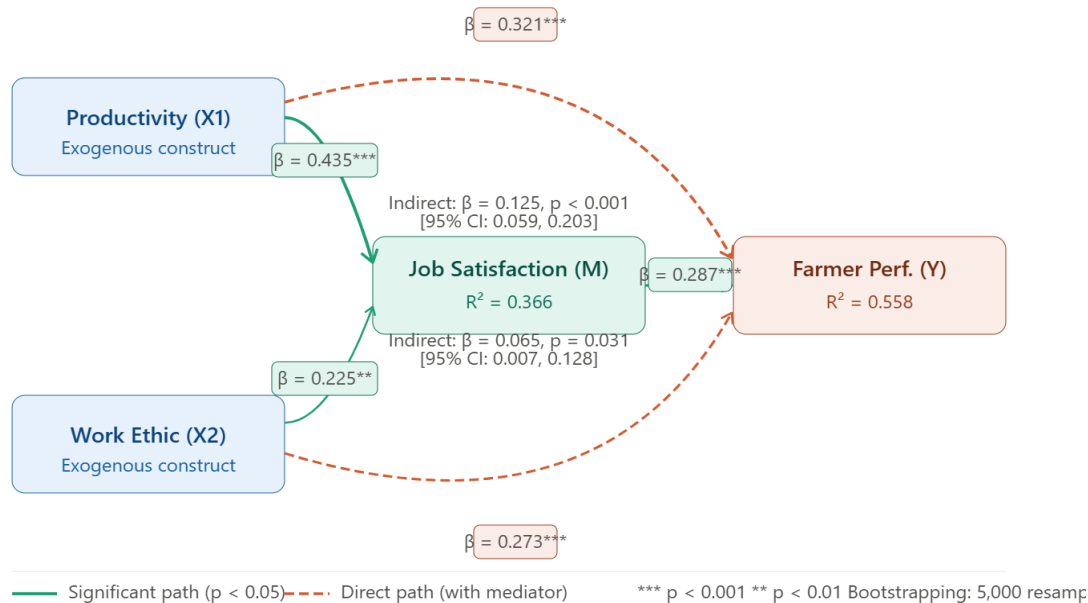


Figure 3. Estimated PLS-SEM structural model with standardised path coefficients (β), R^2 values, and indirect effects with 95% BCa confidence intervals.

Note. ** $p < 0.01$, *** $p < 0.001$. Bootstrapping: 5,000 resamples.

Hypothesis Testing: Mediation Effects (H6)

Table 6 reports the specific indirect effects confirming the mediation role of Job Satisfaction. Both indirect paths were statistically significant and their 95% BCa confidence intervals excluded zero, providing robust evidence for mediation (Nitzl et al., 2016; Zhao et al., 2010).

Table 6. Specific Indirect Effects and Mediation Assessment

Mediation Path	Direct Effect (β)	Indirect Effect (β)	95% BCa CI	T-Stat.	p-Value	Mediation Type
X1 $\rightarrow$ M $\rightarrow$ Y	0.321***	0.125	[0.059, 0.203]	3.649	< 0.001	Partial (Complementary)
X2 $\rightarrow$ M $\rightarrow$ Y	0.273***	0.065	[0.007, 0.128]	2.160	0.031	Partial (Complementary)

BCa CI = Bias-corrected and accelerated confidence intervals (5,000 bootstrap resamples). Partial complementary mediation: direct effect remains significant after introducing the mediator; indirect effect is in the same direction as the direct effect.

Both mediation paths qualify as partial complementary mediation following the classification of Zhao et al (2010). The direct effects of Productivity ($\beta = 0.321$) and Work Ethic ($\beta = 0.273$) on Farmer Performance remained significant after introducing Job Satisfaction as a mediator, indicating that Job Satisfaction operates as one of multiple mechanisms (not the sole pathway) through which technical capacity and work disposition translate into performance. The ratio of the indirect to total effect was 0.28 for the Productivity path ($0.125/0.446$) and 0.19 for the Work Ethic path ($0.065/0.338$), quantifying the relative contribution of the psychological pathway to total effect transmission. The corresponding total effects of Productivity ($\beta = 0.446 = 0.321 + 0.125$) and Work Ethic ($\beta = 0.338 = 0.273 + 0.065$) on Farmer Performance, together with the standardised path coefficients in Table 5, the 95% BCa confidence intervals in Table 6 and the R^2 values of Job Satisfaction (0.366) and Farmer Performance (0.558), provide the complete information required to reproduce the mediation decomposition.

Importance-Performance Map Analysis (IPMA)

IPMA results with Farmer Performance as the target construct are presented in Table 7 and visualised in Figure 4. Productivity ranked highest on importance (total effect = 0.446), followed by Work Ethic (0.338) and Job Satisfaction (0.287). When combined with performance gaps, Productivity yielded the highest total unrealised potential (16.72 index points), confirming its status as the primary strategic leverage point.

Table 7. IPMA Results Targeting Farmer Performance

Construct	Importance (Total Effect)	Performance (0–100)	Gap (100 – Perf.)	Unrealised Potential (Imp. × Gap)
Productivity (X1)	0.446	62.49	37.51	16.72
Work Ethic (X2)	0.338	59.52	40.48	13.67
Job Satisfaction (M)	0.287	50.74	49.26	14.12

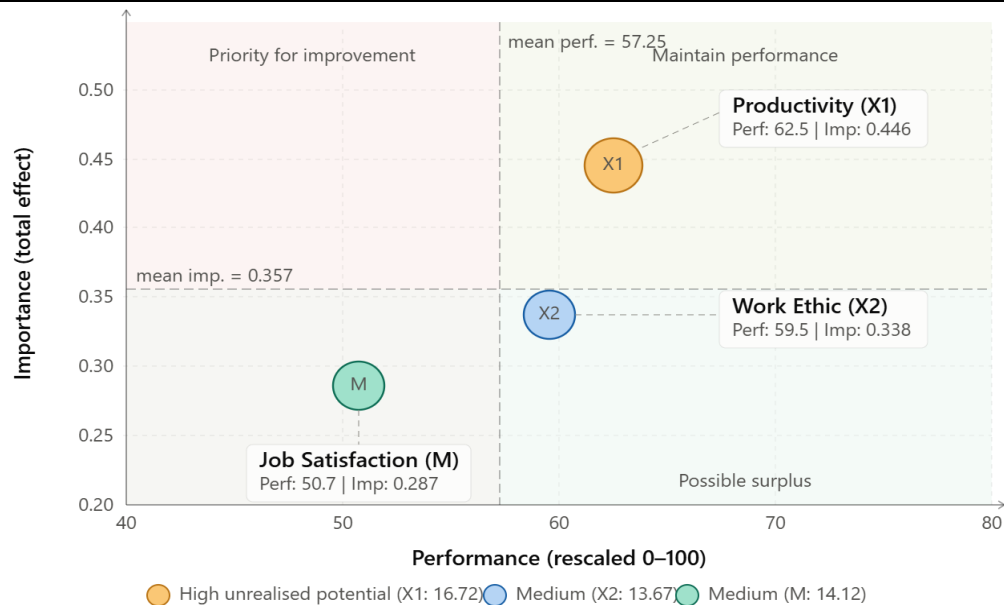


Figure 4. Importance-Performance Map Analysis (IPMA) with Farmer Performance as the target construct.

Note: X-axis = performance score (rescaled 0–100); Y-axis = importance (total effects). Crosshair lines indicate mean performance (57.25) and mean importance (0.357). Bubble size proportional to total unrealised potential.

Although Job Satisfaction shows the lowest performance score (50.74/100), indicating the largest absolute gap, its relatively lower total effect means that the highest return on intervention accrues from addressing Productivity. Crucially, even a modest improvement in Productivity the leverage variable would simultaneously generate performance gains through both the direct path ($\beta = 0.321$) and the indirect path via Job Satisfaction ($\beta = 0.125$), yielding the highest aggregate impact per unit of programme investment.

Productivity as the Primary Determinant

The finding that Productivity is the strongest predictor within the estimated model of both Job Satisfaction (H1: $\beta = 0.435$) and Farmer Performance (H3: $\beta = 0.321$; total effect = 0.446) is consistent with the Porter–Lawler performance–satisfaction model: effective work output is associated with a sense of competence and reward, which is in turn associated with higher performance. Because the data are cross-sectional, this ordering reflects the theoretically specified direction rather than empirically established causal precedence; the reverse possibility, that satisfied farmers become more productive, is examined in the section on alternative explanations. In the context of resource-constrained smallholder farming where 46.7% of respondents manage plots below 0.5 ha productivity gains from efficient land use and distillation technology are immediately experienced as tangible and psychologically rewarding, without intermediary organisational systems. This is consistent with Herrera Sabillón et al. (2022), who found that farm-level factors shape farmers' satisfaction with work, and corroborates their conclusion in an Indonesian smallholder setting; the contribution here lies in positioning satisfaction as a transmitting mechanism toward performance rather than as an end outcome. Comparable productivity–well-being associations have been reported among maize farmers in China, where happier farmers achieved higher productivity (Ma et al., 2021), and among Chinese farmers adopting integrated planting–breeding systems, whose subjective well-being rose through self-worth and income gains (Li et al., 2024). The highest item score within Productivity (X1.3: land use efficiency, mean = 3.87) suggests that even with limited land, farmers derive satisfaction from optimising what they have, a pattern consistent with self-determination theory's competence need (Ryan & Deci, 2000).

Work Ethic as a Necessary but Insufficient Condition

Work Ethic demonstrated significant but smaller effects on both Job Satisfaction (H2: $\beta = 0.225$, $f^2 = 0.047$) and Farmer Performance (H4: $\beta = 0.273$, $f^2 = 0.095$), supporting its role as a necessary but not sufficient condition for performance. The small effect size on job satisfaction is theoretically meaningful: while diligence and discipline provide intrinsic psychological meaning (consistent with Hackman and Oldham's job characteristics model and Protestant Work Ethic theory (Qureshi, 2024)) full satisfaction requires concrete productive achievement, not just dispositional effort. The gap between the highest work ethic item (X2.8: motivation for improvement, mean = 3.74) and the lowest (X2.6: practice of systematic self-evaluation, mean = 3.37) indicates that farmers' work ethic is sustained more by individual drive than by managerial self-regulation, limiting its leverage on satisfaction and, indirectly, on performance. This finding diverges from studies in formal organisational contexts: e.g., Santoso (2024) where work ethic effects are amplified by structured reward systems absent in smallholder agriculture. Evidence from Indonesian service organisations likewise shows that work ethic is related to performance partly through job satisfaction (Amaliasita & Astuti, 2023), whereas in the present smallholder setting the indirect path is comparatively weak (indirect $\beta = 0.065$), suggesting that without structured rewards, dispositional effort converts into satisfaction less efficiently.

Job Satisfaction as a Partial Mediator

The confirmation of Job Satisfaction as a partial complementary mediator in both H6a (X1→M→Y: indirect $\beta = 0.125$, $p < 0.001$) and H6b (X2→M→Y: indirect $\beta = 0.065$, $p = 0.031$) supports the AMO framework and Affective Events Theory, positioning job satisfaction as an affective-motivational bridge transforming technical capacity and dispositional effort into performance behaviour. This is consistent with (Katebi et al., 2022) meta-analysis reporting moderate-to-large effect sizes ($r = 0.39$) between job satisfaction and performance across 87 studies, and with Maniendaran et al (2025) on employee performance. It is also in line with the earlier meta-analysis of Judge et al. (2001), which reported a mean corrected correlation of 0.30 between job satisfaction and job performance, indicating that the magnitude observed among patchouli farmers ($\beta = 0.287$) is typical rather than anomalous.

The critically low performance score of Job Satisfaction (50.74/100), anchored by low satisfaction with income adequacy (M2 = 3.03) and work facilities (M4 = 3.01), reflects a systemic value-chain failure: farm-gate prices (IDR 700,000–900,000/kg) are 40–50% below international market levels, limiting economic satisfaction despite high technical effort. Yet the social relational dimension of satisfaction (M6, mean = 3.55) (reflecting Mapalus communal mutual aid) continues to buffer performance, suggesting that culturally embedded social capital functions as a compensatory mechanism sustaining minimum performance levels even when economic satisfaction is depressed. This finding is novel in the smallholder performance literature and has important implications for culturally sensitive intervention design. The dominance of income adequacy and working conditions as sources of low satisfaction mirrors findings in other farming populations: economic profitability and working conditions determine the job satisfaction of young oil palm plantation workers in Malaysia (Kamaruddin et al., 2018); financial pressure and workload are principal sources of stress for Irish farmers (Brennan et al., 2021) and Finnish dairy farmers (Kallioniemi et al., 2016); financial difficulty is among the key risk factors for farmers' mental health globally (Daghagh Yazd et al., 2019); and farms with better facilities and HRM practices provide better workplaces (Hogan et al., 2024). Conversely, Swiss farmers' work satisfaction depends less on income than that of German farmers (Besser & Mann, 2015), and organic farmers report higher well-being despite modest incomes (David et al., 2021; Mzoughi, 2014), supporting the interpretation that non-monetary and social sources of satisfaction can partly offset economic shortfalls, as observed here for the Mapalus dimension.

A Structural Value-Chain Interpretation

The descriptive paradox (Productivity and Work Ethic rated “High” but Farmer Performance and Job Satisfaction rated only “Moderate”) is explicable through a structural value-chain lens. Technical improvements at the farm level do not automatically translate into economic welfare gains when farmers occupy a weak bargaining position in the commodity supply chain. The lowest performance item (Y8: contribution of patchouli farming to family economic improvement, mean = 3.15) directly reflects this structural constraint. Consequently, comprehensive performance improvement requires simultaneous attention to both on-farm technical dimensions (productivity, work ethic) and off-farm institutional dimensions (price fairness, market access, crop storage infrastructure), pointing to a policy design challenge extending beyond agronomic intervention alone.

Alternative Explanations and Theoretical Boundary Conditions

Three alternative explanations must be weighed against the mediation interpretation. First, reverse causality: satisfied farmers may invest more effort and thereby become more productive, implying a satisfaction-to-productivity path rather than the reverse. The Porter–Lawler model favours the specified direction, but a cross-sectional design cannot empirically exclude reverse or reciprocal effects; indeed, evidence that happier maize farmers in China achieve higher productivity (Ma et al., 2021) shows that the reverse direction is empirically plausible. Second, third-variable confounding: market access, cooperative membership, credit access or climate variability could simultaneously raise productivity, satisfaction and performance, inflating the observed associations. Third, a direct-effects account: because the direct paths from productivity ($\beta = 0.321$) and work ethic ($\beta = 0.273$) remain significant and the indirect effects account for only 28% and 19% of the respective total effects, a substantial share of performance variation is transmitted through non-psychological channels. The mediation evidence should therefore be interpreted as showing that job satisfaction is one statistically significant transmission pathway consistent with theory, not as proof of a causal mechanism; longitudinal or experimental designs and models that include structural controls are required to rule out these alternatives.

Formal-sector theories were also not assumed to transfer to the smallholder context without adaptation. The Porter–Lawler model and social exchange theory presuppose that rewards are allocated by an organisation in exchange for performance; among self-employed patchouli farmers there is no employer, wage or appraisal system, so rewards arise from the harvest itself, from farm-gate prices set by collectors and from reciprocal obligations within Mapalus groups. The results suggest two boundary conditions. First, the output–satisfaction link (H1: $\beta = 0.435$) is stronger than the effort–satisfaction link (H2: $\beta = 0.225$), indicating that in the absence of organisational recognition, visible output rather than effort is the principal source of reward. Second, because the economic component of reward is constrained by the value chain, satisfaction relies disproportionately on social relations. These observations refine, rather than overturn, the performance–satisfaction model by specifying where rewards originate when organisational structures are absent; the study should therefore be read as a contextualised empirical application of existing theory rather than as a new theoretical model.

Measurement Considerations and Interpretation of Effect Sizes

Three measurement issues qualify the interpretation of these results. First, productivity was measured through farmers' self-reports on perceptual items (perceived dry-leaf yield, land use efficiency and technology adoption) rather than through objective yield records, and farmer performance was likewise self-assessed. Because all four constructs were obtained from the same respondents at the same time, common method variance may have inflated the associations among them; Harman's test indicated no dominant method factor (28.3%), but this test cannot rule out moderate method effects (Podsakoff et al., 2012), so the path coefficients may be somewhat overstated. Second, effect sizes were classified using Cohen's (1988) conventional benchmarks because no domain-specific f^2 norms exist for smallholder performance research. These labels should not be read as indicating trivial importance: in field settings where outcomes have many determinants, effects labelled small can be practically consequential when they operate continuously across a whole population (Funder & Ozer, 2019). The f^2 values of 0.047 (work ethic $\rightarrow$ job satisfaction) and 0.095 (work ethic $\rightarrow$ farmer performance) are therefore interpreted as small but non-negligible contributions in a model in which productivity is also present. Third, measurement error propagates through the mediation model. Although PLS-SEM accounts for measurement error better than regression-based mediation analysis using sum scores (Sarstedt et al., 2020), composite scores are not error-free, and job satisfaction has the lowest AVE (0.484). Measurement error in a mediator typically attenuates the mediator–outcome path, and hence the indirect effect, while shifting part of the effect to the direct paths. The indirect effects reported in Table 6 are therefore likely to be conservative estimates, and replication with objective performance data and alternative estimators would help to quantify this bias.

Limitations

Several limitations should be acknowledged. First, the cross-sectional design limits causal inference; the direction of the paths rests on theory, and reverse or reciprocal effects between productivity, job satisfaction and performance cannot be excluded. Second, all variables are self-reported; although Harman's single-factor test did not indicate a dominant method factor, common method bias and social desirability bias, possibly heightened by the involvement of enumerators affiliated with the extension office, cannot be fully eliminated. Third, productivity and performance were measured perceptually rather than with objective harvest or income records. Fourth, the single-village census ($n = 150$) limits generalisability beyond patchouli smallholders in the Minahasa cultural context, and the Mapalus communal norms that sustain the social

dimension of satisfaction may not be present elsewhere. Fifth, relevant contextual variables (commodity price fluctuations, market access, cooperative membership, credit access, climate variation and extension support) were not included in the structural model and may act as confounders or moderators. Future research should adopt longitudinal or panel designs, incorporate objective productivity and income measures (e.g., verified harvest records), include these contextual variables as controls or moderators, test alternative (reverse-causal and direct-effects-only) model specifications, and replicate the model across other smallholder commodity sectors and regional contexts in Indonesia. Until such replications are available, the findings should be treated as context-bound evidence rather than as generalisable estimates for Indonesian smallholders as a whole.

Author Contributions Statement

LOHD: Conceptualisation, funding acquisition, research design, field supervision, formal analysis, interpretation of results, writing original draft, writing review and editing, project administration. IT: Data collection, data curation, writing review and editing. JJP: Data collection, data curation, writing review and editing. SP: Data curation, writing review and editing. All authors have read and agreed to the published version of the manuscript.

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Conclusion

This study tested a structural mediation model of patchouli farmer performance using PLS-SEM on a census sample of 150 smallholder farmers in Tompasobaru Satu Village, Indonesia. All five direct-effect hypotheses and both mediation hypotheses were empirically supported. Five principal conclusions are drawn: (1) Productivity is the primary antecedent of job satisfaction ($\beta = 0.435$) and the strongest overall determinant of farmer performance (total effect = 0.446), operating through both a direct technical-functional pathway and an indirect pathway mediated by job satisfaction; (2) Work ethic functions as a necessary but not sufficient condition for job satisfaction, providing the dispositional foundation for psychological well-being but requiring concrete productive achievement to convert into full satisfaction and high performance; (3) Job satisfaction partially and complementarily mediates both the productivity–performance and work ethic–performance relationships, supporting a dual-pathway model of farmer performance in which psychological and technical mechanisms operate simultaneously; (4) IPMA confirms productivity as the primary strategic leverage point for farmer performance, measured as a composite in-role construct comprising harvest quantity, harvest quality, time efficiency and contribution to household welfare (unrealised potential = 16.72), but the large performance gap in job satisfaction (49.26 points) underscores that psychological well-being interventions are essential complements to technical programmes; (5) The Mapalus communal social capital of the Minahasa context sustains a social dimension of job satisfaction that partially compensates for low economic and facility-based satisfaction, suggesting that cultural assets may contribute to smallholder resilience in this context; whether this compensatory role holds in communities without comparable communal institutions remains to be tested.

Theoretically, this study applies performance–satisfaction theory, supported by the AMO framework and social exchange theory, to non-formal smallholder agricultural contexts, a population largely absent from the HRM literature. Its contribution is an empirical application with a specified boundary condition rather than a new theory: where wages, hierarchy and formal appraisal are absent, the rewards linking performance to satisfaction derive from farm output, market prices and communal relations. In terms of theoretical predictions, the results confirm the Porter–Lawler prediction that achieved output is associated with satisfaction and that satisfaction is associated with performance (H1, H5 and H6), and the AMO expectation that affective states partly transmit capability into performance. They qualify, rather than confirm, two expectations derived from formal-sector theory: effort (work ethic) was a much weaker source of satisfaction than output, and social exchange operated through communal Mapalus reciprocity rather than through employer–employee exchange. The Mapalus finding therefore implies a modification of the reward component of the performance–satisfaction model for self-employed farmers: rewards should be specified as including communal social rewards alongside economic rewards, with the weight of social rewards increasing when economic rewards are constrained by the value chain. These conclusions are context-bound

to patchouli smallholders in a single Minahasa village; their theoretical transferability is a proposition to be tested by replicating the model with multi-village probability samples in other commodities and cultural settings, using measurement-invariance testing and multi-group analysis to establish whether the paths and the role of communal rewards hold across contexts. Practically, agribusiness empowerment programmes targeting patchouli farmers in Indonesia should be designed holistically, integrating: (a) technical-agronomic interventions (certified high-yielding seedlings, distillation equipment modernisation, post-harvest management); (b) work ethic development through communal-cultural channels (farmer group coaching, Mapalus-based collective learning); and (c) economic well-being improvements via value-chain reforms (warehouse receipt systems, minimum price guarantees, collective marketing cooperatives).

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