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Facing the 2026 "Godzilla" El Niño: Readiness, Risk Mitigation, and Multi-Stakeholder Resilience of Independent Oil Palm Smallholders in Indonesia

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ABSTRACT

Indonesia's independent oil palm smallholders are increasingly exposed to climatic shocks while simultaneously facing structural constraints in productivity, finance, farm management, market access, organization, and sustainability compliance. The strengthening 2026 El Niño therefore constitutes more than a temporary meteorological disturbance; it represents a systemic stress test for smallholder resilience. This qualitative literature review synthesizes recent peer-reviewed evidence on oil palm physiology, drought and ENSO impacts, smallholder livelihoods, agronomic management, peat and fire risks, climate services, certification, and institutional support. The review finds that smallholder readiness is highly heterogeneous and should be assessed across six interacting dimensions: climate-information, biophysical-agronomic, fire-environmental, economic-financial, household-livelihood, and institutional-governance readiness. Severe rainfall deficits and high atmospheric water demand may initiate cascading effects from soil-water stress and reproductive disruption to lagged fresh fruit bunch losses, reduced household cash flow, underinvestment in inputs, and declining future productivity. Fire hazards can further transform farm-level vulnerability into landscape-scale environmental and social risk. The article argues that resilience requires a portfolio of anticipatory measures rather than a single technological intervention. Priority actions include actionable climate services, soil-water conservation, strategic nutrient and harvest management, community fire prevention, climate-contingent finance, strengthened farmer organizations, and coordinated government–private-sector support. A sequenced framework spanning anticipation, impact management, recovery, and transformation is proposed to protect both smallholder livelihoods and the long-term sustainability of Indonesia's palm oil sector.

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Introduction

Indonesia's oil palm economy occupies a strategic position at the intersection of rural development, agricultural commodity production, international trade, industrial processing, energy policy, and environmental governance. Palm oil provides income and employment across extensive rural landscapes and supports a downstream industrial system encompassing fresh fruit bunch (FFB) collection, milling, refining, oleochemicals, food industries, biodiesel, and numerous consumer products. Smallholders have become indispensable actors within this production system, meaning that the sustainability of Indonesia's palm oil sector can no longer be understood primarily through the performance of large corporate plantations [1-3].

This structural importance is accompanied by considerable heterogeneity. Independent or swadaya smallholders generally operate outside the more integrated arrangements historically associated with nucleus-estate or plasma schemes. Their farms differ substantially in size, age profile, planting material, soil conditions, management intensity, access to extension, financial capacity, land documentation, farmer-group membership, market channels, and distance from mills. Recent Indonesian evidence demonstrates that smallholders cannot appropriately be treated as a homogeneous socioeconomic category: some possess relatively strong combinations of financial, physical, human and social assets, whereas others remain highly vulnerable to shocks and have limited capacity to modify production practices when conditions deteriorate [4].

Climate variability adds a new layer to these existing structural inequalities. The contextual and initial literature review described Indonesian agricultural readiness for El Niño as uneven, highlighting dependence on rainfall, incomplete dissemination of early-warning information, and unequal access to irrigation and extension services. The same literature anticipated lower agricultural productivity, quality deterioration, pest problems, and heightened risks for young plantation crops and fire-prone areas. Its specific discussion of independent oil palm farmers further emphasized that prolonged dryness could reduce rainfall, increase temperatures, gradually suppress future fruit production, increase maintenance costs, and elevate fire risk.

Importantly, the climatic situation has developed considerably since that initial April assessment. BMKG monitoring during July 2026 indicated that El Niño had become active and subsequently reached strong intensity, while the agency warned that the event could become very strong and contribute to a drier and longer dry season, water scarcity, and increased forest and land fire risk. NOAA's Climate Prediction Center stated on 13 August 2026 that El Niño was strengthening and that there was a greater than 90% probability of a very strong event during Northern Hemisphere autumn and winter 2026–2027; NOAA also estimated a 69% probability that the October–December 2026 seasonal index could exceed the strength of previous events in the post-1950 record. These projections are probabilistic rather than deterministic, and severe impacts cannot be assumed everywhere merely from ENSO intensity. Nevertheless, they substantially increase the urgency of anticipatory risk management.

The expression "Godzilla El Niño", used increasingly in public discourse to communicate the possibility of an exceptionally powerful event, is not an official climatological classification. In scientific terms, this article therefore uses very strong El Niño when discussing ENSO intensity and reserves "Godzilla El Niño" as an explicitly informal shorthand for the exceptional 2026 risk scenario. This distinction is important because communicating climatic risk dramatically may increase public attention, but scientific and policy analysis must retain probabilistic language and recognize regional differences in exposure.

Oil palm deserves particular attention because its response to climatic stress differs from that of short-duration annual crops. The crop's reproductive cycle means that a drought occurring at one point in time can alter sex differentiation, inflorescence development, anthesis, bunch development, abortion, and eventual FFB production many months later. Consequently, palms may continue to produce harvestable bunches during an El Niño episode even though physiological processes determining future yields are already being disrupted. Studies of oil palm weather responses identify water deficit and atmospheric vapor pressure deficit (VPD) among important climatic stresses, with the magnitude of yield impacts depending on location, management, palm age, soil, timing and intensity of the anomaly [5-7].

The latest 22-year regional analysis covering Malaysia and Indonesia confirms that water deficits constitute a dominant El Niño stressor while also demonstrating substantial regional heterogeneity.

Climate impacts are therefore mediated by farm management. Reviews of oil palm and climate change identify soil-water conservation, improved planting materials, nutrient management, mulching, diversification and other adaptation practices as potential responses, although their technical suitability and affordability vary considerably between production systems [8,9].

Experimental and modelling research likewise demonstrates that oil palm responses to heat and water stress are physiologically complex rather than simply proportional to annual rainfall totals [10-14].

For independent smallholders, the crucial issue is not merely whether agronomic solutions exist but whether farmers possess the resources, institutions and incentives needed to adopt them. Indonesian smallholders already exhibit large yield gaps in normal conditions. Research across 977 independent smallholder fields found average yields equivalent to only about 42% of locally attainable yields, with nutrient management, harvest intervals, weed management and pruning among the key explanatory factors [14].

A severe climatic shock imposed on an already underperforming production system may therefore magnify pre-existing vulnerabilities rather than create an entirely new problem.

Moreover, independent farmers operate within economic and institutional environments that influence their adaptive choices. A farmer experiencing reduced cash flow may know that fertilizer, harvesting discipline or fire prevention should be maintained but still be unable to finance them. Certification research has similarly shown that legality, organization, upfront costs and dependence on external facilitators can constrain independent farmers from adopting sustainability standards [15-19]. Thus, preparedness should not be equated with awareness.

The literature remains fragmented across climate science, plant physiology, agronomy, fire ecology, smallholder livelihoods, certification and rural institutions. Biophysical studies frequently establish how drought influences oil palm, while socioeconomic studies explain why smallholders differ in productive capacity. Fire studies reveal landscape-scale consequences of severe dry seasons, whereas climate-services literature identifies the importance of usable information. What remains insufficiently integrated is the question of readiness: whether independent smallholders can anticipate, absorb, adapt to and recover from a very strong El Niño before its full production and livelihood consequences emerge.

Accordingly, this article addresses two questions. First, how prepared are Indonesia's independent oil palm smallholders to anticipate, absorb and mitigate the agronomic, environmental, livelihood, financial and institutional risks associated with the 2026 very strong El Niño? Second, what combination of farm-level adaptation measures, government support and multi-stakeholder collaboration is required to strengthen the resilience and long-term sustainability of independent smallholder oil palm plantations.

The objective is to synthesize recent evidence and develop an integrated framework that links climatic hazard to farm exposure, physiological sensitivity, livelihood vulnerability and adaptive capacity. The article contributes the Six-Dimensional Independent Oil Palm Smallholder El Niño Readiness Framework, a cascading-risk interpretation of climate impacts, and a sequenced model of anticipatory action, impact management, recovery and transformation. Rather than interpreting resilience as the ability simply to survive one dry season, the analysis treats it as the capacity to maintain viable livelihoods and productive plantations without generating maladaptive environmental or financial responses.

Literature Review

Indonesia's Oil Palm Sector from Upstream Production to Downstream Markets

Oil palm has transformed agricultural landscapes and rural economies across Southeast Asia. Its exceptionally high oil yield per unit land has supported a globally important industry, but expansion has also generated substantial environmental and social controversy. Consequently, the contemporary sustainability challenge involves simultaneously maintaining productive livelihoods, limiting further deforestation, increasing efficiency on existing land and improving environmental governance [20].

Smallholders are central to this transition. High-resolution mapping demonstrates that smallholder plantations constitute an extensive and spatially significant component of global oil palm landscapes, particularly in Indonesia and Malaysia. However, the boundary between "smallholder" and industrial production should not obscure diversity in organization. Scheme farmers may have historical relationships with estates or mills, whereas independent farmers typically make production and marketing decisions with less formal support. Their FFB is often sold through intermediaries, and the perishability of harvested bunches limits farmers' ability to delay sales while searching for better prices.

This upstream structure matters for climate adaptation because farm decisions are inseparable from value-chain conditions. Harvest frequency depends not only on fruit maturity but also on labor availability, farm accessibility, FFB prices, transport costs and the ability to aggregate sufficient volume. Research in Indonesian smallholder systems shows that low yields can encourage farmers to lengthen harvest intervals to improve labor and transport efficiency, even though long intervals may increase harvest losses and reduce oil quality. Climate-induced yield reductions can therefore propagate beyond the biological response of palms to alter harvesting behavior and supply-chain efficiency.

Downstream actors are also affected. Mills depend upon a relatively continuous supply of FFB because processing capacity and fruit quality are time sensitive. If widespread drought creates delayed production troughs, mills sourcing heavily from smallholders can experience supply instability. Climate resilience should consequently be understood as a value-chain concern rather than an exclusively farm-level problem. This provides a strong rationale for engaging processors and buyers in financing or facilitating smallholder adaptation rather than treating resilience investment solely as a public-sector responsibility.

Structural Vulnerabilities of Independent Smallholders

The starting point for assessing El Niño readiness is the existing productivity gap. demonstrate that low yields in independent smallholder fields cannot be attributed simply to inferior planting materials. Nutrient management, harvesting, pruning and weed management are substantial determinants of field performance. This finding is important because climatic stress interacts with management quality. A well-managed palm with adequate nutrition, functioning groundcover and healthier soil may be better positioned to withstand transient water stress than a palm already constrained by chronic nutrient deficiencies or poor agronomic practices.

Farm economics further shapes these practices. examining smallholder plots in Jambi, show that management practices and economic performance are closely interconnected. Farmers make agronomic decisions within constraints created by labor, cash, opportunity costs and expected returns [20,21].

similarly demonstrate that fertilization and understory management affect both soil health and oil palm performance, reinforcing the idea that resilience depends on maintaining ecological functions as well as applying purchased inputs.

This observation has direct implications during drought. A simplistic recommendation to "increase inputs" may be unaffordable, while a blanket recommendation to suspend fertilizer expenditure to preserve cash may create longer-term deficiencies. The relevant objective is strategic nutrient management based on soil and plant conditions, weather outlooks, application timing and expected nutrient-use efficiency. Similarly, indiscriminate understory removal can expose soil and reduce desirable ecological functions even if farmers perceive bare ground as cleaner or easier to manage. Independent smallholders also differ in their social and livelihood assets [21].

Identified five resilience classes—vulnerable, economically and socially constrained, low-skilled, semi-secure and adaptive—among Indonesian oil palm smallholders. Particularly noteworthy is the finding that many of the least resilient farmers were older local farmers who had established plantations independently, whereas some of the most resilient had histories of government-supported migration and plantation development. This evidence strongly challenges uniform climate policy. Identical advice or subsidy packages distributed to all smallholders would ignore substantial differences in exposure and adaptive capacity.

Replanting creates another vulnerability window. Smallholders must finance plantation establishment while accepting temporary income losses before young palms become productive. identify financial, organizational, technical and institutional challenges associated with smallholder replanting [22,23].

show that collective action and institutional continuity can be crucial to successful replanting and long-term resilience. A severe El Niño is particularly concerning for recently replanted farms because young palms have smaller and less developed root systems and households may simultaneously be managing reduced plantation income.

Certification, Collective Action and Institutional Capacity

Sustainability certification is relevant to climate resilience even though certification and adaptation are not synonymous. Certification can generate organizational infrastructure, record-keeping practices, training relationships and environmental requirements that may facilitate collective responses to climatic shocks. However, the farmers most in need of resilience support are often those least able to enter certification systems [24]. Document multiple barriers faced by Indonesian smallholders seeking sustainable palm oil certification, while found that many successfully certified independent groups were actually former scheme smallholders possessing pre-existing organizational and legality advantages. Their study also shows that external facilitation remains important because certification imposes financial and administrative demands. Similar work indicates that training, incentives and institutional support influence farmers' willingness and ability to implement sustainability standards [25-27]. The policy implication is not that certification itself protects farmers from drought, but that organized farmers can possess institutional assets that facilitate adaptation. Collective groups can pool equipment, distribute forecasts, negotiate input purchases, organize fire patrols, coordinate transport and establish links with banks or mills.

show the importance of reducing transaction costs in scaling sustainability standards, while Reich and Musshoff (2025) highlight continued barriers along smallholders' pathway toward certification. These institutional lessons are directly applicable to climate preparedness.

Evidence concerning welfare outcomes also urges caution against assuming automatic benefits show that the impacts of palm-oil sustainability certification on village well-being and poverty are context dependent [28,29].

likewise emphasize that smallholder sustainability is multidimensional rather than reducible to a single economic or environmental indicator. Thus, climate resilience should be mainstreamed into broader sustainability systems while preserving attention to livelihood viability.

Alternative organizational models may also become relevant. Witjaksono et al. (2024) discuss corporate-farming arrangements as a potential mechanism for coordinating Indonesian smallholders, while emphasize lessons from long-term collective oil palm cultivation. The common principle is not a single prescribed organizational form but the reduction of fragmentation in functions that benefit from scale—information, finance, fire management, input procurement, mechanization, logistics and marketing.

El Niño, Drought and Oil Palm Physiology

Oil palm is adapted to humid tropical conditions and therefore sensitive to substantial deviations in water availability. The relationship is nevertheless nonlinear and mediated by soil properties, palm age, atmospheric demand, management and the timing of stress relative to reproductive development. Reviews from Malaysia consistently identify changing rainfall, temperature and extreme events as material threats to oil palm productivity and emphasize adaptation through soil, water and agronomic management [30]. Physiological studies help explain the pathways involved. Young oil palms exposed to repeated water-deficit events display measurable physiological responses, demonstrating that repeated drought is not equivalent to a single temporary shortage. Crop modelling similarly emphasizes the importance of correctly representing water limitations when estimating oil palm productivity under varying climatic conditions. Heat stress also induces molecular and physiological responses in Elaeis guineensis, while temperature variation can influence reproductive growth and assimilate storage.

The interaction between soil moisture and atmospheric demand is particularly significant. identify water stress and VPD as important determinants of spatial and temporal oil palm yield variation. Their analysis indicates that weather anomalies occurring around stages such as sex differentiation, anthesis and bunch failure can have substantial consequences for later production. Irrigation research under ENSO-induced drought in the Brazilian Amazon provides further physiological evidence that supplemental water can alter palm transpiration responses under drought, although transfer of these findings to Indonesian independent smallholders requires caution because irrigation costs, water availability, farm scale and environmental conditions differ [31].

Recent evidence strengthens this interpretation. found nonlinear associations between climate anomalies and oil palm productivity, with extreme ENSO conditions affecting FFB and oil yields across lag periods. Naito and Takeuchi (2026), analyzing 22 years of yield and climate data in Malaysia and Indonesia, found that regional sensitivity differs but that water deficits are a dominant El Niño stressor. These findings are particularly important for preparedness because they imply that the visible harvest during a drought can underestimate future losses already embedded in reproductive processes. Not all empirical studies attribute large shares of yield variation directly to measured climate variables. Analyzing commercial Malaysian plantation data, found comparatively limited explanatory power for climatic conditions relative to other factors in their specific dataset. Rather than invalidating climate-risk concerns, this finding highlights the importance of management, site characteristics and data scale. Climate sensitivity is conditional, and the same El Niño anomaly can generate very different yield outcomes across locations. Longer-term climate suitability also matters [32,33].

project changes in the suitability of Southeast Asian tree-crop areas under climate change, including reduced suitability for substantial existing oil palm areas under severe scenarios [34]. similarly demonstrate that climate variables can influence oil-palm productivity within broader agricultural systems, while show that future production responses involve interacting effects rather than simple temperature–yield relationships. These studies reinforce the need to view the 2026 event as both an immediate shock and a preview of the adaptation challenges facing perennial tropical agriculture Field-scale water management must nevertheless remain context specific [35,36].

Demonstrate the importance of soil-water conditions in determining adult oil palm water requirements. The lesson for Indonesian smallholders is not that all farms should install irrigation—an economically and environmentally unrealistic prescription—but that soil-water conservation, farm drainage configuration, water harvesting and prioritization of the most vulnerable palms should be designed according to local hydrological conditions.

El Niño, Peatland and Fire Risk

Drought becomes particularly dangerous when it interacts with combustible biomass, degraded land and drained peat. Indonesian peatlands contain large carbon stocks and become extremely difficult to extinguish once fire penetrates below the surface. Fire therefore represents a qualitatively different risk from temporary yield reduction: it can destroy productive assets, generate smoke exposure, damage neighboring properties and ecosystems, release substantial greenhouse gases and create liabilities far beyond the originating farm.

Research demonstrates strong relationships among hydrology, climatic anomalies and peat-fire risk [37].

Show that peatland groundwater levels can provide warning signals for El Niño and positive Indian Ocean Dipole conditions [38].

Demonstrate that targeted land-management strategies could substantially reduce peat-fire occurrence in Central Kalimantan. Historical evidence also links ENSO variability to fire regimes in Sumatra, while contemporary remote-sensing analyses reveal repeated and spatially heterogeneous fire exposure across threatened Kalimantan peatlands [39,40].

Fire is not determined by climate alone. Ignition sources, land management, drainage, accessibility, land-use conflict and enforcement interact with dryness. stress the importance of understanding multiple factors underlying Indonesian peatland fires. further show how disturbances alter carbon emissions from tropical peat swamp forests, illustrating the broader consequences of degradation and fire-prone conditions [41,42].

In July 2026, BMKG specifically linked the active El Niño outlook to greater drought and forest-and-land-fire risk and identified heightened preparedness needs in major fire-prone provinces. The implication for independent oil palm is clear: fire readiness cannot begin after ignition. The relevant unit of intervention is also larger than the individual farm because fire propagation, smoke, hydrological connectivity and suppression infrastructure operate at village and landscape scales.

Adaptation, Climate Services and Livelihood Resilience

Climate adaptation in smallholder agriculture depends on more than technical availability. A Southeast Asian review identifies household income, education, experience, access to information, training, institutional assistance and social networks among recurring determinants of adaptation behavior. Indonesian evidence from other agricultural commodities similarly demonstrates that farmers' perceptions, resources, extension access and institutional support influence adaptation choices [43-46].

Climate information is useful only when it becomes actionable. emphasizes the value of tailored agrometeorological advisories rather than generic meteorological communication [47]. studying climate-service politics in Indonesian agriculture, show that farmers interpret and use information through local knowledge, social relationships and institutional settings. Consequently, simply transmitting an ENSO index or seasonal rainfall probability to a farmer does not constitute adaptation. Information must be translated into decisions such as when to apply fertilizer, which palms require priority protection, whether fire patrol frequency should increase, and when household cash reserves need to be preserved.

Resilience itself is multidimensional. demonstrate that smallholder plantation resilience can be disrupted simultaneously through social and environmental pathways, while operationalize resilience through the Sustainable Livelihoods Approach. These perspectives support analysis across natural, physical, financial, human and social assets rather than a single measure such as income.

The conceptual framework used here therefore treats climate risk as emerging through the interaction of hazard, exposure, sensitivity and adaptive capacity. Readiness is interpreted through six interdependent domains: (1) climate-information readiness; (2) biophysical-agronomic readiness; (3) fire-environmental readiness; (4) economic-financial readiness; (5) household-livelihood readiness; and (6) institutional-governance readiness. A farmer can score relatively well in one domain and remain highly vulnerable because another constitutes a binding constraint.

Method

Research Design

This study employs a qualitative literature review with interpretive thematic synthesis. It is explicitly not a systematic literature review (SLR). The purpose is to integrate concepts and empirical findings from several partially disconnected bodies of literature—oil palm physiology, ENSO and drought, agronomy, smallholder livelihoods, certification, climate services, peatland fire and institutional governance—to construct a holistic interpretation of smallholder readiness.

Qualitative synthesis is appropriate when the objective extends beyond asking whether an intervention has a statistically measurable average effect and instead seeks to explain relationships, mechanisms, contextual differences and policy implications. Methodological scholarship recognizes that qualitative synthesis can deepen understanding of complex phenomena by comparing and integrating findings across heterogeneous studies [48,49]. Integrative analysis also requires transparent explanation of how literature is interpreted and presented, even when the review is not designed as an exhaustive systematic search [50,51].

Accordingly, no PRISMA flow diagram, exhaustive database enumeration, formal risk-of-bias scoring scheme or meta-analysis is employed. Omitting these components is deliberate rather than a methodological oversight. The study seeks conceptual saturation and theoretical integration rather than a claim that every publication satisfying predetermined eligibility criteria has been captured.

Literature Identification

The review prioritizes peer-reviewed literature published from 2020 through August 2026, with emphasis on reputable international journals and research directly relevant to Indonesia. The thematic search process was iterative and purposive. Combinations of terms included oil palm, independent smallholder, Indonesia, El Niño, ENSO, drought, water deficit, vapor pressure deficit, climate change, fire, peat, resilience, climate services, adaptation, certification, replanting, yield gap, farmer organization, and sustainable intensification. References cited within highly relevant studies were also examined where they helped clarify mechanisms or conceptual relationships.

The initial literature review served as initial contextual and sensitizing material, not as evidence equivalent to a peer-reviewed study. It drew attention to uneven farmer readiness, rainfall dependence, incomplete early-warning dissemination, water limitations, and the particular vulnerability of young plantations and fire-prone areas. Its palm-oil-specific section additionally highlighted delayed yield effects and higher maintenance and fire-management burdens for independent farmers. These propositions were subsequently examined against journal literature.

Because the climatic status of the 2026 event is changing rapidly and cannot be established reliably through journal publications alone, current observations and outlooks were drawn separately from BMKG and NOAA. This institutional evidence was used only for the contemporary status and probabilistic outlook of the event, whereas the substantive analytical synthesis relies primarily on peer-reviewed research.

Thematic Analysis

The analysis proceeded in four stages. First, literature was read for evidence concerning the causal chain linking climate anomalies to soil-water conditions, palm physiology, production and household outcomes. Second, findings were coded around hazard, exposure, sensitivity, adaptive capacity, preparedness, mitigation and recovery. Third, related codes were grouped into thematic clusters concerning agronomic readiness, fire, climate services, financial capacity, livelihoods, collective institutions and government support. Fourth, the themes were interpreted across scales—from palm and plot to household, farmer organization, landscape, value chain and government.

This procedure resembles an inductive–deductive qualitative synthesis: established concepts such as adaptive capacity and livelihood capitals guided interpretation, but additional categories emerged from repeated patterns in the literature. The six-domain readiness framework, cascading-risk pathway, and vulnerability spiral are therefore synthetic constructs generated from the reviewed evidence rather than metrics directly validated through primary field data.

Evidence Quality and Limitations

Priority was given to recent peer-reviewed evidence with explicit methods, direct relevance to oil palm or Indonesian smallholder agriculture, and traceable DOI information. Evidence from Malaysia, Thailand, Colombia and the Brazilian Amazon was retained when it clarified biological or adaptation mechanisms that could reasonably inform Indonesian analysis. However, findings from commercial plantations or foreign environments were not treated as automatically transferable to Indonesian independent smallholders.

The review has three principal limitations. First, because it is qualitative and purposive, it cannot claim exhaustive coverage. Second, direct empirical research specifically examining Indonesian independent oil palm smallholders during the 2026 event is not yet available because the event is ongoing. Third, current ENSO forecasts remain probabilistic. The findings should therefore be interpreted as a readiness and risk-management synthesis based on the best recent evidence rather than as a post-event impact evaluation.

Results: Thematic Findings

Theme 1: Readiness Is Uneven and Multidimensional

The first and most consistent finding is that there is no meaningful single answer to whether Indonesian independent oil palm smallholders are "ready" for a very strong El Niño. Readiness varies across farmers and across dimensions within the same household. A smallholder may understand that rainfall is likely to decline yet lack the cash required for water conservation or fire equipment. Another may possess sufficient financial reserves but have no reliable localized climate information. A farmer group may have good technical knowledge but weak coordination with the village government or mill.

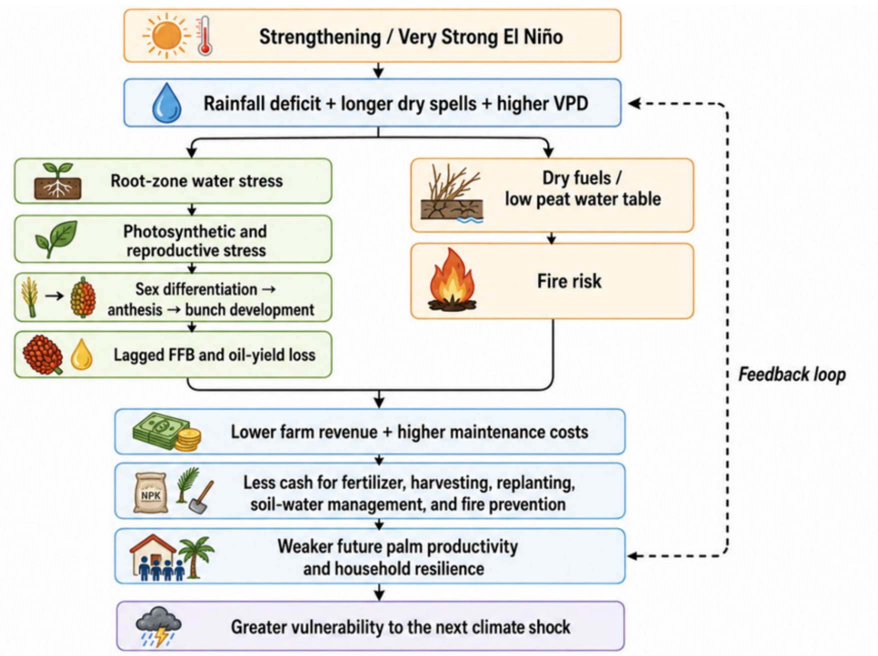
This heterogeneity is consistent with, who identify markedly different resilience classes among Indonesian smallholders. It is also consistent with wider Southeast Asian adaptation evidence showing that income, education, experience, information, training and social networks jointly shape adaptive behavior. The first major synthesis is therefore that awareness, capacity and action must be analytically separated.
Climate-information readiness concerns whether farmers receive timely forecasts, trust them, understand their probabilistic meaning and know what actions correspond to different warning levels. Biophysical-agronomic readiness concerns soil condition, water retention, palm age, nutrient status, groundcover, harvesting and other management variables. Fire-environmental readiness involves ignition prevention, hydrological conditions, combustible material, access to water and collective response arrangements. Economic-financial readiness concerns savings, debt, cash flow, affordable credit and the capacity to absorb additional costs. Household-livelihood readiness captures dependence on palm income, diversification and consumption buffers. Institutional-governance readiness includes membership in functioning groups, extension access, legality, certification links, public support and private-sector relationships.

A key implication is that the weakest domain can become the effective ceiling on overall readiness. Technically sound climate advice has limited value if a household cannot finance it. Credit may have limited value if farmers lack agronomic guidance. Individual fire preparedness may be overwhelmed by unmanaged neighboring land. The six dimensions must therefore be addressed as a system rather than independently.

Theme 2: El Niño Creates a Cascade Rather Than a Single Production Shock

The second theme is that the effects of a very strong El Niño should be interpreted as a cascade of linked risks. The initial climatic signal—reduced precipitation, extended rainless periods and increased atmospheric water demand—changes soil moisture and plant-water status. Palm physiological stress can then affect reproductive development. Because reproductive stages precede harvest by many months, the resulting yield loss may be delayedNaito and Takeuchi, 2026).

Figure 1 summarizes this cascading pathway. It is important to visualize the chain because interventions targeted solely at the moment of visible yield loss occur too late to prevent some of the underlying biological damage.



Source: Author's synthesis based on Brum et al. (2021), Monzon et al. (2022), Kamil et al. (2024), Hendrawan et al. (2024), Sulaiman et al. (2023), and Naito and Takeuchi (2026).

Figure 1: From a Very Strong El Niño to Smallholder Livelihood Stress: A Cascading Risk Pathway

Figure 1 Highlights Why the Effect Should not be Summarized as "Drought Lowers Current Yields." The Cascade Connects Climate, Physiology, Fire, Household Liquidity, and Subsequent Management Quality. If Lower Income Induces Farmers to Cut Fertilizer Excessively, Postpone Harvesting, Delay Pruning, Cancel Replanting Preparation, or Reduce Fire Patrols, The Initial Climate Shock Begins to Reproduce Vulnerability. Demonstrate that Smallholder Management Choices Already Respond Strongly to Economic and Logistical Conditions, While Demonstrate the Productivity Consequences of Suboptimal Management. Climate Stress Can Therefore Intensify an Existing Feedback Between Low Yield and Constrained Management.

this Delayed Pathway is Especially Important for Policy Evaluation. Government Agencies may Observe that FFB Continues Entering Mills During an el Niño Peak and Conclude that Impacts are Limited. Such an Interpretation Would be Premature. The Appropriate Monitoring Horizon Extends Well After Rainfall Normalizes Because Current Bunches Reflect Earlier Reproductive Processes While the Consequences of Current Stress can Emerge Later.

Theme 3: Fire Is a Low-Frequency but Potentially Catastrophic Dimension of Readiness

The third theme is that fire risk should be separated analytically from ordinary agronomic drought risk. A temporary decline in FFB can potentially be absorbed and recovered from; a severe fire can destroy palms and household assets, expose communities to smoke, damage peat ecosystems and impose multi-year recovery costs.

Peatland is especially sensitive because drainage and prolonged dryness lower water tables and increase the depth and persistence of burning. show the diagnostic importance of peat groundwater levels in relation to El Niño and IOD conditions. demonstrate that ENSO-linked fire has deep historical significance in Sumatran peatland environments, while document the continuing importance of fire frequency, intensity and severity across Kalimantan peatlands.

However, fire risk is manageable to some degree. find that targeted land-management strategies could substantially reduce fire occurrence in Central Kalimantan. This supports a transition from reactive suppression toward prevention. Farmers and villages require risk mapping, patrol systems, agreed reporting chains, functioning pumps where appropriate, accessible water sources, restrictions on burning, and rapid coordination with fire-management authorities.

BMKG's July 2026 warning reinforces the immediate relevance of this literature by linking the strengthening event to heightened drought and karhutla risk. Individual preparedness is insufficient because flames, smoke, and peat hydrology cross property boundaries. Fire management is therefore the clearest example of why collective and landscape governance are integral components of farm resilience.

Theme 4: The Most Robust Farm Response Is a Portfolio of No-Regrets Measures

The literature does not support one universal technological solution. Supplemental irrigation can moderate water stress under particular conditions, as demonstrated by, but installing conventional irrigation throughout independent smallholder landscapes would often be financially impractical and could create water-resource conflicts. Similarly, increased fertilizer is not automatically beneficial if applied when soil moisture conditions sharply reduce uptake efficiency.

The more defensible approach is a portfolio of no-regrets and low-regret measures tailored to local conditions. These include protecting soil cover, retaining appropriate organic residues, maintaining favorable soil structure, minimizing unnecessary soil exposure, conserving water, maintaining drainage structures responsibly, avoiding practices that further dry peat, managing nutrients strategically, sustaining reasonable harvest intervals, and giving particular attention to young or newly replanted palms.

Experimental evidence supports the physiological importance of water availability, while field research demonstrates that nutrients, harvesting, pruning, understory and soil-health practices materially influence smallholder performance. The combination suggests that climate adaptation should be incorporated into existing good agricultural practice rather than treated as a separate emergency technology.

Balanced understory management deserves particular attention. A completely bare plantation floor may reduce competition in some circumstances but can also increase soil exposure and undermine ecological functions. show important relationships between understory, fertilization, soil health and palm performance. Drought preparedness should therefore avoid the maladaptive interpretation that "clean" farms must be stripped of all ground vegetation.

Harvesting discipline is another underappreciated adaptation mechanism. When drought reduces production, farmers may lengthen harvest intervals because the volume collected per round becomes too small relative to transport and labor costs. found that such economic logic already affects harvest behavior. Climate-resilience programs should therefore consider collective harvesting or logistics coordination so that low-volume periods do not produce avoidable harvesting losses.

Theme 5: Climate Information Must Be Converted into Climate Services

The availability of a national ENSO forecast is not equivalent to smallholder preparedness. Farmers require information translated across three steps: forecast → local risk → management action. NOAA's probability that the 2026 event will become very strong and BMKG's national warning are scientifically valuable, but an independent farmer ultimately needs to know what the outlook means for rainfall in a specific district and which decisions should be modified.

Walker (2021) demonstrates the importance of tailored agrometeorological advisories. Ariefiansyah and Webber (2022) further show that climate services function through social and political relationships rather than as neutral one-way transfers of information. Smallholders evaluate forecasts alongside local observations, experience and advice from trusted intermediaries.

An effective oil-palm climate service should therefore use impact-based messaging. For example, rather than communicating only that Niño-3.4 has crossed a specified threshold, extension services might communicate that "the probability of below-normal rainfall during the next three months is high; recently replanted palms should receive priority moisture conservation; fertilizer timing should be reviewed; village fire patrol frequency should increase; and water sources should be checked." This converts scientific information into a decision framework.

Digital dissemination can expand reach but should not replace face-to-face interpretation where digital literacy and connectivity are uneven. Farmer organizations, extension officers, mills and village administrations can function as trusted intermediary nodes. The most effective system is therefore likely to combine national forecasting with district interpretation, village-level communication and farmer feedback.

Theme 6: Government Support Must Shift from Reactive Relief to Anticipatory Risk Management

A dominant weakness in conventional disaster response is that assistance often expands only after losses become visible. Oil palm's biological lag makes this approach particularly unsuitable. By the time FFB production drops sharply, preventive opportunities related to soil water, nutrition and reproductive stress may already have passed.

Government intervention should begin with risk stratification. Districts and villages can be categorized according to forecast rainfall deficit, historical drought exposure, peat presence, palm age, recent replanting, reliance on rain-fed production, fire history, smallholder concentration, poverty indicators and farmer-group coverage. Such stratification would allow scarce resources to be directed toward locations where hazard and vulnerability overlap.

The second requirement is targeted technical support. Extension systems can deliver drought-management protocols, soil-water guidance, fire-prevention training and fertilizer-timing recommendations. Experience from Indonesian adaptation research indicates that access to training, information and institutional support materially affects farmers' adaptive behavior. Government should therefore regard extension as climate-resilience infrastructure.

Third, temporary financial support may be necessary. Climate shocks can increase costs exactly when farm revenues begin to weaken. Without liquidity, farmers may defer inputs or borrow under unfavorable conditions. Assistance should therefore distinguish consumption protection from productive working capital. Vulnerable households may require adaptive social protection, while otherwise viable farms may need short-term concessional credit or climate-contingent repayment arrangements.

Any financial instrument must nevertheless avoid encouraging excessive indebtedness. Credit that merely postpones insolvency is maladaptation. Financial support should be linked to realistic farm cash-flow projections, expected lagged yield effects and technical assistance. Weather-index or area-yield insurance may merit pilot testing, but basis risk, farmer understanding, premium affordability and reliable data should be carefully evaluated before large-scale adoption.

Theme 7: Farmer Organizations Can Become Climate-Resilience Institutions

Farmer groups and cooperatives are usually discussed in relation to certification, market access or input procurement. The literature suggests a broader potential role: they can become local climate-resilience platforms.

Collective institutions reduce the transaction costs of adaptation. One extension officer can train a functioning group more efficiently than hundreds of isolated farmers. Groups can purchase inputs collectively, coordinate harvesting and transport, maintain shared pumps or reservoirs where technically appropriate, organize fire patrols, disseminate forecasts, map vulnerable members, and negotiate financing or support from mills.

Evidence from certification and replanting supports this institutional logic. show that pre-existing organization facilitates certification, whereas demonstrate the long-term significance of collective action for replanting and resilience. And likewise indicate that incentives, learning and transaction costs influence farmer participation in sustainability arrangements.

Organization alone, however, should not be romanticized. Weak or elite-dominated groups may fail to distribute resources fairly. Administrative requirements may exclude farmers with insecure documentation. Climate programs should therefore strengthen accountability and inclusivity rather than merely route funds through any organization bearing the label "cooperative."

Theme 8: Multi-Stakeholder Collaboration Is Necessary Because No Single Actor Controls the Risk

The final result is that smallholder El Niño resilience is a collective-action problem distributed across multiple institutions. Farmers control plot-level practices but not climate forecasts, landscape hydrology, public fire-fighting capacity, credit conditions, mill procurement, certification requirements or regional infrastructure. Government possesses regulatory and fiscal authority but cannot observe every farm. Mills have supply-chain relationships but not universal coverage. Banks can provide finance but require risk information. Research institutions generate knowledge but require extension channels.

This interdependence explains why isolated projects often have limited durability. and show that independent smallholders frequently depend on facilitators to overcome institutional barriers. explores organizational solutions to smallholder fragmentation, while Reich and Musshoff (2025) demonstrate that the pathway toward certification remains shaped by access to enabling conditions.

The resilience objective should therefore align incentives. Government benefits from reduced fire and rural economic instability; mills benefit from sustained FFB supply; banks benefit from reduced default; certification bodies benefit from stronger compliance; farmers benefit from protecting yields and livelihoods. These shared interests create a basis for co-financing adaptation rather than allocating its full cost to resource-constrained households [52].

Discussion and Analysis

How Ready Are Independent Oil Palm Smallholders

The evidence indicates that the most defensible answer to the first research question is: readiness is heterogeneous but, for a substantial proportion of independent smallholders, incomplete in the domains most necessary for coping with an exceptional climatic event.

This conclusion does not imply that independent farmers lack knowledge or agency. Smallholders actively adapt production and household strategies to changing conditions. Indonesian and Southeast Asian studies document farmers' capacity to combine experience, local knowledge, diversification and technological response. The critical distinction is between adaptive agency and access to enabling resources.

Climate-information readiness may improve relatively quickly because forecasts can be transmitted electronically and through extension networks. Financial and physical readiness are harder to change. A farmer cannot instantly create a water-storage system, build savings, restore degraded peat hydrology, replace aging palms or establish a functioning cooperative simply because a seasonal forecast becomes alarming. Thus, short lead times expose structural constraints accumulated over years.

Figure 2 presents the six-dimensional framework proposed by this review. It treats readiness as a configuration rather than a binary condition.

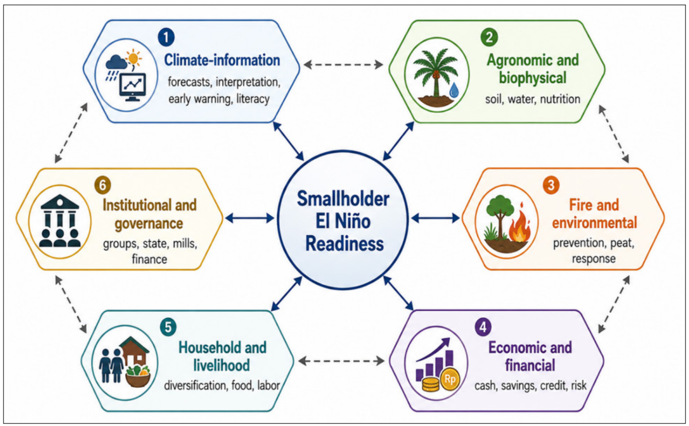


Figure 2: Six-Dimensional Independent Oil Palm Smallholder El Niño Readiness Framework

The framework Illustrates an Important Policy Principle: Resilience Interventions Should Identify binding constraints. A technically Capable Farmer May Primarily Need Affordable Finance. A financially secure farmer may need localized climate guidance. A community on peat may require collective water and fire governance beyond the capacity of any individual household. A newly replanted farmer may need both water protection and temporary income support. Tailoring interventions is therefore more efficient than distributing identical assistance.

The Importance of Delayed Production Effects

A central analytical problem is the temporal mismatch between climatic stress, biological response and observable economic loss. Oil palm's reproductive processes mean that stress can influence yield with substantial lags. The "crisis period" should consequently not be defined as the months in which El Niño indices peak.

This insight changes both household and government planning. Smallholders may experience relatively normal FFB sales during the early dry period and therefore underestimate the need to preserve savings. Later, when weather improves, yield reductions can coincide with the resumption of normal production costs. Banks and policymakers may similarly withdraw emergency attention once rainfall returns, even as smallholder cash flows deteriorate.

Figure 3 translates this biological lag into a policy timeline.

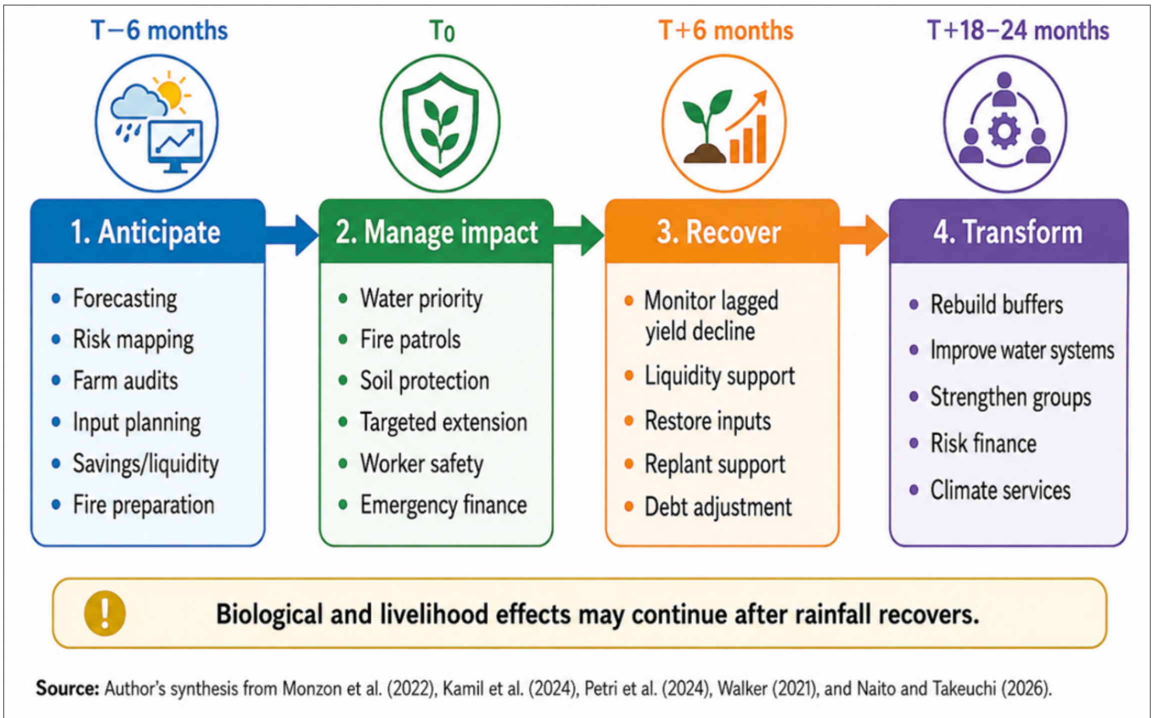


Figure 3: Anticipatory–Impact–Recovery–Transformation Timeline for Smallholder El Niño Risk Management

Figure 3: Emphasizes that Preparedness Should Begin Months Before the Most Severe Expected Dryness and Monitoring Should Continue for Approximately 18–24 Months or Longer Where Local Agronomic Evidence Justifies it. The Precise Lag is not Identical Across Farms; the Diagram Therefore Represents a Planning Horizon Rather than a Deterministic Biological Calendar.

The El Niño Smallholder Vulnerability Spiral

The combination of lagged yield losses and pre-existing yield gaps creates what this review terms the El Niño Smallholder Vulnerability Spiral. The spiral begins when climatic stress reduces productive potential. Declining FFB revenue then tightens household liquidity. Farmers respond rationally to immediate financial pressure by reducing expenditures perceived as deferrable. Yet some deferred expenditures—fertilizer, harvesting, maintenance, fire prevention or replanting preparation—are precisely those that influence future productivity.

The mechanism is supported by several bodies of evidence. identify key agronomic management variables explaining yield gaps; demonstrate that economic and logistical circumstances alter harvesting practices; link management with smallholder economic performance; and shows that livelihood resilience differs according to asset configurations. Together, these findings imply that climate shocks can become endogenous productivity shocks if temporary financial constraints force farmers into management practices that reduce subsequent output.

This mechanism also explains why climate adaptation and poverty reduction cannot be separated. A wealthier farmer may absorb one poor year without materially reducing management quality. A poorer farmer may have to choose between household consumption and plantation inputs. The same rainfall anomaly therefore produces different future productivity trajectories.

Adaptive social protection becomes relevant at this point. Protecting minimum household consumption may indirectly protect plantations by reducing pressure to liquidate productive assets or abandon essential management. Conversely, productive working-capital support may protect household welfare by preventing future yield collapse. Well-designed policy should therefore coordinate social and agricultural instruments rather than treating them as separate sectors.

Sustainable Intensification as Climate Adaptation

Climate adaptation should not be interpreted as a justification for continued plantation expansion into forests or other high-conservation-value landscapes. In fact, climate resilience strengthens the case for sustainable intensification on existing smallholder land. Li (2024) argues that securing smallholder livelihoods without further deforestation requires addressing the performance of existing farms. provides strong evidence that better agronomy offers substantial scope for closing yield gaps on current plantations.

Sustainable intensification in this context means maintaining or improving productivity while protecting soil, water and ecosystem functions and avoiding expansion-driven environmental costs. This approach aligns climate resilience with broader sustainability rather than positioning the two as competing agendas. Groundcover, organic-matter management, appropriate nutrient applications, efficient harvesting and improved planting material can contribute to both yield performance and adaptive capacity.

Certification systems can support this alignment if climate resilience becomes embedded in practical farmer support. However, certification should not become another administrative barrier for vulnerable farmers. and Reich and Musshoff (2025) collectively show that institutional complexity can limit smallholder inclusion. Climate-readiness requirements should therefore be accompanied by financing, technical assistance and simplified implementation pathways.

Avoiding Maladaptation

Not every response that reduces immediate drought stress improves long-term sustainability. The first potential maladaptation is indiscriminate groundwater extraction. Supplemental irrigation can be agronomically effective, but widespread pumping during a severe regional drought could intensify competition for scarce water and undermine local hydrology. Irrigation recommendations should therefore be based on water availability, priority needs and environmental safeguards rather than generalized prescriptions.

The second risk is excessive land clearing within plantations. Removing understory vegetation to create visibly "clean" farms can expose soil and reduce beneficial ecological functions. Management should distinguish between controlling damaging competition and maintaining appropriate groundcover.

Third, peatland drainage must not be deepened in an attempt to facilitate farm operations during extreme conditions. Lower water tables can increase fire risk and carbon loss, creating consequences far exceeding short-term agronomic benefits.

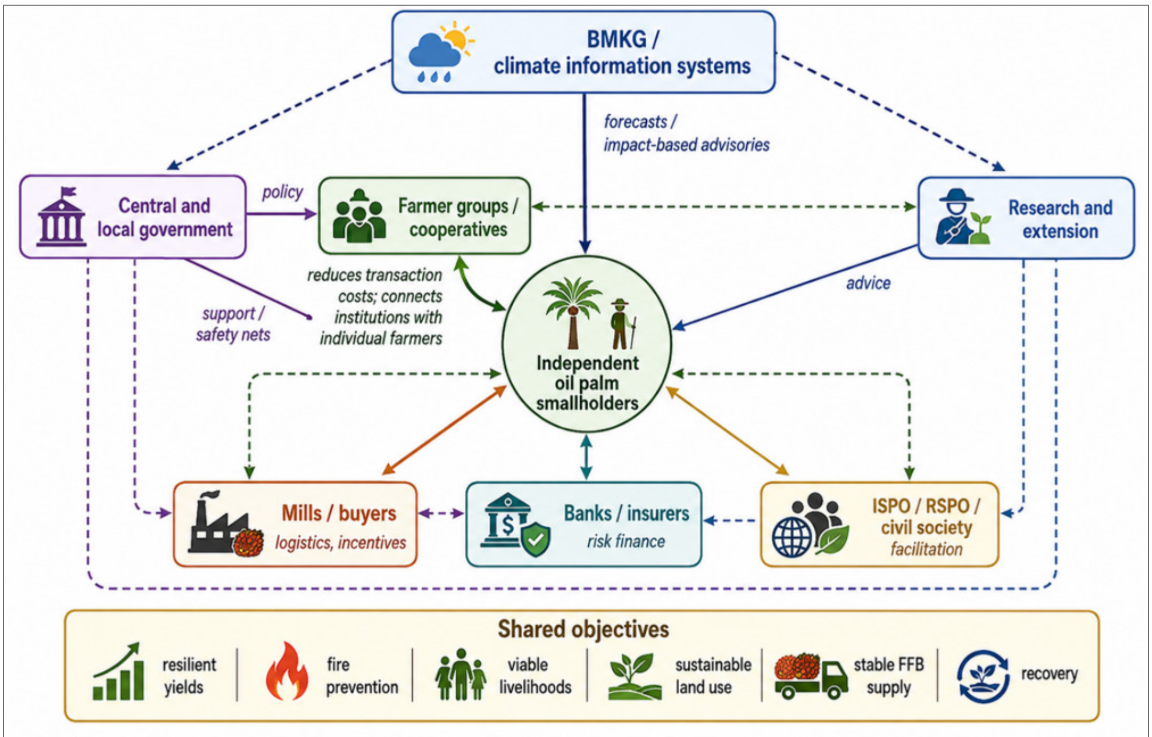
Fourth, poorly designed credit can transform climate stress into a debt trap. Financial products should incorporate realistic post-El Niño yield expectations and, where possible, climate-contingent repayment rather than assuming rapid normalization of cash flow.

Fifth, livelihood diversification should not encourage new environmentally destructive activities. Diversification is valuable when it creates additional income buffers, but it should be compatible with land-use regulation and local ecological capacity.

From Individual Adaptation to Multi-Stakeholder Governance

The second research question asks what combination of interventions can maintain long-term sustainability. The evidence indicates that resilience must be distributed across levels. Farmers need farm-level capacities, but organizations, local government, climate agencies, mills, finance providers and sustainability institutions must address risks that individuals cannot control.

Figure 4 presents the governance architecture implied by this synthesis.



Source: Author's synthesis based on Watts et al. (2021), de Vos et al. (2023b), Jelsma et al. (2024), Witjaksono et al. (2024), Irawan et al. (2024), and Hendrawan et al. (2024).

Figure 4: Multi-Stakeholder Governance Architecture for Climate-Resilient Independent Oil Palm Smallholders

The diagram places farmer organizations between external institutions and individual households because they can reduce transaction costs in both directions. BMKG and extension agencies can distribute localized advice through groups; mills can coordinate harvest logistics; banks can use organized farmer records to improve credit assessment; government can channel targeted assistance; and farmers can communicate local conditions upward.

Mills and buyers have particularly strong reasons to participate. Their continuity depends on FFB supply, and delayed climate effects can reduce throughput. Private-sector adaptation finance therefore need not be framed as philanthropy; it can be treated as supply-chain risk management. Potential mechanisms include co-financed training, shared fire equipment, climate information platforms, input finance with safeguards and incentives for good agronomic practices.

Financial institutions also require better climate-risk information. Rather than reducing lending indiscriminately when El Niño risk rises, lenders could differentiate borrowers according to exposure, farm age, agronomic condition, diversification and farmer-group support. This would help avoid a procyclical response in which precisely those farmers needing working capital are denied finance because the regional climate outlook has deteriorated.

A Sequenced Policy Architecture

The findings support four policy phases.

The anticipatory phase begins once seasonal forecasts indicate materially elevated drought probability. Activities should include risk mapping, communication, fire-prevention preparation, water-source assessment, checking recently replanted farms, input planning, financial-buffer preparation and coordination among local agencies. The aim is to act while farmers still possess normal or near-normal cash flow.

The impact-management phase begins as dry conditions intensify. Priorities shift toward water conservation, young-palm protection, fire patrols, worker safety, localized technical advice, monitoring of pest and plant stress, and rapid liquidity assistance where justified. Recommendations should remain adaptive because rainfall anomalies vary geographically.

The recovery phase should not begin merely because ENSO indices decline. It should be triggered by observed farm and household conditions. Monitoring needs to include FFB output, household cash flow, debt, input use and fire damage. Temporary finance and input support may become more necessary during this phase than during the meteorological peak because lagged yield losses can then become visible.

Finally, the transformation phase converts lessons from the event into permanent resilience. This involves strengthening climate-service systems, upgrading farmer organizations, improving water and landscape governance, institutionalizing fire prevention, integrating climate readiness into ISPO and other sustainability programs, and developing carefully designed agricultural risk-finance instruments.

Policy Priorities for the 2026 Event

Based on the synthesis, ten priority actions emerge.

First, Indonesia should establish an Independent Oil Palm Smallholder El Niño Early-Action Protocol linking BMKG thresholds to predefined agricultural and fire-management actions. This would reduce uncertainty about who acts when risk increases.

Second, national forecasts should be translated into district- and village-level impact advisories. Climate information must answer management questions rather than merely describe ENSO.

Third, recently replanted and young palms should receive priority attention because their developing root systems and households' replanting-related financial exposure create compound vulnerability.

Fourth, fire prevention should be organized at landscape level, especially in peat-containing and historically fire-prone districts. Evidence on peat groundwater levels and targeted fire management provides a strong scientific basis for anticipatory action.

Fifth, agronomic guidance should prioritize soil-water conservation, strategic nutrition, appropriate groundcover and harvesting discipline instead of promoting blanket prescriptions.

Sixth, climate-contingent working capital should be made available to viable but liquidity-constrained farmers, with safeguards against over-indebtedness.

Seventh, adaptive social protection should target households whose consumption security would otherwise force severe cuts in productive farm investment.

Eighth, farmer groups and cooperatives should be funded and assessed as climate-resilience institutions rather than only as marketing or certification organizations.

Ninth, mills and major buyers should participate in resilience financing and logistics because protecting smallholder productivity also protects their future FFB supply.

Tenth, post-event monitoring should continue well beyond meteorological normalization. At minimum, monitoring systems should be designed around the possibility of 18–24 months of lagged biological and livelihood effects, with local data determining the exact duration.

Conclusion and Policy Recommendations

The 2026 El Niño represents a major test of whether Indonesia's smallholder-centered palm oil economy can move from reactive climate response toward anticipatory resilience. The term "Godzilla El Niño" may communicate the exceptional concern surrounding the event, but scientific and policy decisions should remain anchored in formal ENSO monitoring, probabilistic forecasts and locally differentiated impacts.

The first research question concerned the readiness of independent oil palm smallholders. The review concludes that readiness is highly heterogeneous and generally incomplete when evaluated across all dimensions required for an exceptional climatic shock. The primary problem is not simply a lack of farmer awareness. Vulnerability emerges from combinations of water exposure, palm condition, fire risk, limited liquidity, household dependence on FFB income, weak organization, uneven extension access and institutional fragmentation. Farmers who are already constrained under normal conditions are likely to have the least capacity to invest in preventive adaptation.

The second research question concerned the combination of measures required to maintain sustainability. The central conclusion is that no stand-alone intervention is sufficient. Resilience requires simultaneous attention to six interacting domains: climate information, agronomic and biophysical management, fire and environmental protection, finance, household livelihoods, and institutional governance. Weakness in one domain can undermine progress in the others.

The most urgent agronomic priority is not universal irrigation but locally appropriate water and soil conservation, strategic nutrient management, protection of young palms, maintenance of sustainable groundcover and timely harvesting. The most urgent environmental priority is prevention of ignition and protection of fire-prone landscapes, particularly peatlands. The most urgent socioeconomic priority is preventing temporary climate stress from becoming a persistent poverty–productivity spiral in which lower income produces underinvestment and future yield decline.

Government support should therefore begin before production losses are fully visible. An El Niño Early-Action Protocol should link climate-warning levels with predetermined actions covering extension, fire prevention, water management, vulnerable-household identification and financial preparation. Climate services should translate meteorological information into specific agricultural decisions at district, village and farm-group levels.

Farmer organizations should become central delivery institutions. Well-functioning groups and cooperatives can aggregate information, finance, input procurement, harvest logistics and community fire management. Their role should be complemented by mills and buyers, whose own supply security gives them an economic interest in smallholder resilience. Banks and insurers should develop carefully designed risk-finance products, while research and extension institutions should provide location-specific technical guidance.

Policy must also recognize oil palm's delayed biological response to drought. The end of an El Niño event does not necessarily mark the end of its economic effects. Yield, household cash flow, debt, input use and farm condition should therefore continue to be monitored well into the recovery period.

Ultimately, the sustainability question is not whether Indonesian independent smallholders can prevent El Niño. They cannot. The relevant question is whether the institutional environment enables them to anticipate a climate shock, absorb it without destroying productive assets, adapt management practices, recover without entering unsustainable debt or poverty, and emerge better prepared for the next event. Building that capacity would transform the 2026 El Niño from a recurring emergency into a catalyst for a more climate-resilient, inclusive and sustainable Indonesian palm oil sector.

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