JOURNAL OF AGRICULTURE, LIVESTOCK AND FISHERIES

Volume 1, Number 1 (2026) · November 2026

Research Center Progresif
jalf@researchcenterprogresif.org

BREADTH WITHOUT BALANCE: FIVE CROPS AND ONE THAT MATTERS IN INDONESIAN PROVINCIAL PLANTATIONS

Abdul Wahid Alfarizi[1*]

[1]Universitas Primagraha

*Corresponding author: alfarizifariz38@gmail.com

Article History
Received: 09-09-2026
Accepted: 12-11-2026

Keywords:
crop diversification; specialisation; Herfindahl-Hirschman index; plantation crops; provincial economy

ABSTRACT

The typical Indonesian province grows five of the country's seven plantation crops, which sounds diversified, and takes 77.18 per cent of its plantation tonnage from one of them, which is not. Using Central Statistics Agency figures for 2024 across thirty-eight provinces and seven crops, this article computes for each producing province a Herfindahl-Hirschman index over its own crop mix. The mean is 0.6774 and the median 0.7369; twenty-one of the thirty-seven producing provinces take at least 80 per cent of their output from a single crop and thirty-two take at least half. The number of crops a province grows explains very little of this: the correlation between crop count and the index is only minus 0.3194. Kalimantan Utara is the clearest case, growing five of the seven crops and obtaining 99.72 per cent of its tonnage from oil palm. At the other end Jawa Barat, with an index of 0.2027, grows all seven and takes 27.66 per cent from its largest. Oil palm is dominant in twenty-two of the thirty-seven provinces and coconut in ten. A count of crops grown is not a measure of diversification, and the two must be reported together.

1. INTRODUCTION

Diversification is a standing objective of Indonesian regional agricultural policy. A province that depends on one commodity is exposed to its price, its pests and its regulatory treatment, and the standard prescription is to broaden the mix.

Whether a province has broadened its mix is usually assessed by counting what it grows. On that measure the Indonesian provinces do well: the average producing province records positive output of 4.95 of the seven plantation crops for which national figures are published, and only four provinces grow three or fewer.

The count is the wrong measure. What determines a province’s exposure is not how many crops appear in its statistics but how its tonnage is divided among them, and those are very different quantities. This article computes both for every Indonesian province and reports how weakly they are related.

The mean Herfindahl-Hirschman index across a province’s own crop mix is 0.6774, with a median of 0.7369. Twenty-one of thirty-seven producing provinces obtain at least 80 per cent of their plantation tonnage from a single crop. The correlation between the count of crops grown and

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the index is −0.3194, so knowing how many crops a province grows accounts for about a tenth of the variation in how concentrated its output is.

The research gap is that provincial crop diversification in Indonesia is reported as breadth and not as balance, so the distinction between the two has not been quantified. This article quantifies it on the complete provincial population.

2. LITERATURE REVIEW

2.1 Diversification as an objective

A first strand treats the crop mix as an outcome that can be influenced and that carries welfare consequences.

Hemond, Butsic, Moanga and Wartenberg (2023) find farm consolidation associated with greater crop diversity and higher input use, so that the mix responds to structural change in the sector. Almekinders, Hebinck, Marinus, Kiaka and Waswa (2021) explain why West Kenyan farmers plant many maize varieties rather than the recommended one, a within-crop diversification driven by risk and by heterogeneous plots.

De Groote, Kariuki, Ndegwa, Mbugua, Chivasa and Jaleta (2025) treat varietal turnover as an outcome shaped by seed systems, and Opata, Okorie, Iwuchukwu, Ume and Oyinbo (2021) show that what is recorded as grown may not be what is grown. Both bear on the reliability of any count of crops or varieties.

The literature at farm level therefore treats diversification as a portfolio decision. At provincial level the aggregate mix is not a decision at all but the sum of many, and this article measures the sum without attributing intention to it.

2.2 Exposure and its consequences

A second strand concerns what a concentrated mix exposes a place to.

Li, Wang, Kharrazi, Fath, Liu, Liu, Xiao and Lai (2024) analyse how shocks propagate through a trade network in which the concentration of supply determines vulnerability. Skjerstad, Kallio, Bergland and Solberg (2021) estimate global demand elasticities for a forest product, establishing that a commodity price is set outside the producing region.

Drechsel, Madhuwanthi, Nisansala, Ramamoorthi and Bandara (2025) analyse Sri Lanka's fertiliser ban, a single policy shock that struck an entire agricultural system at once. Amondo, Nshakira-Rukundo and Mirzabaev (2023) link extreme weather events to child nutrition outcomes, and Adem, Cochrane, Miceikiene, Skominas and Azadi (2023) trace multidimensional food security through time in a rural economy.

Whitaker (2024) examines how government policies and regulations affect farmers' subjective well-being in two Italian mountain areas, which is the mechanism by which a concentrated exposure becomes a lived one. Consentino, McAreavey and Peri (2026) deconstruct

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how generational renewal is represented in regional development programmes, an example of policy framing determining what counts as a problem.

2.3 Measuring a mix

A third strand concerns the measurement of composition.

The Herfindahl-Hirschman index over a unit's own composition is the standard summary and has a useful property: its reciprocal is the effective number of components, so an index of 0.5 corresponds to two equally sized components regardless of how many are nominally present. A province growing seven crops with an index of 0.7369, the median value here, has an effective number of about 1.36.

Aragon, Restuccia and Rud (2024) show that the unit of aggregation determines what composition is visible, and Akune and Hosoe (2021) that heterogeneity survives inside aggregates. A provincial mix is an aggregate of farm mixes, and a province could be diversified in aggregate while every farm within it was specialised, or the reverse.

Ulucak and Miao (2026) and Chen, Wang and Wang (2025) both work with administrative units chosen for policy relevance rather than economic homogeneity, which is the position of the province here. Wen (2023) models spatial structure explicitly, a reminder that neighbouring provinces are not independent draws.

2.4 Land, capital and what can be added

A fourth strand concerns the constraints on changing a mix.

Holden and Tilahun (2021) examine access to rented land among land-poor youth and Takada and Shuto (2023) how tenure insecurity alters factor demand; both establish that adding a crop requires access to land on terms that many producers lack. Slavchevska, Veldman, Park, Boero, Gurbuzer and Macchioni Giaquinto (2025) document how unequally those terms are distributed. Khanna and Kaur (2023) study techniques adopted for land administration, which govern what can be recorded as planted.

Perennials compound the constraint. Oil palm, rubber and cocoa require years between planting and first harvest, so a province's current mix reflects decisions taken long before, and a diversification policy adopted today would appear in these statistics only after a delay. Marcos-Perez, Sanchez-Navarro, Martinez-Martinez, Martinez-Mena, Garcia and Zornoza (2023) show that intercropping can raise yield and fertility simultaneously, which is the one route to adding a crop without displacing another.

2.5 The research gap

Provincial crop diversification in Indonesia has been described by breadth and not by balance, and the relationship between the two has not been reported. This article computes a composition index for every producing province, sets it against the count of crops grown, and shows that the two are only weakly related.

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3. METHOD

The data are the Central Statistics Agency series Produksi Tanaman Perkebunan Menurut Provinsi dan Jenis Tanaman (Ribu Ton) for 2024, retrieved on 30 August 2026, covering seven crops — oil palm, coconut, rubber, coffee, cocoa, tea and sugarcane — across the thirty-eight provinces of the current administrative division.

DKI Jakarta records zero output of all seven crops and is excluded, leaving thirty-seven producing provinces. For each of these, two statistics are computed over its own seven-crop vector: the count of crops with strictly positive output, and the Herfindahl-Hirschman index, being the sum of squared shares of the province's own plantation total. The index runs from a minimum of 0.1429, attained by a province with seven equal crops, to a maximum of 1.0, attained by a province growing only one.

The dominant crop is the one with the largest tonnage in the province, and its share is that tonnage as a percentage of the province's plantation total. The effective number of crops is the reciprocal of the index, reported where it aids interpretation.

The association between count and index across the thirty-seven provinces is reported as a Pearson correlation. Because the index is bounded and the count takes only six distinct values in this population, the coefficient is a summary rather than a model, and the distributional detail in Table 3 is the substantive evidence.

Five limitations apply, and the first is fundamental. Production is measured in thousand tonnes of physically incomparable products: fresh oil palm fruit bunches, whole coconuts, dry rubber, green coffee, dry cocoa beans, made tea and cane. A tonne of one is not economically equivalent to a tonne of another, so a tonnage share is not a value share, and every index reported here is an index of physical composition. Oil palm fruit is heavy and low in value per tonne, so provinces growing it will appear more concentrated on tonnage than they would on value. Second, only plantation crops are counted, so a province with a large food-crop or livestock sector appears specialised when its wider agriculture is not. Third, the figures are for one year. Fourth, the province is coarse. Fifth, the analysis is descriptive.

4. RESULTS AND DISCUSSION

4.1 Breadth

Table 1 gives the distribution of the number of crops grown.

Table 1. Number of the seven plantation crops grown, 37 producing provinces, 2024

Crops grown	Provinces	Share of provinces	Cumulative
Two	1	2.7%	2.7%
Three	3	8.1%	10.8%
Four	9	24.3%	35.1%

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Crops grown	Provinces	Share of provinces	Cumulative
Five	11	29.7%	64.9%
Six	10	27.0%	91.9%
Seven	3	8.1%	100.0%

Computed by the authors from Central Statistics Agency, Produksi Tanaman Perkebunan Menurut Provinsi dan Jenis Tanaman (Ribu Ton), 2024, retrieved 30 August 2026. DKI Jakarta, which records zero output of all seven crops, is excluded.

On breadth the picture is one of substantial diversity. The mean is 4.95 crops and the median five; twenty-four of the thirty-seven provinces grow five or more, and only one grows fewer than three.

Three provinces grow all seven. A reader given this table alone would conclude that Indonesian provincial agriculture is well diversified across the plantation sector.

The conclusion would be wrong, and Table 2 shows why.

4.2 Balance

Table 2 reports the distribution of the composition index and of the dominant crop's share.

Table 2. Concentration of each province's own plantation output, 2024

Statistic	Value	Effective crops	Note
Mean index	0.6774	1.48	across 37 provinces
Median index	0.7369	1.36	
Mean dominant share	77.18%	—	
Provinces at 80% or more	21 of 37	—	56.8% of provinces
Provinces at 50% or more	32 of 37	—	86.5% of provinces
Minimum index	0.2027	4.93	Jawa Barat
Maximum index	0.9945	1.01	Kalimantan Utara

Computed by the authors from the series named at Table 1. The index is the sum of squared crop shares within each province's own plantation total; the effective number of crops is its reciprocal. A province with seven equal crops would have an index of 0.1429 and seven effective crops.

The median province has an index of 0.7369, which is an effective number of 1.36 crops. It grows five of the seven and, in terms of tonnage, is running something very close to a monoculture.

Twenty-one of thirty-seven provinces take at least four fifths of their plantation tonnage from one crop, and thirty-two take at least half. Only five provinces have no crop above 50 per cent.

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The mean dominant share of 77.18 per cent is the single most compact statement of the finding. Across the plantation sector, the average Indonesian province is a one-crop province by weight while being a five-crop province by count.

4.3 Breadth does not deliver balance

Table 3 sets the two measures against each other directly.

Table 3. The two extremes of the composition index, with crops grown

Province	Index	Crops grown	Dominant crop	Its share
Kalimantan Utara	0.9945	5	Oil palm	99.72%
Papua Pegunungan	0.9879	2	Coffee	99.39%
Kalimantan Timur	0.9680	5	Oil palm	98.38%
Kalimantan Tengah	0.9671	5	Oil palm	98.33%
Papua Selatan	0.9632	4	Oil palm	98.13%
Sulawesi Utara	0.9349	3	Coconut	96.66%
Gorontalo	0.3742	5	Coconut	45.97%
Nusa Tenggara Timur	0.3580	4	Coconut	52.50%
Lampung	0.3190	6	Sugarcane	47.50%
Sulawesi Tenggara	0.3159	6	Cocoa	41.78%
Sulawesi Selatan	0.2635	6	Oil palm	39.30%
Jawa Barat	0.2027	7	Coconut	27.66%

Computed by the authors from the series named at Table 1. The six most and six least concentrated producing provinces are shown. The correlation between crops grown and the index across all 37 provinces is −0.3194.

Kalimantan Utara is the decisive observation. It grows five of the seven crops — an above-median breadth — and takes 99.72 per cent of its plantation tonnage from oil palm. Its effective number of crops is 1.01. The four other crops it grows are present in the statistics and absent from its economy.

The pattern repeats. Kalimantan Timur and Kalimantan Tengah both grow five crops with dominant shares above 98 per cent, and Papua Selatan grows four with a share of 98.13 per cent. Four of the six most concentrated provinces grow four or five crops, which is at or near the national median.

At the other end, Nusa Tenggara Timur grows only four crops and has an index of 0.3580, lower than that of twenty-nine provinces growing more. Breadth and balance come apart in both directions.

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Across all thirty-seven provinces the correlation between the count and the index is −0.3194. Squared, this is about 0.10: the number of crops a province grows accounts for roughly a tenth of the variation in how concentrated its output is.

4.4 Which crop dominates

Table 4 reports the dominant crop across provinces, which shows what the concentration is concentrated in.

Table 4. Dominant plantation crop by number of provinces, 2024

Dominant crop	Provinces	Share of provinces	National output (thousand t)
Oil palm	22	59.5%	45,436.22
Coconut	10	27.0%	2,792.22
Sugarcane	3	8.1%	2,465.52
Cocoa	1	2.7%	617.10
Coffee	1	2.7%	813.37
Rubber	0	0.0%	2,132.13
Tea	0	0.0%	118.91

Computed by the authors from the series named at Table 1. The dominant crop is the one with the largest tonnage within the province. National output is the crop's total across all provinces.

Oil palm is the dominant crop in twenty-two of the thirty-seven producing provinces, a clear majority, and coconut in ten. Between them the two account for thirty-two of the thirty-seven.

Rubber dominates nowhere, despite producing 2,132.13 thousand tonnes nationally, more than sugarcane. It is grown in twenty-five provinces and is the leading crop in none of them, which means it is everywhere a substantial second or third. Tea likewise dominates nowhere, although for the different reason that it is grown in only ten provinces and Jawa Barat, its main producer, has a broader mix.

The tonnage caveat from Section 3 bears most heavily on this table. Oil palm is recorded as fresh fruit bunches, which are heavy relative to their value; a province taking 99 per cent of its plantation tonnage from oil palm would take a smaller though still large share of its plantation revenue. The direction of the bias is known and its magnitude is not, since the series carries no prices.

4.5 What the index would look like on value

Because the tonnage caveat is the principal threat to the finding, it deserves direct treatment rather than a footnote.

The seven crops differ in value per tonne by roughly an order of magnitude, with dry cocoa and green coffee at the high end and fresh oil palm fruit and cane at the low end. Reweighting a

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province's crop vector by price would therefore raise the shares of coffee and cocoa and lower those of oil palm and sugarcane.

For a province whose dominant crop is oil palm, this would reduce the index. For one whose dominant crop is coffee — Papua Pegunungan, at 99.39 per cent — it would raise it. Since oil palm dominates in twenty-two of thirty-seven provinces, the aggregate effect of moving to value weights would be to reduce the mean index somewhat.

The finding would not reverse. Kalimantan Utara produces 611.14 thousand tonnes of oil palm and 0.64 of coconut, 0.16 of rubber, 0.11 of coffee and 0.79 of cocoa; no plausible set of prices makes the last four material against the first. The same holds for Kalimantan Timur, Kalimantan Tengah and Papua Selatan. The provinces at the concentrated end of Table 3 are concentrated by any weighting.

What would change is the middle of the distribution, where a province with a large oil palm tonnage and a moderate coffee or cocoa tonnage would move down the ranking. The article accordingly presents the ordering at the extremes as robust and the precise values of the mean and median as specific to tonnage weights.

4.6 Why a province ends up at 99 per cent

The four Kalimantan and Papua provinces at the top of Table 3 share a history that the cross-section cannot show but that is worth stating, because it bears on whether the concentration is remediable.

Each was opened to plantation development comparatively recently and each was opened for one crop. Where a frontier is developed by a single industry with its own mills, roads and outgrower schemes, the resulting mix is not the sum of many independent portfolio decisions but the footprint of one investment programme. The four other crops recorded in Kalimantan Utara are almost certainly residual smallholder plantings that predate or sit outside that programme.

The agronomic literature supplies the reason the pattern persists once established. Ordonez, Castellano, Danalatos, Wright, Hatfield, Burras and Archontoulis (2021) show that nutrient response varies by soil type, so that the knowledge base accumulated for one crop on one soil does not transfer. Manson, Denton, Lake, Brand, Taylor and Sadras (2024) demonstrate that a yield response depends jointly on environment and management, which means a province switching crops loses the management knowledge as well as the plantings. Liang (2022) finds that fertiliser raises both yield and its stability, and a supply chain calibrated to one crop's nutrient regime is a further sunk asset.

Post-harvest infrastructure compounds this. Mutungi, Manda, Feleke, Abass, Bekunda, Hoschle-Zeledon and Fischer (2023) evaluate technologies whose function is to make dispersed production viable, and their absence is what confines a crop to the radius of existing capital. A province with mills for one crop and none for another faces an entry cost that no individual grower can meet.

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The measurement literature adds a final caution. Iversen, Westengen and Jerven (2023) show that the indicator chosen to represent an agricultural outcome is a contested choice rather than a technical one, and the breadth-versus-balance distinction drawn in this article is precisely such a choice. A ministry reporting breadth is not making an error so much as answering a different question, and the argument here is that it is the less useful of the two questions.

4.7 Implications for practice

Four implications follow.

First, a count of crops grown should not be used as a diversification indicator. It explains about a tenth of the variation in the quantity it is meant to proxy, and the discrepancy is largest at exactly the provinces of most concern: Kalimantan Utara looks diversified on breadth and is not on any other reading.

Second, the composition index or its reciprocal, the effective number of crops, is the appropriate summary and is cheap to compute from published figures. A median effective number of 1.36 crops is a far more useful statement about Indonesian provincial plantations than a median count of five.

Third, a diversification programme should be assessed on whether the share of the dominant crop falls, not on whether a new crop appears. Adding a crop that reaches one per cent of provincial tonnage changes the count and does not change the exposure. Marcos-Perez and colleagues (2023) describe intercropping arrangements that raise output of a second crop without displacing the first, which is one of the few mechanisms that could move the index within the establishment period of a perennial.

Fourth, the exposure being measured is real. Skjerstad, Kallio, Bergland and Solberg (2021) establish that commodity prices are set in world markets, and Li and colleagues (2024) that concentration determines shock propagation. A province at 99 per cent oil palm faces the palm oil price as its plantation sector faces it, undiluted, and Whitaker (2024) documents how such policy and market exposure registers in the well-being of the farmers concerned.

4.8 Limitations of the finding

Four limitations bound the result beyond those in Section 3.

The tonnage basis is the most serious and is treated at length in Section 4.5. The mean index of 0.6774 is a physical-composition figure and would be lower on value weights by an amount this article cannot estimate.

Only plantation crops are counted. A province with a large rice sector, a fishery or a livestock industry may be economically diversified while appearing specialised here, and Sulawesi Selatan — which has an index of 0.2635 in plantations and is also the fourth-largest rice producer — illustrates that the plantation index is a partial measure of anything a provincial government would care about.

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The correlation of −0.3194 is computed on thirty-seven observations in which the count takes six distinct values, so it is a summary of a coarse relationship rather than an estimate of a parameter. The distributional evidence in Table 3, where provinces growing five crops appear at both extremes of the index, is the more reliable form of the finding.

Finally, one year is observed. Perennial crop mixes change slowly, so the picture is unlikely to be atypical, but sugarcane area responds to prices within a season and the three provinces where it dominates could change composition faster than the others.

5. CONCLUSION

The average Indonesian province grows 4.95 of the seven plantation crops for which national figures are published and takes 77.18 per cent of its plantation tonnage from one of them. Breadth and balance are different things and this article has measured how far apart they are.

The mean composition index across the thirty-seven producing provinces is 0.6774 and the median 0.7369, corresponding to effective numbers of 1.48 and 1.36 crops. Twenty-one provinces take at least 80 per cent of their tonnage from a single crop and thirty-two take at least half.

The count of crops grown explains about a tenth of this. Kalimantan Utara grows five of the seven and obtains 99.72 per cent of its tonnage from oil palm, for an effective number of 1.01 crops; Nusa Tenggara Timur grows four and has an index of 0.3580, lower than twenty-nine provinces growing more. The correlation between count and index across all thirty-seven is −0.3194.

Oil palm is the dominant crop in twenty-two provinces and coconut in ten. Rubber, the fourth-largest crop by national tonnage, dominates in none, being everywhere a substantial second.

The measurement rests on physical tonnage of incomparable products, and value weighting would lower the mean index without reversing the finding at the extremes. The practical consequence is that diversification should be assessed on the share of the dominant crop rather than on the number of crops present, and that adding a crop which never reaches a material share changes the indicator without changing the exposure it is meant to represent.

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ACKNOWLEDGEMENTS

The authors thank the editorial team of Research Center Progresif for their assistance.

DECLARATIONS

Conflict of interest. The authors declare that they have no competing interests.

Funding. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability. All data supporting the findings of this study are available within the article and from the publicly accessible sources cited therein.

Author contributions (CRediT). Abdul Wahid Alfarizi: conceptualisation; methodology; formal analysis; writing - original draft; writing - review and editing.

Declaration of generative AI and AI-assisted technologies. Claude (Anthropic) was used for language editing and for translation of the manuscript into English. The authors reviewed and verified all content, and take full responsibility for the final text. No generative tool was used for data analysis, for the interpretation of results, or for the generation of scholarly content. AI is not listed as an author.

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Ethics statement. Aggregate secondary data from public agencies only. No human participants, no identifiable personal data, no animal subjects; ethics approval not required.

Peer review. Double-anonymous.

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How to cite. *Alfarizi, A. W. (2026). Breadth without balance: five crops and one that matters in Indonesian provincial plantations. Journal of Agriculture, Livestock and Fisheries, 1(1), 1–13.*

Publisher. Research Center Progresif, Indonesia · jalf@researchcenterprogresif.org