
Beyond Farmers' Terms of Trade: Resolving Indonesia's High-NTP-low-welfare Paradox Through an Integrated Multidimensional Measurement Framework

Loso Judijanto

<https://orcid.org/0009-0007-7766-0647>

IPOSS Jakarta, Indonesia

doi.org/10.51505/IJEBMR.2026.11007 URL: <https://doi.org/10.51505/IJEBMR.2026.11007>

Received: Sep 03, 2026

Accepted: Sep 11, 2026

Online Published: Oct 08, 2026

Abstract

The Farmers' Terms-of-Trade Index, known in Indonesia as Nilai Tukar Petani (NTP), is frequently interpreted as a direct indicator of farmer welfare. This interpretation is problematic because NTP primarily measures the relative movement of prices received by farmers against prices they pay for household consumption and agricultural production. It does not directly measure production volume, net income, farm size, land tenure, debt, asset accumulation, food security, health, education, subjective well-being, or resilience. This qualitative literature review examines why high or rising NTP values can coexist with persistent deprivation among agricultural households. Recent Indonesian evidence provides an illustrative paradox: NTP may increase because the prices paid by farmers decline faster than the prices they receive, even though producer prices, farm revenue, or profitability do not improve. The review identifies seven interrelated themes: construct mismatch, aggregation bias, the denominator effect, incomplete price transmission, household heterogeneity, multidimensionality, and the importance of farmers' subjective evaluations. It proposes an integrated four-tier measurement architecture comprising monthly market indicators, agricultural-household economic accounts, a multidimensional Farmer Welfare Index, and distributional and longitudinal statistics. NTP should therefore be retained as a high-frequency indicator of relative-price conditions but should not serve as a stand-alone proxy for achieved welfare. Indonesian agricultural policy needs to distinguish statistical changes in purchasing power from substantive improvements in farmers' capabilities, economic security, quality of life, and resilience.

Keywords: Farmer welfare; farmers' terms of trade; Nilai Tukar Petani; multidimensional well-being; agricultural households; subjective well-being; food security; livelihood resilience; composite indicators; Indonesia.

JEL Classification: I31; Q12; Q18; C43; O13.

1. Introduction

Agricultural development is ultimately meaningful only when it improves the lives of the people who produce food and manage agricultural resources. Farmers contribute not only to food availability but also to rural employment, landscape management, local economic circulation, cultural continuity, and national resilience. Nevertheless, agricultural-policy performance is frequently assessed through sector-level indicators—production, productivity, commodity prices, exports, agricultural gross domestic product, and inflation—that do not necessarily reveal whether agricultural households have achieved adequate incomes, secure livelihoods, nutritious diets, decent housing, good health, education, dignity, and confidence about the future. Recent scholarship therefore increasingly treats farmer welfare as a multidimensional outcome rather than a simple function of commodity prices or gross agricultural revenue [1], [2].

In Indonesia, one of the most visible indicators associated with farmer welfare is the Farmers' Terms-of-Trade Index, or Nilai Tukar Petani (NTP). Equation (1) expresses the index for reporting period τ , where $I_{t,\tau}$ denotes the index of prices received by farmers and $I_{b,\tau}$ denotes the index of prices paid by farmers.

$$NTP_{\tau} = \frac{I_{t,\tau}}{I_{b,\tau}} \times 100 \quad (1)$$

An NTP above 100 indicates that, relative to the base period, the index of prices received by farmers exceeds the index of prices they pay; an NTP below 100 indicates the opposite relationship. BPS describes the measure as an indicator of farmers' rural purchasing capacity and of the terms at which agricultural products exchange for goods and services used for household consumption and agricultural production. This definition establishes NTP primarily as a relative-price index rather than a complete household-welfare account [3], [4].

The empirical material motivating this review demonstrates why the distinction matters. The source material supplied with the manuscript, based on the official statistical release of 3 August 2026, reports that Indonesia's national NTP reached 127.84 in July 2026 and increased slightly even though the index of prices received by farmers declined. The increase occurred because the index of prices paid by farmers fell more rapidly, so the statistical terms of trade improved without necessarily generating higher farm revenue or income. At the same time, the horticulture subsector experienced a sharp deterioration associated with falling producer prices for chilli, tomato, and shallot, whereas West Kalimantan recorded a much higher NTP because its commodity structure included oil palm, rubber, pepper, and paddy. Rising rice prices at milling, wholesale, and retail levels likewise did not establish that farmers captured the resulting value added [5], [6], [7], [8].

This case illustrates the high-NTP–low-welfare paradox. A high index can coexist with low net income, small landholdings, indebtedness, inadequate nutrition, poor housing, limited healthcare access, insecure tenure, vulnerability to crop failure, and low subjective well-being. It can also

conceal major differences among commodities, provinces, commercial and subsistence producers, landowners and tenants, male- and female-headed households, and farmers with different levels of market access. Indonesia-specific studies show that farm size, land control, non-farm employment, gender roles, market participation, and access to finance significantly influence agricultural-household welfare, food security, and subjective well-being [9], [10], [11], [12], [13].

The problem is not that NTP is statistically invalid. It is useful for monitoring changes in agricultural output prices, consumer prices faced by agricultural households, production costs, and short-term market pressures. The problem emerges when an indicator of relative-price movements is treated as if it were a direct and exhaustive measure of achieved welfare; this is a problem of construct validity because the phenomenon being measured is narrower than the phenomenon about which conclusions are drawn. The same caution applies to the Agricultural Business Terms-of-Trade Index, or Nilai Tukar Usaha Pertanian (NTUP), which compares It with the Production Costs and Capital-Goods Addition Index (BPPBM), as shown in Equation (2). NTUP more closely represents farm-business purchasing capacity, but it still does not measure quantities produced, household size, net disposable income, debt, health, education, food security, or subjective well-being.

$$NTUP_{\tau} = I_{\tau}(t, \tau) / I_{\tau}(BPPBM, \tau) \times 100 \quad (2)$$

The urgency of correcting this interpretation is substantial. When NTP is used as a stand-alone welfare proxy, governments may classify agricultural populations as improving even when their real income or capabilities are stagnating. Social assistance may be reduced prematurely, commodity interventions may be mistargeted, and the success of agricultural programs may be overstated. National averages may also obscure severe deterioration within particular subsectors or regions. Composite values can communicate complex information efficiently, but they can also conceal distributional disparities and allow improvement in one component to compensate statistically for serious deprivation in another [14], [15].

Indonesia has begun to recognize this limitation institutionally. BPS implemented the 2025 Farmer Welfare Survey to obtain information on the socioeconomic characteristics of agricultural households, classify households by welfare status, and generate the data required for a Farmer Welfare Index, or Indeks Kesejahteraan Petani (IKP). BPS explanations describe the proposed index as multidimensional and distinguish its role from the monthly price-monitoring function of NTP. This development is consistent with international evidence showing that farmer well-being encompasses material, social, health, environmental, psychological, cultural, governance, and place-based dimensions [2], [16], [17].

Against this background, the article addresses four questions. First, what components of farmers' economic position are captured by NTP, and what important dimensions remain outside its measurement boundary? Second, through which mechanisms can high or increasing NTP coexist with stagnant or declining welfare? Third, which objective, subjective, relational, and resilience-

related dimensions should be incorporated into a more comprehensive assessment? Fourth, how can NTP, NTUP, household economic data, and a multidimensional welfare index be combined into a coherent statistical architecture?

The article argues that NTP should not be abandoned. It should be repositioned. It is best understood as a timely indicator of relative-price conditions that must be read alongside measures of farm output, net real income, assets, debt, consumption, food security, capabilities, health, social relations, subjective well-being, and resilience. The principal contribution is an integrated four-tier framework designed to separate market signals from farm-business outcomes, household welfare achievements, and distributional dynamics [2], [18], [19].

2. Literature Review

2.1 Conceptualizing Farmer Welfare

Farmer welfare has often been approximated through income, expenditure, profitability, or asset ownership. These are indispensable components, but they do not exhaust the concept. A household may record income above a specified threshold while experiencing food insecurity, unsafe working conditions, excessive debt, poor health, social isolation, or limited freedom to make livelihood choices. Conversely, farmers with modest monetary incomes may derive important forms of well-being from occupational autonomy, family continuity, community belonging, environmental stewardship, and attachment to land. A credible framework must therefore distinguish objective living conditions from people's evaluations of those conditions [1], [20].

Objective or material welfare includes real income, consumption, productive assets, savings, debt, housing quality, landholding, access to water and sanitation, healthcare, education, transport, energy, and communication. For agricultural households, material welfare must be calculated after accounting for production costs, unpaid family labor, asset depreciation, rent, interest, crop losses, and inflation. Gross sales are not equivalent to net farm income, and net farm income is not equivalent to disposable household income. Income from wage labor, migration, trading, livestock, processing, and other non-farm sources can substantially alter a household's welfare position [10], [21].

Subjective well-being concerns how farmers evaluate their own lives. Common measures include life satisfaction, happiness, satisfaction with work, perceived financial security, optimism, stress, anxiety, and confidence in the future. Such measures should not replace objective indicators because expectations may adapt to persistent deprivation. Nevertheless, they reveal aspects of welfare that income and prices cannot capture. Farmers' satisfaction with work is associated with broader quality of life, while financial struggle and financial worry are strongly associated with poorer mental-health outcomes [1], [22], [23], [24], [25].

Relational welfare encompasses social capital, family relations, trust, community participation, reciprocity, recognition, and membership in collective organizations. Rural well-being is

produced through relationships rather than exclusively through individual resources. Evidence from Indonesia and China indicates that social participation, reciprocal relations, and cooperative membership can improve subjective well-being directly and indirectly through income and social capital [26], [27], [28], [29].

A capability-oriented understanding goes further by focusing on what people are genuinely able to be and do. For farmers, relevant capabilities include the ability to obtain sufficient food, maintain health, educate children, participate in decisions, obtain fair market access, control productive resources, recover from shocks, and continue farming voluntarily rather than through lack of alternatives. Land ownership can affect subjective well-being beyond its income effect because it provides identity, security, bargaining power, and a basis for long-term planning [24], [30], [31].

The sustainable-livelihood perspective similarly emphasizes combinations of financial, natural, physical, human, and social capital. Welfare depends not simply on the current flow of income but on the household's capacity to mobilize assets and adjust livelihood strategies over time. Access to land, irrigation, machinery, information, education, credit, savings, producer organizations, and diversified sources of income may reduce vulnerability even when current commodity prices are unfavorable. The relationship is not always linear: specialization can raise efficiency and income but may also heighten exposure to commodity or climatic shocks and increase psychological pressure [32], [33].

Finally, farmer welfare must incorporate resilience. A household can appear non-poor immediately before a drought, disease outbreak, price collapse, or health emergency yet lack the capacity to withstand the disturbance. Resilience includes absorptive capacity, adaptive capacity, transformation potential, insurance, savings, diversification, social support, access to information, and the ability to rebuild productive assets. Studies of farming systems show that resilience can be evaluated through both objective farm performance and farmers' subjective satisfaction with their capacity to cope [34], [35], [36].

2.2 NTP as a Relative-Price Indicator

The statistical construction of NTP makes it useful but inherently limited. The numerator represents changes in the prices of agricultural outputs sold by farmers. The denominator combines changes in prices associated with household consumption and production requirements. Accordingly, NTP changes whenever either component changes, even if the physical volume of agricultural production remains constant or declines. A higher index may reflect stronger output prices, lower consumer prices, lower input prices, or different combinations of all three. BPS's monthly releases appropriately report (It), (Ib), the household consumption component, NTUP, production costs, and commodity-level developments because interpretation of the headline index requires examination of its components [3], [4], [8], [37].

NTP is therefore strongest as a market-condition indicator. It can identify whether the prices farmers receive are moving more or less favorably than the prices they face. It can reveal inflationary pressure on agricultural households, commodity-price volatility, and differences

among provinces or subsectors. It can also provide an early warning of deteriorating terms of trade before annual household surveys become available[4], [37].

However, NTP does not contain an output-quantity term. Consider a farmer whose product price rises by 10 percent while production falls by 30 percent because of drought. The price index received may improve, but gross revenue falls. If the household also incurs higher irrigation, replanting, transport, or debt-service costs, net income may decline further. This disconnect is important under climate volatility, because environmental shocks influence yields, assets, health, and subjective well-being through channels not captured by price ratios [38], [39], [40].

Nor does NTP measure the scale of the farm business. Two farmers may face identical percentage changes in output and input prices but have radically different welfare outcomes because one owns ten hectares and the other cultivates a fraction of a hectare under an insecure tenancy arrangement. Farm size influences the marketed surplus, total income, ability to adopt technology, access to formal finance, and exposure to food insecurity. Indonesian evidence indicates that smaller agricultural households have a greater probability of moderate or severe food insecurity, while control over land remains an important determinant of income, expenditure, and subjective well-being [12], [13], [23], [24], [30].

NTP also does not measure value-chain distribution. A rise in retail food prices may occur because of processing costs, transport constraints, storage losses, market concentration, or larger intermediary margins. The farmer may receive only a small portion of the final consumer price. Indonesian horticultural evidence suggests that participation in modern marketing systems can improve income and food security through more stable prices and demand, illustrating that market organization and contractual conditions matter in addition to the general direction of prices [19], [41], [42].

2.3 The Mechanisms behind the High-NTP–Low-Welfare Paradox

The first mechanism is the denominator effect. Because NTP is a ratio, it can rise even when the numerator declines, provided the denominator declines faster. In this situation, the price relation becomes statistically more favorable, but the farmer may receive lower prices for agricultural outputs. The July 2026 case described in the literature is a direct example: NTP increased while the price index received fell, because the price index paid fell by a larger percentage.

The second mechanism is the price–quantity divergence. For a single product, total revenue is the product of price and quantity ($TR = P \times Q$), whereas an output-price index captures only the price component. Crop failure, reduced planted area, livestock mortality, quality deterioration, post-harvest losses, and unsold production can all reduce the quantity from which income is earned. Consequently, a higher It does not establish higher revenue.

The third mechanism is the difference between gross revenue and net real income. Farmers must purchase seed, fertilizer, pesticides, feed, fuel, equipment, hired labor, transport, storage, veterinary services, and credit. Some costs may not be represented fully or contemporaneously in

the index. The economic value of unpaid household labor, depreciation, environmental degradation, and interest obligations must also be recognized. Studies of Indonesian rural finance show that loan conditions, interest rates, income, expenditure, and the purpose for which credit is used affect whether borrowing improves household welfare [11], [43].

The fourth mechanism is limited commercialization. Subsistence and semi-subsistence farmers may sell only a small share of production. Higher market prices then generate little additional cash income, while the household may simultaneously face higher food-purchase costs during seasons when its own stocks are insufficient. Food-producing households can therefore experience food insecurity, especially when farms are small, household dependency ratios are high, education is limited, or income depends exclusively on agriculture [13].

The fifth mechanism is aggregation bias. National NTP is a weighted average and does not represent every farmer's experience. Commodity weights, regional specialization, and divergent seasonal conditions can produce a national increase despite sharp losses among particular producers. The July 2026 contrast between declining horticultural NTP and the very high index in West Kalimantan demonstrates how national figures can conceal opposite movements across subsectors and regions.

The sixth mechanism concerns land and labor differentiation. Landowners, tenant farmers, sharecroppers, farm laborers, and contract growers occupy different positions in agricultural value chains. A commodity-price rise may benefit an owner with a large marketed surplus while providing little advantage to a landless worker whose wage is fixed. Longitudinal Indonesian evidence suggests that retaining agricultural land remains important for household expenditure and poverty dynamics, while movement out of agriculture improves welfare mainly when workers can enter more secure and productive non-agricultural employment [10].

The seventh mechanism is intertemporal vulnerability. A favorable monthly index may not reverse debt accumulated after previous crop failures, rebuild livestock sold during a crisis, restore degraded soil, pay deferred school or medical expenses, or compensate for years of low investment. Current price conditions must therefore be distinguished from the stock of household assets and liabilities and from the trajectory of welfare over time[8].

2.4 Multidimensional and Subjective Approaches

A major review of 92 studies found substantial variation in how farmer well-being is defined and assessed. Economic conditions and social relationships were among the most frequent domains, whereas governance, place attachment, and values directly expressed by farmers were much less consistently incorporated. The review concluded that farmer-centred and place-based approaches are required to prevent welfare indicators from being imposed exclusively through top-down expert definitions [2], [44].

This finding has two implications. First, a farmer-welfare index needs multiple dimensions. Second, those dimensions should not be selected solely because data are already available.

Statistical convenience can produce a narrow representation of welfare. Farmer participation is needed to identify locally meaningful concerns, such as water security, access to customary land, cultural obligations, occupational identity, dignity in market relations, or confidence that children can continue farming [2], [18].

Agricultural-sustainability assessment provides useful methodological lessons. Reviews show extensive diversity in indicator selection, stakeholder participation, weighting, aggregation, and the definition of sustainability. Tools may include economic, environmental, and social indicators, but social domains are often underdeveloped. Incorporating farmer satisfaction, working conditions, community engagement, and quality of life can improve the social validity of farm-level assessments [15], [45], [46].

Subjective measures are particularly relevant because farming is both an occupation and a way of life. Automation can reduce physical labor but create new technological dependencies or work pressures. Regenerative and agroforestry practices may affect self-efficacy, environmental satisfaction, and quality of life in addition to profitability. Cooperative participation can strengthen both income and social relations. These examples demonstrate why the welfare consequences of agricultural change cannot be inferred only from yields and prices [26], [36], [47], [48], [49].

Health must also be treated as a core dimension. Farmers face occupational injuries, pesticide exposure, heat, physical strain, isolation, financial stress, and climate-related uncertainty. Research involving Canadian and Australian farmers shows meaningful levels of stress, anxiety, depression, and financial worry, while rural financial counsellors and agricultural advisors may serve as important points of contact for distressed farmers [22], [43], [50], [51], [52].

Environmental quality and welfare are similarly interdependent. Land, soil, water, biodiversity, and climate conditions influence productivity, health, identity, and the possibility of continuing agriculture. Diversified agricultural systems can generate joint environmental and social benefits, while environmental-protection behavior and ecological awareness may strengthen social interaction and perceived quality of life [53], [54], [55], [56].

2.5 Indonesia's Emerging Farmer Welfare Index

The 2025 Farmer Welfare Survey represents an important shift from price-based inference toward direct household measurement. BPS stated that the survey was designed to obtain agricultural-household socioeconomic characteristics, estimate the share of households in different welfare categories, and provide the information required to construct IKP. Public explanations describe a multidimensional approach containing domains related to income and resources, education, health, decent living conditions, food and nutrition security, and risk mitigation [16], [17].

IKP should be viewed as institutionally complementary to NTP. NTP can continue to supply monthly information on price developments. IKP can provide periodic evidence about whether

households actually possess the resources and capabilities needed for a decent life. NTUP can occupy an intermediate position by focusing more specifically on the price relation between farm outputs and production costs. Household income and expenditure accounts are then needed to connect these indices to actual financial outcomes[16], [17].

Care is necessary, however, in constructing a composite index. A single score can obscure the dimensions in which deprivation persists. A household with adequate housing but severe food insecurity should not be classified as unambiguously prosperous because the housing score offsets the food-security score. The final index should therefore be accompanied by a dashboard reporting each domain, the number of dimensions in which households are deprived, and the intensity and duration of deprivation [14], [57].

3. Method

This study applies a qualitative literature review, not a systematic literature review. Its purpose is interpretive and concept-centred: to clarify concepts, compare measurement approaches, identify mechanisms producing the NTP–welfare divergence, and formulate an integrated framework appropriate to Indonesia. The review does not claim exhaustive identification of every publication, calculate pooled effect sizes, or employ a PRISMA-based screening procedure.

Academic literature was identified through combinations of terms including “farmer welfare,” “farmer well-being,” “farm household welfare,” “farmers’ terms of trade,” “subjective well-being,” “farm sustainability indicators,” “multidimensional poverty,” “food insecurity,” “land tenure,” “farm size,” “livelihood resilience,” “price transmission,” “social capital,” and “Indonesia.” Priority was assigned to peer-reviewed journal articles published from 2020 onward. Earlier theoretical ideas informed the interpretation but were not relied upon to meet the requested contemporary-reference threshold.

The review included four broad categories of literature. The first concerned the conceptualization and measurement of human and farmer well-being. The second addressed farm-household income, land, food security, market access, and rural poverty. The third examined health, subjective well-being, social capital, place attachment, and environmental relations. The fourth covered agricultural sustainability, resilience, composite indicators, and policy measurement. Official BPS material was used to define NTP, describe recent index movements, and contextualize the development of the Farmer Welfare Survey and IKP. Official documents were treated as contextual sources rather than as peer-reviewed journal articles [19], [58].

The analytical procedure involved iterative thematic coding. Initial codes included relative prices, output quantities, farm scale, land tenure, gross revenue, production costs, household consumption, debt, assets, food security, education, health, social capital, agency, subjective well-being, environmental quality, climate risk, resilience, aggregation, and index construction. These codes were consolidated into seven themes: NTP’s measurement boundary, the denominator effect, heterogeneity and aggregation, incomplete value transmission, material welfare, multidimensional welfare, and measurement architecture [19], [58].

Rigor was strengthened through source triangulation. International reviews were compared with empirical studies from Indonesia and other agricultural contexts, while official statistical definitions were distinguished from broader welfare claims. Particular attention was given to studies using household-level data because the household, rather than the commodity or province, is the most appropriate primary unit for assessing achieved welfare.

The method has limitations. A qualitative review cannot estimate the average causal effect of NTP changes on household welfare. Publication and language bias may influence the literature available. Farmer-welfare concepts also vary across countries and agricultural systems. The framework proposed below should therefore be tested empirically and validated through consultation with farmers from different regions, subsectors, gender groups, age categories, landholding classes, and tenure arrangements.

4. Results

4.1 Theme One: NTP Measures Relative Prices, Not Achieved Welfare

The first and strongest finding is that NTP and farmer welfare are conceptually different constructs. NTP answers a price question: how have the prices received for agricultural outputs moved relative to prices paid for consumption and production? Farmer welfare answers a life-condition question: do farmers have sufficient resources, capabilities, security, health, nutrition, dignity, and resilience?

The distinction can be expressed through the simplified analytical chain below. The sequence clarifies why an upstream relative-price signal should not be interpreted automatically as a downstream welfare achievement.

Relative prices → gross revenue and costs → net household resources → achieved welfare outcomes

NTP is located near the beginning of this chain. Numerous intervening factors determine whether a relative-price improvement becomes a welfare improvement. These include output quantity, land area, marketed surplus, cost structure, labor requirements, debt, household size, off-farm income, public services, and exposure to shocks [7]. Figure 1 shows why a higher NTP cannot be translated automatically into higher farmer welfare. The index must first operate through production, market, financial, and household mechanisms.

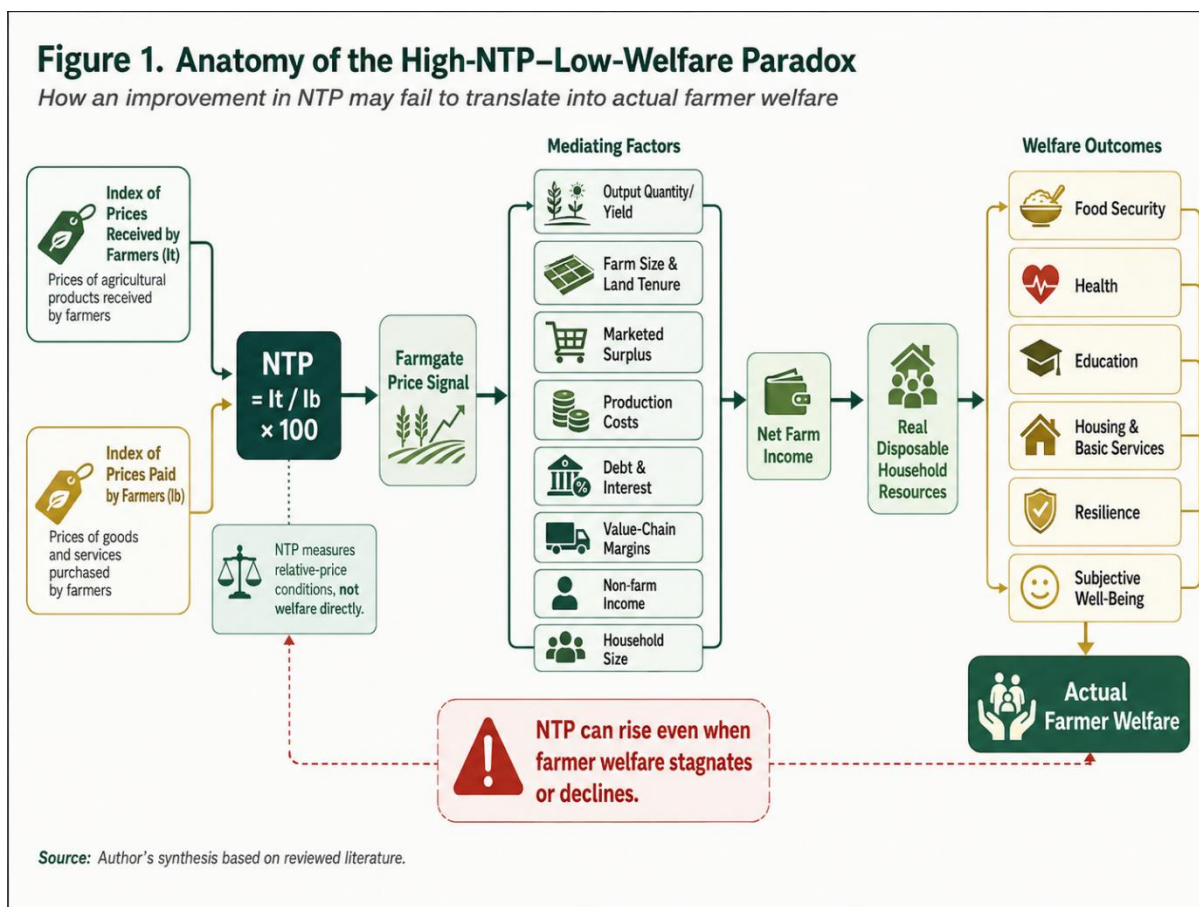


Figure 1. Anatomy of the High-NTP–Low-Welfare Paradox

Source: Author's synthesis based on the reviewed literature

Figure 1 identifies several points at which the expected transmission can fail. A high output price may be offset by a low harvest. High gross revenue may be absorbed by costs or interest. Higher net farm income may be insufficient when divided among a large household or used to restore previously depleted assets. Improvements in disposable income may also fail to produce health or education gains where services are inaccessible.

4.2 Theme Two: The Direction of NTP Is Insufficient without Component Analysis

The second theme is that the same NTP increase can arise from economically different situations. An increase caused by rapidly rising output prices is not equivalent to an increase caused by declining consumption prices, declining input prices, or a denominator falling faster than the numerator. Policy interpretation must therefore report the contributions of (I_t), household consumption prices, and production costs separately[8].

The July 2026 illustration is analytically important. The national index rose even though prices received declined, because prices paid declined more. The outcome may imply temporary relief

on the expenditure side, which is beneficial, but it does not demonstrate that agricultural earnings increased. Moreover, the large decline in horticultural NTP reveals that the national average did not represent all producer groups.

BPS's monthly statistics already provide many of the components needed for more careful interpretation. For example, national releases distinguish NTP from NTUP, report household consumption inflation, and describe price changes for rice and other commodities. The principal reform needed is therefore partly communicative: official and public narratives should avoid equating an increase in the ratio with an unqualified increase in welfare [3].

4.3 Theme Three: National Averages Conceal Heterogeneity

A national NTP is not the welfare experience of an individual agricultural household. It is an aggregate index shaped by commodity and regional weights. A plantation producer benefiting from high oil-palm or rubber prices, a horticultural farmer facing a sudden price collapse, a rice tenant with a small marketed surplus, and a landless agricultural laborer can experience the same month very differently.

Heterogeneity operates through at least five dimensions. The first is subsector: food crops, horticulture, plantations, livestock, capture fisheries, and aquaculture have different production cycles and risk structures. The second is geography: infrastructure, agroecology, transport costs, and dominant commodities differ among provinces. The third is production scale. The fourth is land tenure. The fifth is household composition, including gender, age, education, dependency ratios, and access to off-farm employment[7].

Indonesian studies reinforce these distinctions. Oil-palm cultivation can raise income and improve nutrition through market purchases, but effects are mediated by labor allocation and gendered access to off-farm work [9]. Oil-palm smallholders may also gain welfare while becoming exposed to economic risk [59]. Seaweed farming can generate household benefits, but women's well-being depends on how labor, income, and decision-making are distributed within the household [9], [23], [44], [60].

4.4 Theme Four: Higher Consumer Prices Do Not Guarantee Higher Producer Welfare

The fourth theme concerns price transmission. The rise of a retail food price is often interpreted as favorable for farmers, but the relationship depends on who captures the margin between the farmgate and retail price. Processing, storage, transportation, market concentration, quality standards, contracting arrangements, and information asymmetry determine the producer's share. In the rice example presented in the literature, prices rose at milling, wholesale, and retail stages while national production was nearly unchanged. Such increases do not automatically become additional farm income when higher distribution costs or intermediary margins absorb the change.

Market participation can improve welfare where contracts stabilize demand and prices, but it may exclude farmers who cannot meet quality, volume, certification, or logistical requirements. It has been found that participation in modern horticultural markets was associated with income and food-security benefits [41]. This implies that indicators should measure the marketing channel, producer share of the consumer price, payment timing, rejected output, transaction costs, and bargaining power—not only the general price level [41].

4.5 Theme Five: Material Welfare Requires Household Economic Accounts

The fifth theme is the need to connect price statistics to household economic outcomes. At a minimum, measurement should include real net farm income, total disposable household income, per-capita or adult-equivalent consumption, savings, debt, productive assets, and changes in asset stocks.

Net farm income should deduct purchased inputs, hired labor, land rent, interest, transport, storage, marketing fees, depreciation, and abnormal losses. A supplementary measure should estimate the return to unpaid family labor. Without this adjustment, a farm may appear profitable even though the household receives a very low return per hour of work.

Total household income should include off-farm earnings. Indonesian agricultural households frequently combine farming with wage employment, trading, services, migration income, or transfers. Income diversification can improve welfare and technology adoption, although access to remunerative non-farm employment is uneven [10], [21].

Assets and debt must be recorded because temporary consumption stability can be financed by borrowing or asset sales. A household that maintains food consumption by selling livestock or productive equipment is not maintaining welfare sustainably. Conversely, a household investing current income in irrigation, livestock, machinery, education, or savings may be strengthening future welfare even when current consumption changes little [61], [62].

4.6 Theme Six: Farmer Welfare Is Intrinsically Multidimensional

Economic resources are necessary but not sufficient. The literature consistently supports the inclusion of food and nutrition, education, health, housing, basic services, social relations, agency, environmental quality, subjective well-being, and resilience.

Food and nutrition security deserve separate treatment because agricultural production does not guarantee dietary adequacy. Indonesian evidence shows that farm size, household size, educational attainment, gender of the household head, and exclusive dependence on agriculture influence food-insecurity risk [13]. Land-use change and market integration can improve dietary quality through income, but the effects depend on gender roles and household allocation [9].

Health and occupational well-being include access to healthcare, chronic illness, mental health, occupational injuries, pesticide exposure, heat stress, and work burden. Climate change affects

smallholder health through nutrition, disease, heat, injuries, and financial stress [25], [38]. Financial worry is closely associated with poorer mental health among farmers, demonstrating that economic and psychological dimensions interact rather than operate independently [22], [23], [43].

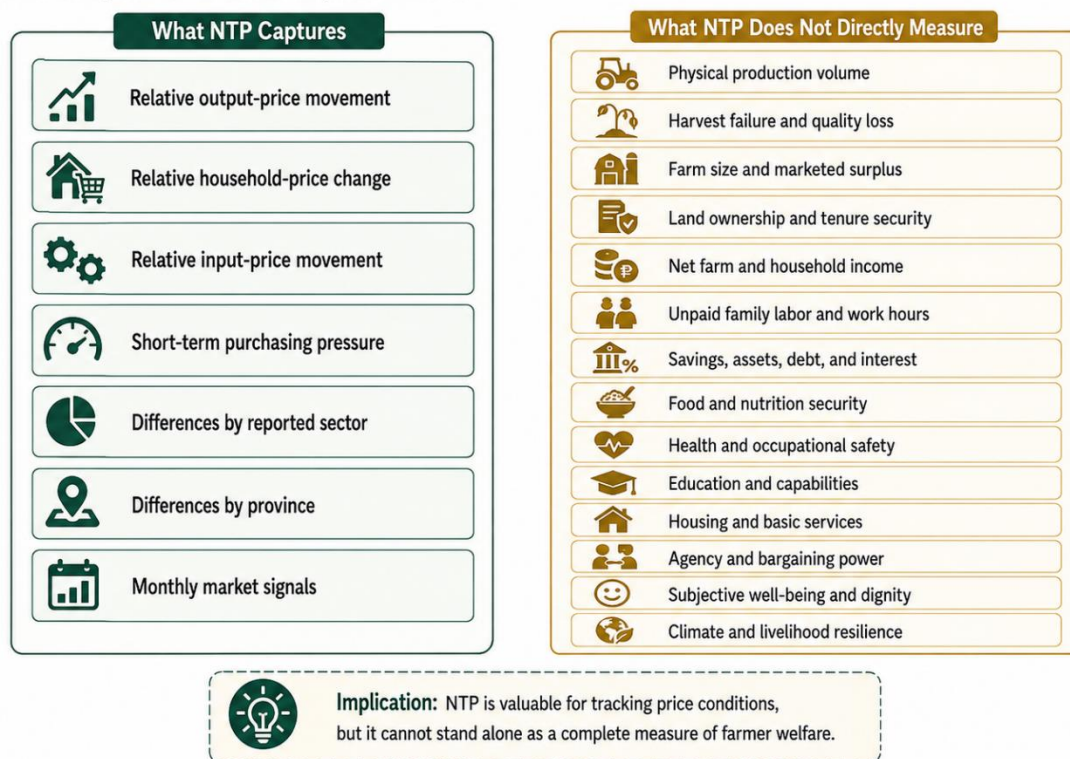
Education and capabilities encompass formal schooling, agricultural knowledge, extension access, digital literacy, financial literacy, and the ability to obtain and interpret market or climate information. Internet access can improve subjective well-being through learning, social interaction, and entertainment, although digital inequalities remain substantial [24], [44], [63]. Agency and social capital concern control over livelihood decisions, membership in organizations, access to collective marketing, trust, reciprocity, and the ability to negotiate. Cooperative membership can improve subjective well-being through both income and social-capital pathways, while Indonesian evidence shows that rural social capital is significantly associated with subjective well-being [24], [26], [28], [29].

Environmental and climate resilience concern the natural resource base and the household's ability to manage disturbance. Soil condition, water reliability, biodiversity, crop diversification, climate information, insurance, savings, and adaptive practices affect both future income and present security. Diversified agriculture can produce joint social and environmental benefits, while regenerative practices may enhance farmer self-efficacy and well-being [36], [53], [55], [64], [65].

Subjective well-being and dignity capture life satisfaction, happiness, perceived security, occupational pride, respect, and optimism. Agroforestry adoption in East Java has been associated with higher life satisfaction and happiness, and land ownership has a positive effect on Indonesian farmers' subjective well-being after income is controlled [24], [30], [44], [49], [65], [66].

4.7 Theme Seven: A Single Composite Score Is Not Enough

The seventh theme concerns index design. A multidimensional composite index provides an accessible summary, but it can conceal the profile of deprivation. The score should therefore be presented alongside a dashboard and distributional statistics. Figure 2 distinguishes the legitimate information contained in NTP from the broader evidence required to determine whether farmers are genuinely better off.

Figure 2. What NTP Captures and What It Leaves Unmeasured*The boundary of NTP as a relative-price indicator**Source: Author's synthesis.***Figure 2. What NTP Captures and What It Leaves Unmeasured***Source: Author's synthesis.*

The figure does not imply that every omitted variable should be inserted into NTP. Doing so would destroy the clarity and frequency of the price index. Instead, the omitted variables should be measured through complementary instruments linked by a common analytical framework.

5. Discussion and Analysis

5.1 Resolving the Apparent Paradox

The high-NTP–low-welfare paradox is resolved once the constructs are separated. There is no statistical contradiction in observing better relative prices and poor welfare simultaneously. The two measures occupy different stages in the causal pathway.

A household may experience an NTP increase but remain deprived because the improvement is too small, too brief, concentrated in commodities the household does not sell, or offset by lower production. It may be indebted, land-poor, food-insecure, unable to access healthcare, or recovering from earlier shocks. The policy error occurs when “more favorable relative prices” is rewritten as “farmers are prosperous.”

The distinction between statistical improvement and substantive improvement is therefore essential. Statistical improvement means that an index has moved in the desired direction according to its formula. Substantive improvement means that the underlying objective of policy—better lives—has been achieved. A reliable evaluation system must demonstrate the pathway from the first to the second.

5.2 An Integrated Four-Tier Measurement Architecture

The synthesis supports a four-tier architecture rather than a single substitute indicator. The tiers are analytically distinct but operationally connected, thereby preventing a price index from being treated as a complete measure of welfare [2], [57].

Tier 1: Monthly Market and Price Conditions

The first tier should retain NTP, NTUP, (It), (Ib), the household consumption price component, and the production and capital-goods cost component. These should be supplemented with commodity-specific farmgate prices, input prices, producer-to-retail spreads, and price volatility. Tier 1 answers: Are current market conditions becoming more or less favorable to farmers?

Tier 2: Agricultural-Household Economic Outcomes

The second tier should measure annual or seasonal real net farm income, return to family labor, total disposable household income, consumption per adult equivalent, savings, debt, asset accumulation or depletion, income diversification, and the producer share of final consumer prices. Tier 2 answers: Are favorable market signals becoming additional and sustainable household resources?

Tier 3: Multidimensional Achieved Welfare

The third tier should contain a Farmer Welfare Index and a domain dashboard covering material resources, food and nutrition, health, education, housing and basic services, social protection, agency, social capital, subjective well-being, and resilience. Tier 3 answers: Are additional resources becoming improvements in capabilities, security, and quality of life?

Tier 4: Distribution and Welfare Dynamics

The fourth tier should disaggregate all results by province, subsector, farm size, tenure, gender, age, income group, poverty status, and commercialization level. Panel or repeated longitudinal data should identify households entering, exiting, or remaining in deprivation. Tier 4 answers: Who benefits, who is excluded, how severe is deprivation, and do improvements persist? Figure 3 presents the proposed hierarchy. Its central principle is complementarity: each tier answers a different policy question, and no single tier is sufficient by itself.

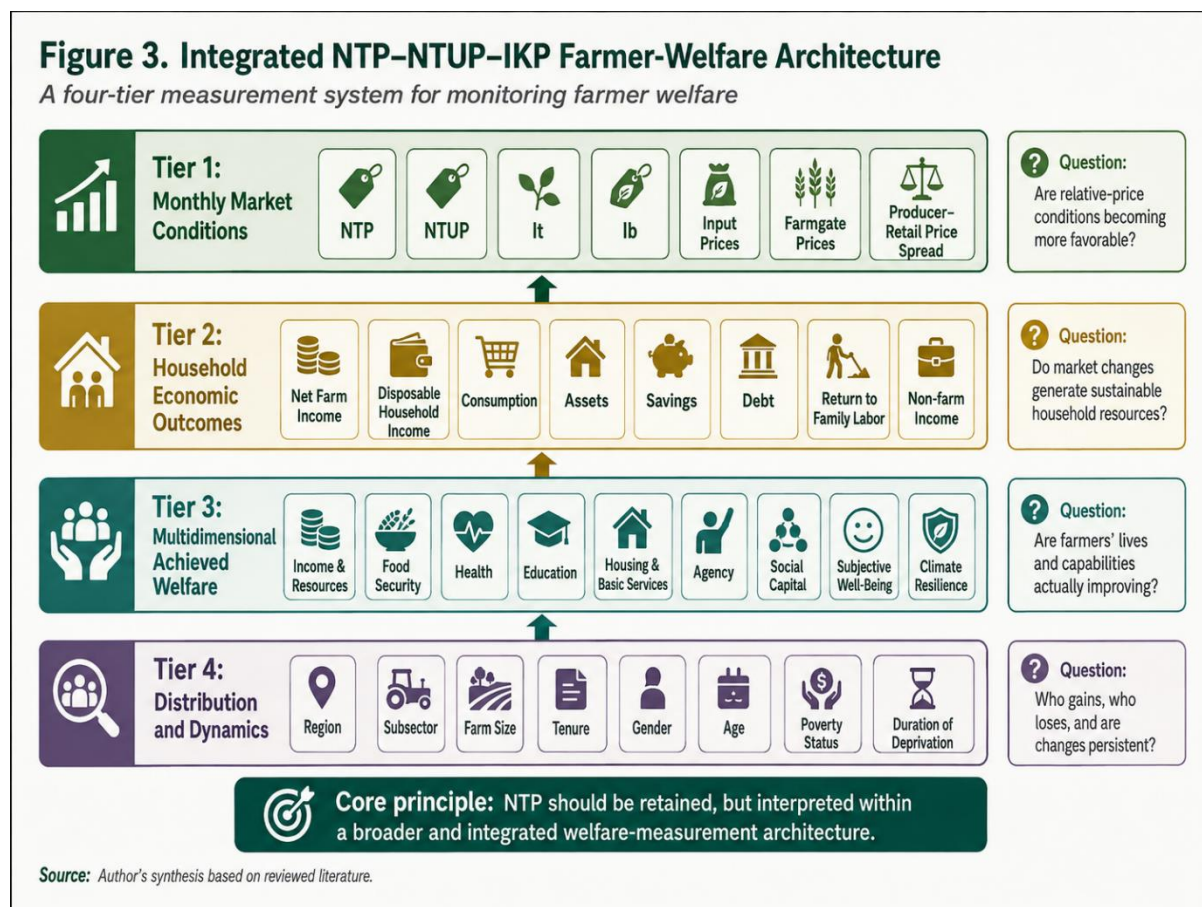


Figure 3. Integrated NTP–NTUP–IKP Farmer-Welfare Architecture

Source: Author's synthesis based on BPS concepts and reviewed literature.

This hierarchy prevents conceptual overreach. NTP remains useful because it is timely and standardized. Its interpretation becomes more accurate because conclusions are limited to the question it can answer. Similarly, IKP need not be required to provide monthly market signals; it can focus on achieved welfare and be collected at an interval compatible with household surveys.

5.3 Recommended Domains for a Farmer Welfare Index

The first domain should be income and productive resources. Indicators could include real disposable income per adult equivalent, net farm income, return to family labor, secure land access, productive assets, savings, and manageable debt. Both income flow and asset stock are necessary because households can temporarily maintain income by liquidating productive capital, and multidimensional assessments show that economic conditions should be interpreted together with living conditions, social security, community life, and psychological well-being [44], [67].

The second domain should be food and nutrition security. Indicators should include an experience-based food-insecurity measure, dietary diversity, frequency of meal reduction, affordability of a nutritious diet, and nutrition-related outcomes where ethically and statistically appropriate. Food security should not be inferred from crop production [42], [58], [64].

The third domain should be education, knowledge, and capabilities. Relevant indicators include schooling, literacy, extension access, agricultural and financial skills, digital connectivity, and access to market and climate information. These capabilities influence both current welfare and adaptive capacity.

The fourth domain should be physical, mental, and occupational health. It should cover healthcare access, insurance, chronic illness, work-related injury, exposure to hazardous chemicals, heat stress, psychological distress, life satisfaction, and excessive working hours. Studies of farmers consistently show that financial conditions, workload, isolation, and uncertainty influence psychological well-being [25], [50], [51].

The fifth domain should be housing and essential services. Housing quality, drinking water, sanitation, electricity, transport, mobile connectivity, internet access, and proximity to health and education services are central welfare achievements.

The sixth domain should be risk mitigation and social protection. Indicators could include crop or livestock insurance, savings sufficient for emergencies, access to disaster assistance, diversification, formal credit, social transfers, early-warning information, and the ability to recover production after a shock.

The seventh domain should be agency, bargaining power, and social capital. It should measure participation in producer groups, control over production and income decisions, ability to negotiate prices, access to grievance mechanisms, trust, reciprocity, and inclusion in public decision-making.

The eighth domain should be environmental and climate resilience. This could include water reliability, soil condition, crop and income diversification, adaptive practices, secure access to common resources, and the perceived ability to manage climatic uncertainty.

The ninth domain should be subjective well-being, dignity, and place attachment. Farmers should be asked directly whether they are satisfied with their lives and work, feel secure, are treated fairly, and believe farming offers a viable future. Place attachment and occupational identity are particularly important in agricultural livelihoods because land is simultaneously a productive asset, family inheritance, social location, and source of meaning [2], [18], [24], [68].

5.4 Principles for Index Construction

Several methodological principles should guide the construction of IKP or any related index. These principles are necessary because indicator selection, normalization, weighting,

aggregation, and temporal updating can materially alter composite scores and rankings [14], [57].

First, the principal unit of analysis should be the agricultural household, while recognizing that welfare can differ among members of the same household. Gender-sensitive modules are needed because income, workload, nutrition, land rights, and decision-making may be unequally distributed.

Second, thresholds and weights should be transparent. Equal weights are simple but not inherently neutral. Statistical weights may reflect variation in data rather than normative importance. Participatory weighting can improve legitimacy but may vary across regions. Results should therefore be tested under alternative weighting structures.

Third, the index should use limited compensability. Severe food insecurity or lack of healthcare should not be fully offset by good performance in another domain. One option is to combine a composite score with minimum-domain conditions.

Fourth, each headline score should be published with a dashboard. Users should see which domains drive change. The dashboard should report averages, medians, deprivation headcounts, deprivation intensity, and the distribution of scores.

Fifth, sensitivity analysis should test whether provincial rankings or policy conclusions change when indicators, thresholds, or weights change. Composite indicators can produce misleading precision if uncertainty is not disclosed [14].

Sixth, farmer participation should occur before, during, and after index construction. Literature on farmer well-being shows that farmer-expressed values and place-based meanings are frequently underrepresented. Participatory validation would identify dimensions that standardized household questionnaires may overlook [2].

5.5 Frequency and Data Integration

Different indicators require different frequencies. NTP and NTUP should remain monthly. Commodity prices and input prices may be monitored weekly or monthly where data systems permit. Net agricultural income should be estimated seasonally or annually because production cycles differ. A multidimensional welfare survey could be conducted annually or biennially, with selected modules integrated into existing large surveys [18], [57].

Data integration could connect NTP price surveys, the Farmer Welfare Survey, the Agricultural Integrated Survey, agricultural censuses, household socioeconomic surveys, labor-force surveys, food-security modules, administrative social-protection records, and geospatial climate data. Privacy protection and clear statistical governance would be essential.

Panel data would add particular value. Cross-sectional surveys identify who is deprived at one point in time, but panel surveys reveal whether deprivation is temporary, recurrent, or chronic. A panel could also show whether an NTP improvement predicts later gains in income, assets, food security, health, or subjective well-being [10], [19], [35], [42], [58].

5.6 Policy Uses

An integrated system would improve policy in four ways. Its value lies in matching each diagnosed source of deprivation to an appropriate intervention and then evaluating whether the intended household-level outcomes are achieved.

First, it would strengthen early warning. Falling NTP, falling NTUP, rising input prices, or widening marketing margins could trigger investigation before household welfare deteriorates severely.

Second, it would improve targeting. Different deprivation profiles require different responses. A household with viable production but unmanageable debt needs different support from a land-poor, food-insecure household or a farmer experiencing health-related work limitations.

Third, it would improve program evaluation. A fertilizer subsidy should not be judged only by distribution volume or yield. Evaluation should examine net income, debt, soil outcomes, food security, and distribution among farm sizes. Market infrastructure should be assessed through producer margins, losses, payment times, and bargaining power [58].

Fourth, it would improve accountability. Government communications could state precisely whether improvement occurred in relative prices, farm profitability, disposable income, multidimensional welfare, or all four. This language would reduce the risk of turning a partial indicator into a claim of comprehensive success. Figure 4 links measurement to intervention. It emphasizes that data collection is not the final objective; indicators must diagnose specific forms of deprivation and guide appropriate responses.

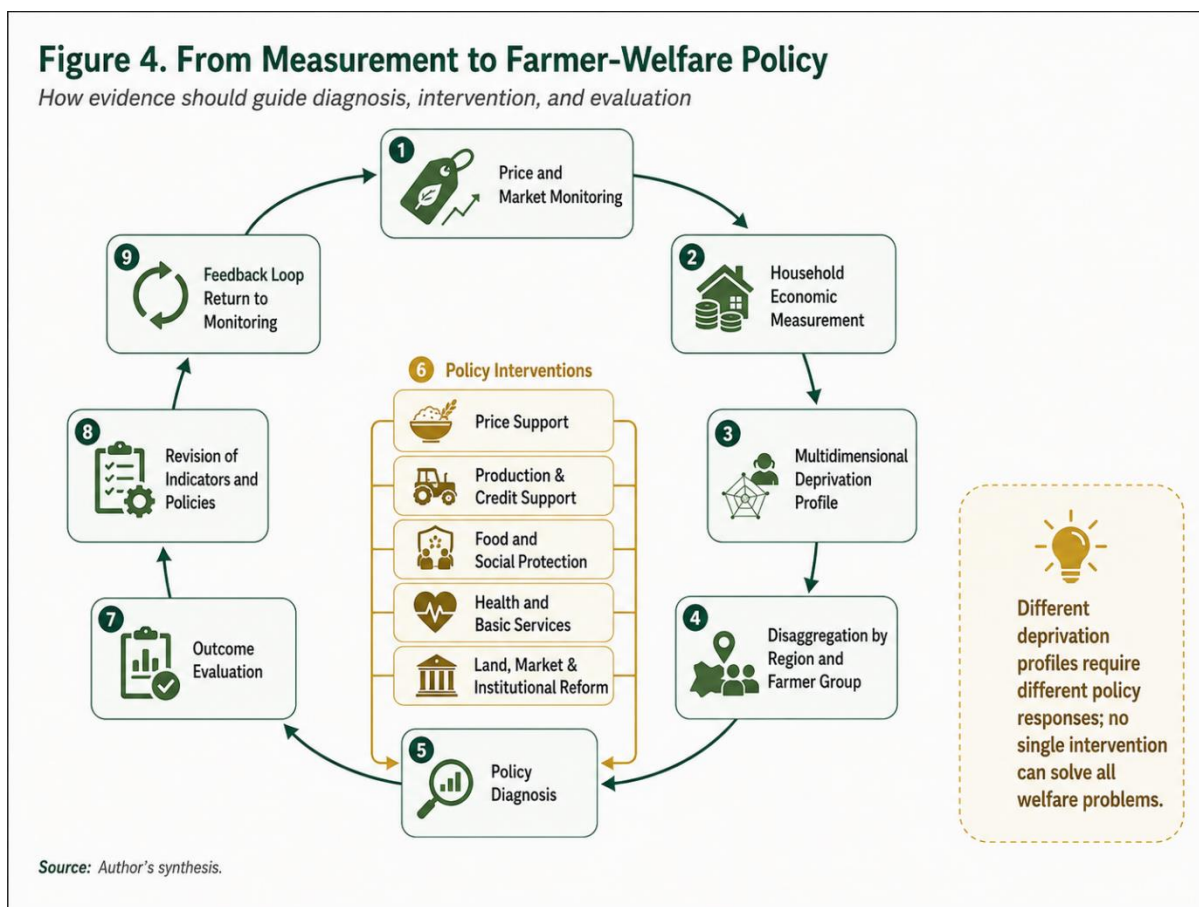


Figure 4. From Measurement to Farmer-Welfare Policy

Source: Author's synthesis.

This cycle also prevents a common policy mistake: applying a single agricultural intervention to all welfare problems. Low welfare may arise from weak prices, low productivity, small scale, poor health, insecure tenure, high debt, inadequate public services, or several interacting disadvantages. The measurement system must identify the mechanism before an intervention is selected.

6. Conclusion

NTP is an important but incomplete indicator. It measures changes in the relative prices received and paid by farmers and provides valuable high-frequency information about agricultural market conditions. It does not directly measure production volume, gross or net income, farm size, land tenure, marketed surplus, debt, assets, household needs, food security, education, health, basic services, agency, subjective well-being, or resilience.

The apparent paradox of high NTP and low farmer welfare is therefore not a statistical anomaly. It is the predictable consequence of using a relative-price index to represent a multidimensional

household outcome. NTP can rise because prices paid fall faster than prices received. It can also rise while production, revenue, or profitability falls. National averages can conceal severe losses within particular regions, commodities, tenure groups, or farm-size classes. Rising consumer prices can coexist with weak producer returns when value-chain margins are captured downstream.

Indonesia should consequently adopt a layered approach. NTP and NTUP should continue to monitor monthly price conditions. Seasonal and annual household accounts should measure real net farm income, disposable income, consumption, assets, debt, and returns to family labor. IKP should measure multidimensional achievements and deprivation across material resources, food security, education, health, housing, social protection, agency, social capital, subjective well-being, and resilience. All results should be disaggregated and, where possible, tracked longitudinally.

Three policy recommendations follow. First, official communication should stop treating every NTP increase as direct evidence that farmers have become more prosperous. Second, IKP should be published with a domain dashboard, transparent methodology, sensitivity analysis, and farmer participation. Third, welfare indicators must be linked to clearly differentiated policy responses and outcome evaluation.

The ultimate test of agricultural policy is not whether an index rises but whether farmers obtain adequate real incomes, nutritious food, secure assets, accessible services, meaningful agency, dignity, and the capacity to withstand future shocks. Measuring these outcomes directly is indispensable for determining whether Indonesia is genuinely succeeding in improving farmer welfare.

References

- B. Herrera Sabillón, M. Gerster-Bentaya, and A. Knierim, "Measuring farmers' well-being: Influence of farm-level factors on satisfaction with work and quality of life," *J. Agric. Econ.*, vol. 73, no. 2, pp. 452–471, Jun. 2022, doi: 10.1111/1477-9552.12457.
- M. E. Isaac et al., "Multidimensional measures of farmer well-being: A scoping review," *Agron. Sustain. Dev.*, vol. 44, no. 4, p. 39, Aug. 2024, doi: 10.1007/s13593-024-00971-7.
- BPS, "The Farmers' Terms of Trade (FTT) in June 2026 reached 127.65, decreased by 0.06 percent," BPS - Product Official Statistics News. Accessed: Aug. 05, 2026. [Online]. Available: <https://www.bps.go.id/en/pressrelease/2026/07/01/2591/the-farmers--terms-of-trade--ftt--in-june-2026-reached-127-65--decreased-by-0-06-percent-.html>
- BPS, "Farmer Terms of Trade Statistics 2023," BPS Product Publication. Accessed: Aug. 05, 2026. [Online]. Available: <https://www.bps.go.id/en/publication/2024/04/23/d49e2636396e0b8311a2b53b/statistik-nilai-tukar-petani-2023.html>
- BPS, "Nilai Tukar Petani (NTP) Juli 2026 sebesar 127,84 atau naik 0,15 persen," BPS Produk Berita Resmi Statistik. Accessed: Aug. 05, 2026. [Online]. Available:

- <https://www.bps.go.id/id/pressrelease/2026/08/03/2602/nilai-tukar-petani--ntp--juli-2026-sebesar-127-84-atau-naik-0-15-persen-.html>
- P. Dorimulu, "NTP Juli 2026 Naik 0,15% ke 127,84, Tapi Petani Hortikultura Tertekan," Investor Trust ID. Accessed: Aug. 05, 2026. [Online]. Available: <https://investortrust.id/macro/111568/ntp-juli-2026-naik-0-15-ke-127-84-tapi-petani-hortikultura-tertekan>
- S. H. Susilowati, E. Suryani, I. S. Anugrah, F. S. Nida, and A. Suryana, "Dinamika dan Struktur Pendapatan Rumah Tangga Perdesaan di Berbagai Agroekosistem di Indonesia," Anal. Kebijak. Pertan., vol. 18, no. 2, pp. 121–134, Dec. 2020, doi: 10.21082/akp.v18n2.2020.121-134.
- R. A. Nugrahapsari and M. P. Hutagaol, "Tinjauan Kritis terhadap Kebijakan Harga Gabah dan Harga Beras di Indonesia," Forum Penelit. Agro Ekon., vol. 39, no. 1, p. 11, Aug. 2021, doi: 10.21082/fae.v39n1.2021.11-26.
- D. Chrisendo, V. V Krishna, H. Siregar, and M. Qaim, "Land-use change, nutrition, and gender roles in Indonesian farm households," For. Policy Econ., vol. 118, p. 102245, 2020, doi: <https://doi.org/10.1016/j.forpol.2020.102245>.
- F. R. Moeis, T. Dartanto, J. P. Moeis, and M. Ikhsan, "A longitudinal study of agriculture households in Indonesia: The effect of land and labor mobility on welfare and poverty dynamics," World Dev. Perspect., vol. 20, p. 100261, 2020, [Online]. Available: <https://scholar.ui.ac.id/en/publications/a-longitudinal-study-of-agriculture-households-in-indonesia-the-e/>
- D. B. Santoso, C. Gan, M. D. Revindo, and N. W. G. Massie, "The impact of microfinance on Indonesian rural households' welfare," Agric. Financ. Rev., vol. 80, no. 4, pp. 491–506, Mar. 2020, doi: 10.1108/AFR-11-2018-0098.
- M. Budi Amalia, H. Harianto, and S. Sumaryanto, "Pengaruh Penguasaan Lahan Terhadap Pendapatan dan Kesejahteraan Rumah Tangga Pertanian pada Agroekosistem yang Berbeda," J. Agribisnis Indones., vol. 11, no. 2, pp. 299–310, Dec. 2023, doi: 10.29244/jai.2023.11.2.299-310.
- K. Kadir and O. R. Prasetyo, "Impact of Farm Size and Sociodemographic Characteristics on Agricultural Households' Food Security," J. Ekon. Indones., vol. 12, no. 2, pp. 109–124, Dec. 2023, doi: 10.52813/jei.v12i2.492.
- E. Masset and J. García-Hombrados, "Sensitivity matters. Comparing the use of multiple indicators and of a multidimensional poverty index in the evaluation of a poverty eradication program," World Dev., vol. 137, p. 105162, Jan. 2021, doi: 10.1016/j.worlddev.2020.105162.
- P. Chopin, C. P. Mubaya, K. Descheemaeker, I. Öborn, and G. Bergkvist, "Avenues for improving farming sustainability assessment with upgraded tools, sustainability framing and indicators. A review," Agron. Sustain. Dev., vol. 41, no. 2, p. 19, Apr. 2021, doi: 10.1007/s13593-021-00674-3.
- BPS, "Survei Kesejahteraan Petani (SKP) Tahun 2025," BPS Produk Berita dan Siaran Pers. Accessed: Aug. 05, 2026. [Online]. Available: <https://minahasakab.bps.go.id/id/news/2025/10/15/338/survei-kesejahteraan-petani--skp--tahun-2025.html>

- BPS, "Memahami Indeks Kesejahteraan Petani (IKP)," BPS: Berita dan Siaran Pers. Accessed: Feb. 11, 2026. [Online]. Available: <https://babel.bps.go.id/id/news/2025/10/04/1227/memahami-indeks-kesejahteraan-petani-ikp-.html>
- J. Knook, D. Carver, K. Gear, and C. Eastwood, "Assessing rural wellbeing through design of a farmer-focused survey methodology: The importance of cultural health, ease of use and farming specific questions," *J. Rural Stud.*, vol. 111, p. 103412, Oct. 2024, doi: 10.1016/j.jrurstud.2024.103412.
- T. Assefa and E. B. Abide, "Determinants of food insecurity in rural households: A case of lemo district, southern Ethiopia," *Heliyon*, vol. 9, no. 1, p. e12764, Jan. 2023, doi: 10.1016/j.heliyon.2022.e12764.
- K. Brown, J. Schirmer, and P. Upton, "Regenerative farming and human wellbeing: Are subjective wellbeing measures useful indicators for sustainable farming systems?," *Environ. Sustain. Indic.*, vol. 11, p. 100132, Sep. 2021, doi: 10.1016/j.indic.2021.100132.
- G. Danso-Abbeam, G. Dagunga, and D. S. Ehiakpor, "Rural non-farm income diversification: implications on smallholder farmers' welfare and agricultural technology adoption in Ghana," *Heliyon*, vol. 6, no. 11, p. e05393, Nov. 2020, doi: 10.1016/j.heliyon.2020.e05393.
- P. J. Batterham, K. Brown, A. L. Cleave, D. Lindenmayer, K. Hingee, and C. Poyser, "The FarmWell study: Examining relationships between farm environment, financial status and the mental health and wellbeing of farmers," *Psychiatry Res. Commun.*, vol. 2, no. 2, p. 100036, Jun. 2022, doi: 10.1016/j.psycom.2022.100036.
- E. C. Betley et al., "Assessing human well-being constructs with environmental and equity aspects: A review of the landscape," *People Nat.*, vol. 5, no. 6, pp. 1756–1773, Dec. 2023, doi: 10.1002/pan3.10293.
- X. Ouyang, W. Qi, D. Song, and J. Zhou, "Does Subjective Well-Being Promote Pro-Environmental Behaviors? Evidence from Rural Residents in China," *Int. J. Environ. Res. Public Health*, vol. 19, no. 10, p. 5992, May 2022, doi: 10.3390/ijerph19105992.
- C. D. Witt, D. B. Reed, M. K. Rayens, and S. Hunsucker, "Predictors of Job Satisfaction in Female Farmers Aged 50 and Over: Implications for Occupational Health Nurses," *Workplace Health Saf.*, vol. 68, no. 11, pp. 526–532, Nov. 2020, doi: 10.1177/2165079920931895.
- L. Wu, C. Li, and Y. Gao, "Regional agricultural cooperatives and subjective wellbeing of rural households in China," *Reg. Sci. Policy Pract.*, vol. 14, pp. 138–159, Nov. 2022, doi: 10.1111/rsp3.12502.
- W. Zhang, "Social capital, income and subjective well-being: evidence in rural China," *Heliyon*, vol. 8, no. 1, p. e08705, Jan. 2022, doi: 10.1016/j.heliyon.2021.e08705.
- M. Alarcon, P. Marty, and A.-C. Prévot, "Caring for vineyards: Transforming farmer-vine relations and practices in viticulture French farms," *J. Rural Stud.*, vol. 80, pp. 160–170, Dec. 2020, doi: 10.1016/j.jrurstud.2020.08.029.
- T. W. Nugroho, N. Hanani, H. Toiba, and S. Sujarwo, "Promoting Subjective Well-Being among Rural and Urban Residents in Indonesia: Does Social Capital Matter?," *Sustainability*, vol. 14, no. 4, p. 2375, Feb. 2022, doi: 10.3390/su14042375.

- K. E. Pratiwi and J. P. Moeis, "The Impact of Agricultural Land Ownership on the Subjective Wellbeing of Farmers in Indonesia," *J. Ekon. dan Pembang.*, vol. 30, no. 2, pp. 157–172, Mar. 2023, doi: 10.14203/JEP.30.2.2022.157-172.
- X. Zhao, L. Jin, and S. B. Sun, "'Gone with the land': Effects of land expropriation on health and subjective well-being in rural China," *Health Place*, vol. 73, p. 102614, Jan. 2022, doi: 10.1016/j.healthplace.2021.102614.
- S. Poudel, S. Funakawa, H. Shinjo, and B. Mishra, "Understanding households' livelihood vulnerability to climate change in the Lamjung district of Nepal," *Environ. Dev. Sustain.*, vol. 22, no. 8, pp. 8159–8182, Dec. 2020, doi: 10.1007/s10668-019-00566-3.
- L. Niu, C. Lu, and R. Sun, "The Impact of Livelihood Capital on Subjective Well-Being of New Professional Farmers: Evidence from China," *Sustainability*, vol. 15, no. 14, p. 11305, Jul. 2023, doi: 10.3390/su151411305.
- A. Perrin, M. S. Cristobal, R. Milestad, and G. Martin, "Identification of resilience factors of organic dairy cattle farms," *Agric. Syst.*, vol. 183, p. 102875, Aug. 2020, doi: 10.1016/j.agsy.2020.102875.
- H. Freudenreich and S. W. Kebede, "Experience of shocks, household wealth and expectation formation: Evidence from smallholder farmers in Kenya," *Agric. Econ.*, vol. 53, no. 5, pp. 756–774, Sep. 2022, doi: 10.1111/agec.12718.
- K. Brown, J. Schirmer, and P. Upton, "Can regenerative agriculture support successful adaptation to climate change and improved landscape health through building farmer self-efficacy and wellbeing?," *Curr. Res. Environ. Sustain.*, vol. 4, p. 100170, 2022, doi: 10.1016/j.crsust.2022.100170.
- BPS, "Farmer's Terms of Trade Statistics 2021," BPS Product Publication. Accessed: Aug. 05, 2026. [Online]. Available: <https://www.bps.go.id/en/publication/2022/04/07/ae9ee394ec47b2c686d10703/farmer-s-terms-of-trade-statistics-2021.html>
- B. Talukder, G. W. van Loon, K. W. Hipel, S. Chiotha, and J. Orbinski, "Health impacts of climate change on smallholder farmers," *One Heal.*, vol. 13, p. 100258, Dec. 2021, doi: 10.1016/j.onehlt.2021.100258.
- M. S. Rahman et al., "Climate Disasters and Subjective Well-Being among Urban and Rural Residents in Indonesia," *Sustainability*, vol. 14, no. 6, p. 3383, Mar. 2022, doi: 10.3390/su14063383.
- E. Martey, P. M. Etwire, and J. K. M. Kuwornu, "Economic impacts of smallholder farmers' adoption of drought-tolerant maize varieties," *Land use policy*, vol. 94, p. 104524, May 2020, doi: 10.1016/j.landusepol.2020.104524.
- H. Toiba, T. W. Nugroho, D. Retnoningsih, and M. S. Rahman, "Food system transformation and its impact on smallholder farmers' income and food security in Indonesia," *Cogent Econ. Financ.*, vol. 8, no. 1, p. 1854412, Jan. 2020, doi: 10.1080/23322039.2020.1854412.
- W. Awoke, K. Eniyew, G. Agitew, and B. Meseret, "Determinants of food security status of household in Central and North Gondar Zone, Ethiopia," *Cogent Soc. Sci.*, vol. 8, no. 1, Dec. 2022, doi: 10.1080/23311886.2022.2040138.
- F. Jacquet et al., "Pesticide-free agriculture as a new paradigm for research," *Agron. Sustain. Dev.*, vol. 42, no. 1, p. 8, Feb. 2022, doi: 10.1007/s13593-021-00742-8.

- A. Bailey and J. Kingsley, "Connections in the garden: opportunities for wellbeing," *Local Environ.*, vol. 25, no. 11–12, pp. 907–920, Dec. 2020, doi: 10.1080/13549839.2020.1845637.
- M. Brennan, T. Hennessy, and E. Dillon, "Towards a better measurement of the social sustainability of Irish agriculture," *Int. J. Sustain. Dev.*, vol. 23, no. 3/4, p. 263, 2020, doi: 10.1504/IJSD.2020.10037663.
- J. Mills et al., "Developing Farm-Level Social Indicators for Agri-Environment Schemes: A Focus on the Agents of Change," *Sustainability*, vol. 13, no. 14, p. 7820, Jul. 2021, doi: 10.3390/su13147820.
- M. Abdul-Majid, S. A. Zahari, N. Othman, and S. Nadzri, "Influence of technology adoption on farmers' well-being: Systematic literature review and bibliometric analysis," *Heliyon*, vol. 10, no. 2, p. e24316, 2024, doi: <https://doi.org/10.1016/j.heliyon.2024.e24316>.
- B. G. Hansen, C. T. Bugge, and P. K. Skibrek, "Automatic milking systems and farmer wellbeing—exploring the effects of automation and digitalization in dairy farming," *J. Rural Stud.*, vol. 80, pp. 469–480, Dec. 2020, doi: 10.1016/j.jrurstud.2020.10.028.
- H. W. Wijayanto, K. A. Lo, H. Toiba, and M. S. Rahman, "Does agroforestry adoption affect subjective well-being? Empirical evidence from smallholder farmers in East Java, Indonesia," *Sustainability*, vol. 14, no. 16, p. 10382, 2022, doi: 10.3390/su141610382.
- A. Jones-Bitton, C. Best, J. MacTavish, S. Fleming, and S. Hoy, "Stress, anxiety, depression, and resilience in Canadian farmers," *Soc. Psychiatry Psychiatr. Epidemiol.*, vol. 55, no. 2, pp. 229–236, Feb. 2020, doi: 10.1007/s00127-019-01738-2.
- K. M. Gunn and D. Hughes-Barton, "Understanding and addressing psychological distress experienced by farmers, from the perspective of rural financial counsellors," *Aust. J. Rural Health*, vol. 30, no. 1, pp. 34–43, Feb. 2022, doi: 10.1111/ajr.12815.
- C. Hammersley, N. Richardson, D. Meredith, P. Carroll, and J. G. McNamara, "Supporting farmer wellbeing: exploring a potential role for advisors," *J. Agric. Educ. Ext.*, vol. 29, no. 4, pp. 511–538, Aug. 2023, doi: 10.1080/1389224X.2022.2082498.
- M. E. Isaac, H. Nyantakyi-Frimpong, P. Matouš, E. Dawoe, and L. C. N. Anglaaere, "Farmer networks and agrobiodiversity interventions: the unintended outcomes of intended change," *Ecol. Soc.*, vol. 26, no. 4, p. art12, 2021, doi: 10.5751/ES-12734-260412.
- L. Ma, Y. Qin, H. Zhang, J. Zheng, Y. Hou, and Y. Wen, "Improving Well-Being of Farmers Using Ecological Awareness around Protected Areas: Evidence from Qinling Region, China," *Int. J. Environ. Res. Public Health*, vol. 18, no. 18, p. 9792, Sep. 2021, doi: 10.3390/ijerph18189792.
- L. V. Rasmussen et al., "Joint environmental and social benefits from diversified agriculture," *Science (80-.)*, vol. 384, no. 6691, pp. 87–93, Apr. 2024, doi: 10.1126/science.adj1914.
- W. Qi, W. Xu, X. Qi, and M. Sun, "Can Environmental Protection Behavior Enhance Farmers' Subjective Well-Being?," *J. Happiness Stud.*, vol. 24, no. 2, pp. 505–528, Feb. 2023, doi: 10.1007/s10902-022-00606-2.
- A. Sarra, E. Nissi, A. Evangelista, and T. Di Battista, "A Functional approach for constructing dynamic Composite Indicators," *Stat. Methods Appl.*, vol. 33, no. 1, pp. 173–204, Mar. 2024, doi: 10.1007/s10260-023-00728-8.

- M. Anwar and R. Nasrudin, "The Household Food Insecurity Amidst the Covid-19 Pandemic in Indonesia," *JEJAK*, vol. 14, no. 2, pp. 244–260, Sep. 2021, doi: 10.15294/jejak.v14i2.28511.
- N. Mehraban, C. Kubitza, Z. Alamsyah, and M. Qaim, "Oil palm cultivation, household welfare, and exposure to economic risk in the Indonesian small farm sector," *J. Agric. Econ.*, vol. 72, no. 3, pp. 901–915, Sep. 2021, doi: 10.1111/1477-9552.12433.
- S. Larson et al., "Women's well-being and household benefits from seaweed farming in Indonesia," *Aquaculture*, vol. 530, p. 735711, Jan. 2021, doi: 10.1016/j.aquaculture.2020.735711.
- A. M. Nadeem, T. Ali, W. Wei, Q. Cui, and S. Huang, "Can Irrigation Conditions Improve Farmers' Subjective Well-being? An Investigation in Rural Pakistan," *Water*, vol. 13, no. 4, p. 505, Feb. 2021, doi: 10.3390/w13040505.
- S. Lauer and M. Sanderson, "Irrigated agriculture and human development: a county-level analysis 1980–2010," *Environ. Dev. Sustain.*, vol. 22, no. 5, pp. 4407–4423, Jun. 2020, doi: 10.1007/s10668-019-00390-9.
- H. Zhou, X. Zhang, C. Ge, J. Wang, and X. Sun, "Does Internet Use Boost the Sustainable Subjective Well-Being of Rural Residents? Evidence from Rural China," *Sustainability*, vol. 15, no. 2, p. 1652, Jan. 2023, doi: 10.3390/su15021652.
- S. Archibald, C. Allinne, C. R. Cerdán, and M. E. Isaac, "From the ground up: Patterns and perceptions of herbaceous diversity in organic coffee agroecosystems," *Ecol. Solut. Evid.*, vol. 3, no. 3, Jul. 2022, doi: 10.1002/2688-8319.12166.
- J. Hanspach et al., "Biocultural approaches to sustainability: A systematic review of the scientific literature," *People Nat.*, vol. 2, no. 3, pp. 643–659, Sep. 2020, doi: 10.1002/pan3.10120.
- W. Ma, P. Vatsa, X. Zhou, and H. Zheng, "Happiness and farm productivity: insights from maize farmers in China," *Int. J. Soc. Econ.*, vol. 49, no. 1, pp. 97–106, Jan. 2022, doi: 10.1108/IJSE-08-2021-0474.
- L. Wang, X. Ding, M. Hong, W. Xiong, and Y. Tan, "Exploring changes and influencing factors of farmers' welfare in different villages under the background of homestead system reform," *Habitat Int.*, vol. 153, p. 103190, Nov. 2024, doi: 10.1016/j.habitatint.2024.103190.
- L. Sebastien, "The power of place in understanding place attachments and meanings," *Geoforum*, vol. 108, pp. 204–216, Jan. 2020, doi: 10.1016/j.geoforum.2019.11.001.