

Legal Reconstruction of Chemical Pesticide Use Within Sustainable Agricultural System Based on The Precautionary Principle in Indonesia

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ABSTRACT: The use of chemical pesticides remains a primary instrument in Indonesia's agricultural cultivation system because it is deemed effective in boosting crop yields and controlling plant damaging organisms. However, unregulated pesticide use poses various new environmental problems, such as environmental degradation, and threatens human health through either direct exposure or residual contamination. Although regulations on pesticide use are in place, they have not yet fully integrated the precautionary principle to mitigate future risk. This study aims to analyse the application of the precautionary principle in regulating pesticide use within Indonesia's agricultural cultivation system. This study employs a normative legal research method with statutory, conceptual, and comparative approaches, supported by comprehensive literature relevant to this type of research. The research findings indicate that pesticide regulations have failed to exercise the precautionary function and remain focused solely on production and marketing. Therefore, a reconstruction of the regulations on pesticide risk prevention is imperative to protect present and future generations, as well as all natural elements that maintain the balance of life on earth.

KEYWORDS: Chemical Pesticides, Precautionary Principle, Sustainable Agriculture, Regulatory Reconstruction, Environment.

I. INTRODUCTION

Agriculture in Indonesia serves as a cornerstone for elevating living standards across various dimensions. Societal welfare and economic growth are the direct outcomes of well-managed agricultural sectors (Purwito, 2023). In supporting agricultural development whether managed directly by the government or by independent farmers there must, consequently, be regulatory control over the agricultural sector (Ambarsari et al., 2022). One of the critical areas requiring state regulation in modern agriculture is the management of pesticides. As the agricultural sector expands, chemical pesticides remain the predominant alternative for pest control, both in terms of production volume and application frequently, unregulated pesticide application poses severe adverse effects, including air pollution, ecological degradation, and the accumulation of hazardous chemical waste generated by both industrial and home-based production (Silva et al., 2018).

While modern farmers generally aim to apply precise dosages of pesticides to their crops, various studies demonstrate that such practices still inflict adverse effects on human health due to persistent chemical residues. Furthermore, repeated applications within the same agricultural zone inevitably contaminate critical environmental matrices, including soil, air, and water resources, through cumulative residue exposure (Silva et al., 2018). These ecological disruptions demonstrate that regulatory control over pesticide use must transcend economic and productivity considerations; it must intrinsically encompass environmental protection and the public's right to a healthy and sustainable environment (Ambarsari et al., 2022).

Global concern for the wellbeing of future generations continues to escalate, with a profound emphasis on the dimensions of environmental sustainability (Maulidyna, 2022). The report by the World Commission on Environment and Development (WCED, titled *Our Common Future*, asserts that the development needs of the present generation must be met without compromising the ability of future generations to meet their own needs (Holden et al., 2014).

Within the modern environmental law framework, the precautionary principle serves as a pivotal preventive instrument. This principle dictates that scientific uncertainty shall not be invoked as a reason to postpone protective measures when there is a threat of serious or irreversible environmental damage that could impair ecological restoration and management (Prayoga et al., 2023). Pesticide regulation and control must be fundamentally oriented toward the preventive stage. In this regard, the right to a good and healthy environment is constitutionally guaranteed by the state under Article 28H paragraph (1) of the 1945 Constitution of the Republic of Indonesia (Sihombing & Maharaja, 2026). Furthermore, the principles of sustainability and environmental insight are explicitly enshrined in Article 33 Paragraph (4) of the 1945 Constitution of the Republic of Indonesia as core tenets of the national economic framework. Consequently, the regulatory control of pesticides spans across multiple sectoral legislations, including Law

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No. 22 of 2019 on Sustainable Agricultural cultivation Systems, Law no. 32 of 2009 on Environmental Protection and Management aimed at mitigating ecological pollution, and Law No. 18 of 2012 on Food, which safeguards public interest by ensuring access to safe and wholesome food.

Although pesticide management is governed by various regulation in Indonesia, lax administrative supervision, the marginalization of the precautionary principle, unchecked market distribution, and persistent chemical residues collectively demonstrate an enforcement deficit in the existing legal framework. Consequently, Indonesia's agricultural practices must be anchored upon a robust framework of sustainability that genuinely aligns with statutory mandates for the welfare of both current and future generations. Therefore, a comprehensive legal reconstruction of pesticide regulation and control is imperative to safeguard environmental integrity and ensure long term food security.

II. RESEARCH METHOD

This study employs a normative legal research method (doctrinal research) focusing on the dogmatic analysis of legal norms governing chemical pesticide regulation within the framework of sustainable agricultural practices in Indonesia. This approach is executed by evaluating the coherence among statutory legislations, legal principles, and relevant jurisprudence, with a particular emphasis on the application of the precautionary principle within environmental law.

III. DISCUSSION

A. The Operationalization of the Precautionary Principle Within Indonesia's Regulatory Regime on Chemical Pesticides Under Sustainable Agricultural Frameworks.

The application of the precautionary principle within chemical pesticide regulation in Indonesian is manifested across several cross sectoral legal instruments. These encompass Law No. 22 of 2019 on Sustainable Agricultural Cultivation Systems, Law No.32 of 2009 on Environmental Protection and Management specifically concerning pollution mitigation, and Law No. 18 of 2012 on Food. However, these normative frameworks have not been fully materialized in practise, creating a gap between law in books and law in action regarding the precautionary principle and the protection of public, farmers, and food safety rights. Empirically, a significant knowledge gap persists among farmers regarding the ecological impacts of excessive chemical application, while pesticide waste pollution continues to present widespread socio environment threat (Andesgur, 2019).

The integration of the precautionary principle within the Indonesian legal system is fundamentally demonstrated by the state's regulatory approach toward the circulation of Highly Hazardous Pesticides (HHPs) (L'opez-Bao & Mateo-tom, 2022). While numerous jurisdictions have enacted absolute bans due to the propensity of these chemicals to disrupt soil ecological networks and trigger human carcinogenesis, Indonesia's regulatory framework consistently tolerates compromises through conditional or restricted licensing mechanisms. Furthermore, the scientific testing and environmental impact assessments required for registration rely disproportionately on secondary data furnished by the applicant corporations a loophole that crucially demand the imposition of criminal liability in cases of data falsification on fraud (Ambarsari et al., 2022), such assessments are notably not derived from independent, long term research funded by the state. Consequently, the existing statutory framework fails to mitigate the cumulative ecotoxicological effects resulting from the daily, multi chemical pesticide combinations applied by farmers, which gradually eradicates soil microbiomes and contaminates subterranean aquifers.

To realize sustainable agriculture, the model for applying the precautionary principle within Indonesian law must be radically reconstructed from upstream to downstream. This pivotal step necessitates shifting the burden of proof onto applicants within the agrochemical licencing process (M. Hadin, Muhjad, 2015). The burden of proving that a pesticide product is safe for long term ecosystems must rest entirely upon the manufacturers, rather than placing the onus the government or the public to prove its toxicity after ecological damage has already manifested. If corporations fail to present conclusive science that their chemical products will not degrade biodiversity over the coming decades, then by operation of law, the respective marketing authorization must be revoked or strictly restricted ab initio pre-empt environmental degradation (Schäfer et al., 2019).

The obsolescence of pesticide regulations in Indonesia becomes increasingly apparent when examining how national laws formulate maximum residue limits. Existing frameworks consistently rely on a conventional approach that quantifies acute toxic effects while dangerously neglecting the bioaccumulation of chronic toxicity within the human body over decades (Achza et al., 2025). The environmental quality standards enforced by competent state authorities are persistently outdated, lagging behind the trajectory of global scientific advancements. This regulatory gap is further exacerbated by the slow domestication of international environmental law into national legislation.

Through Law No. 10 of 2013, the Republic of Indonesia officially ratified the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Environmental and health protections under this convention are hindered because its integration into domestic implementing regulations and organic legislation remains profoundly suboptimal. Domestic legal frameworks frequently exploit regulatory gaps within such conventions, deploying the

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pretext of urgent national necessities to justify a continuous reliance on imported hazardous active ingredients under the guise of stabilizing agricultural yields (Kubiak et al., 2023).

A profound institutional challenge within the current administrative framework system from the erosion of the precautionary principle, which opens systemic loopholes for corruption via industry led manipulation of scientific research and data, given that environmental impact assessments and toxicity studies submitted during the pesticide registration process are predominantly generated through internal corporate research, rendering them inherently riddled with severe conflicts of interest (M. Hadin, Muhjad, 2015). Indonesian law not yet possess a rigorous screening mechanism to independently verify the validity of safety claims submitted by these manufacturers, a situation compounded by the fact that domestic academic institutions and research laboratories are rarely engaged in a structured manner by the state due to chronic research funding limitations. Consequently, our agricultural and agrarian legal frameworks are frequently driven by commissioned pseudoscience tailored to serve market interest, thereby reducing the precautionary principle which should fundamentally serve as a safeguard for life into a mere bureaucratic rubber stamp to legitimize the circulation of toxicants across the nation.

The implementation of sustainability within agricultural systems which inherently prioritizes ecological longevity renders circulation a critical regulatory factor, particularly because current frameworks governing the online sale of chemical pesticides represent a major blind spot in state oversight (Weerasinghe et al., 2018). High dose pesticides can be effortlessly acquired without any verification of the buyer's professional expertise in their application, as neither the regulatory frameworks governing sustainable agricultural systems nor those regulating electronic commerce contain synchronized provisions that mandate digital marketplace to halt the transaction of hazardous agrochemicals failing to comply with the precautionary principle.

The establishment of absolute standards based on a zero-tolerance policy for active ingredients listed in Annex III of the Rotterdam Convention must be radically reconstructed to mandate automatic cross sectoral coordination that integrates global standards from the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) into domestic law automatically, thereby bypassing national political bureaucratic processes notoriously rife with corporate agrochemical lobbying. Furthermore, the state must institutionalize substantive criminal liability against public officials who intentionally grant marketing authorizations or provisional research permits for agrochemicals that independent scientific assessments have proven to be persistent organic pollutants and bioaccumulative within living tissues (Solomon et al., 2013).

The integration of the precautionary principle must be deeply embedded within quota restriction policies and phase out schedules for synthetic chemical pesticides, whereby the law must mandate an absolute, non-derogable ban on all pesticide variants listed under global highly Hazardous Pesticides (HHPs) frameworks. These restrictions must not stand in isolation but must be coupled with a statutory obligation for the state to provide affordable biological alternatives, such as biopesticides, to farmers consequently, by shifting the application of the precautionary principle from its originally passive administrative dimension into an active substantive framework, Indonesia's agricultural legal regime can transition from a mechanism that legitimizes toxic chemical exposure into an instrument of ecological protection that genuinely secures the longevity of the nation's food supply (Sihombing & Maharaja, 2026).

Inconsistencies in the application of the precautionary principle in Indonesia have also given rise to tangible socio ecological injustices for smallholder farmers, given that under the current agrarian legal framework, the state systematically shifts the entire burden of environmental health and safety risks onto farmers as end user, while the hazard warning labels printed on pesticide packaging serve merely as a legal shield for corporations absolve themselves of liability in the event of acute poisoning or land contamination. The law turns a blind eye to the reality that the majority of smallholder farmers lack both the financial capital to purchase standardized personal protective equipment (PPE) and the necessary access to information required to comprehend complex chemical terminology (Achza et al., 2025). By allowing hazardous products to circulate unchecked without absolute safety guarantees from manufacturers, the state indirectly legitimizes ecological discrimination, positioning impoverished farmworkers as the commercial continuity of largescale, transnational agrochemical industries that supply developing nations (Tang et al., 2022).

The global institutionalization of the precautionary principle fundamentally crystallized during the 1992 Rio Declaration, which mandated the prevention of impending environmental degradation even when absolute scientific certainty is absent and ecological risks are primarily predictive (Sand, 2000). Within the Indonesian framework, however, this principle remains merely implicit and largely unenforceable in regulating and controlling pesticide distribution consequently, national policy is heavily skewed toward intensifying chemical pesticide usage to boost short term agricultural productivity at the cost of long-term environmental preservation.

Furthermore, the operationalization of the precautionary principle is heavily obstructed by institutional fragmentation and poor intersectoral integration, as pesticide regulations are atomized across environmental, agricultural, and food safety laws consequently, Indonesia remains mired in a regulatory dilemma where these three separate frameworks operate in institutional silos, causing friction and counterproductive clashes that inevitably weaken enforcement mechanisms and compromise long term ecological and food biosecurity (Prayoga et al., 2023).

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Ideally, environmental law must position ecological prevention as its primary objective, contrasting sharply with the reactive, post facto nature of traditional legal paradigms that intervene only after environmental degradation has manifested therefore, the operationalization of the precautionary principle mandates rigorous regulatory oversight over pesticide management, encompassing comprehensive risk assessments, continuous environmental monitoring, and the mandatory restriction or substitution of active ingredients that pose systemic risks to both ecosystems and human health (Tudi et al., 2021).

The urgency of applying the precautionary principle inextricably linked to the inherently toxic characteristics of chemical pesticides will significantly elevate the relevance and efficacy of regulatory oversight, especially since taking early, anticipatory action against unpredictable environmental degradation is vital. Under the sustainable development paradigm, however, pesticides remain economically critical for agricultural yields consequently, the state maintains a parallel obligation to support safe pesticide development to harmonize economic viability, social welfare, and environmental preservation (Popp et al., 2013). The agriculture sector plays an indispensable role in safeguarding both the micro level livelihoods of smallholder farmers and the macro level national economy, thereby serving as a foundational pillar for fostering long term, sustainable economic growth.

Agricultural productivity achieved through intensive pesticide reliance inevitably triggers substantial environmental costs these negative externalities manifested through soil degradation, water source contamination, dwindling biodiversity, and heightened public health risks constitute critical environmental liabilities that must be strictly integrated into the formulation of national agricultural policies.

The regulatory limitations of the precautionary principle concerning pesticide management are further evidenced by systemic health risks inherent to the agricultural sector, as empirical studies increasingly demonstrate that environmental pesticide residues inflict severe, long term health complications upon exposed communities (Nicolopoulou-stamati, 2016). This indicates that the theoretical discourses surrounding pesticide governance must transition into actionable regulatory enforcement, compelling the state to implement preventive policies anchored in the precautionary principle crucially, because the ecological and pathological impacts of chemical pesticides are inherently cumulative interventions are mandatory before the environmental degradation becomes irreversible and widespread.

This risks persists not only within atmospheric and aquatic pathways but also manifests across various mediums contaminated by pesticide residues, demonstrating that current administrative controls remain largely deficient and continuously generate ecological hazards furthermore, existing regulations governing the registration, distribution, and application of pesticides operate merely as formalistic oversight, which remains dangerously detached from actual, dynamic risk assessments (Kalyabina et al., 2021) .

Despite the existence of formalistic distribution regulations, their failure to institutionalize the precautionary principle ensures that pesticide residues remain a deeply contentious ecological crisis consequently, the current regulatory framework fails to reconcile administrative market compliance with actual environmental safety, creating a legal paradox where these formally legal products become substantively illegitimate due to their devastating cumulative impacts. The ecological degradation caused by these chemical agents is uniquely characterized by its protracted timeline and multifaceted risks profile originating from a single product this is exemplified by the progressive depletion of agricultural soil fertility, the contamination of critical water resources essential for human sustenance, and the proliferation of airborne pathologies driven by atmospheric pollution (Silva et al., 2018).

This institutional shortcoming stems from an ineffective regulatory framework that deviates from its primary objective, as the precautionary principle demands a proactive, risk-based approach to mitigate latent, non-actualized future hazard a mechanism distinct from traditional legal remedies. Consequently, Indonesia's rigid adherence to a scientific certainty approach server to delay critical environmental protections, undermining what should fundamentally be an active commitment to concrete, preventive measures (Peter & Kaszuba, 2002). The paradigm pesticide management must extend beyond mere administrative oversight to encompass sustainable application practices indeed, as long as regulatory interventions remain strictly reactive focusing solely on ecological risks that have already materialized overarching environmental objectives will remain unattainable. Consequently, it is imperative to deeply institutionalize the precautionary principle throughout the entire regulatory lifecycle, spanning from the initial drafting of statutes to the implementation of preventive agricultural practices by smallholder farmers.

B. Why the Existing Regulations on Chemical Pesticides in Indonesia Have Failed to Actualize a Sustainable Agricultural Production System, and What Structural Model is Required for its Legal Reconstruction.

A sustainable agricultural system constitutes both an ecological projection and a constitutional mandate that must be comprehensively actualized to guarantee food sovereignty and the fundamental right to a healthy environment in Indonesia (Fahamsyah & Chansrakao, 2022). However, agrarian development Indonesia remains overshadowed by the ecocide pathologies of hazardous chemical pesticides, as current legal instruments fundamentally fail to guarantee environmental sustainability for future agriculture this institutional failure presents a severe crisis that demands a structural legal reconstruction one that pivot toward regulating field application and protecting affected ecosystems, rather than preserving the existing framework that strictly prioritizes formalistic production, distribution, and economic yields.

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Short term economic orientation constitutes the root cause of the current regulatory deficiency although Law No. 22 of 2019 concerning Sustainable Agricultural Cultivation Systems textually incorporates the concept of sustainability, its field implementation continuously treats hazardous pesticides as mere commercial commodities. Consequently, the primary focus of the existing framework remains heavily biased toward streamlining administrative product registration and safeguarding the agrochemical industry's market stability to chase quantitative food production targets. Indonesian regulations have not yet legally classified pesticides as inherently hazardous substances whose distribution must be stringently restricted for the preservation of ecological integrity. As a consequence, the domestic market is inundated with hundreds of pesticide brand, including those formulated with highly hazardous active ingredients this permissive regulatory environment effectively legitimizes the unchecked, mass application of chemical pesticides, paradoxically subverting the state's obligation to protect the environment from ecological degradation.

A pivotal aspect the state must address in reconstructing the legal framework for pesticide management in Indonesia is the substantive reinforcement of state responsibility in environmental protection historically, existing regulations have limited the government's role to that of a passive regulator, merely tasked with setting baseline administrative standards and conducting formalistic oversight of pesticide application (Fahri et al., 2023). However, within the paradigm of modern environmental law, the state must transcend its role as a mere lawmaker to become the ultimate custodian of ecological integrity, guaranteeing the fulfilment of the public's fundamental right to a healthy environment. Consequently, any regulatory framework governing pesticide use must be strictly anchored in the state's proactive obligation to mitigate systemic ecological risks that threaten public welfare. Thus, the precautionary principle must be conceptualized not merely as a technical instrument of environmental management, but as a direct operationalization of the state's constitutional obligation to safeguard human rights.

The strategic direction for reconstructing pesticide regulations must be oriented toward strengthening a preventive framework within legal policymaking this preventive approach holds a paramount position because environmental degradation induced by toxic pesticides is frequently irreversible. In stark contrast to purely economic losses that can be readily remedied through monetary compensation mechanisms, ecosystem collapse resulting from bioaccumulative chemicals persists across generations, meaning that the reconstructed legal framework must never function merely as a reactive mechanism for post disaster dispute resolution (Gonçalves Cezar & Coelho Abrantes, 1992).

Preventive instruments constitute the most effective mechanism for diagnosing systemic vulnerabilities and formulating solutions within environmental law consequently, the precautionary principle executes a critical mandate to safeguard public health and ensure environmental preservation. Ultimately, the accumulation of talent, long term ecological risks will pose an existential threat to society if agricultural governance continues to operate without robust, ex ante preventative interventions (Andesgur, 2019). Once executed, this structural legal reconstruction effectively mitigates systemic risks to the public, and its subsequent implementation firmly anchored in the precautionary principle will ultimately guarantee long term biosecurity and environmental safety.

This inherently passive character of the existing legal framework renders current regulations obsolete in addressing contemporary ecological crises conversely, numerous developed jurisdictions have already enacted total prohibitions on agricultural chemicals categorized as Highly Hazardous Pesticides (HHPs) (Donley, 2019), regulatory frameworks in Indonesia continuously perpetuate loopholes through the issuance of conditional or limited permits, characterized by an opaque and highly secretive oversight mechanism. Consequently, the legal framework fails to rigorously enforce the precautionary principle from an early stage instead, the government tends to prioritize environmental degradation only when it garners substantial public outcry. By the masses, this reactive, firefighting legal approach proves fundamentally incompatible for establishing sustainable agriculture, especially given that restoring a landscape already severely contaminated by chemical toxins requires decades of remediation and exorbitant fiscal expenditures that will ultimately burden the state.

Lax oversight and deficient law enforcement in the field inevitably undermine the structural framework designed to achieve an ecologically healthy environment in practice, the Indonesian Fertilizer and Pesticide Supervisory Commission (KP3), spanning from the central to the regional levels, is frequently incapacitated in executing its statutory functions. Consequently, incapacitated in executing its statutory functions. Consequently, for egregious field violations such as dosage manipulation, the proliferation of counterfeit pesticides, and the direct discharge of chemical waste into river systems the enforcement mechanism remains toothless, as imposed sanctions are strictly confined to minor administrative penalties or temporary product recalls, which fail to minor administrative penalties or temporary product recalls, which fail to deter environmental offenders (Aslina et al., 2016). Consequently, the legal apparatus exhibits a palpable ambivalence, appearing either indifferent or hesitant to enforce justice against powerful corporate giants. To rectify this disparity, the institutionalization of stringent environmental criminal liabilities and substantial civil damages is imperative to ensure that the agrochemical industry is held strictly accountable for the ecological degradation it creates.

At the grassroots level, legal framework exhibits systemic inequity by disproportionately scapegoating farmers as the primary culprits behind pesticide misuse, whereas they are inherently victims of a distorted market structure. State sponsored agricultural

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extension programs, originally mandated to guide farmers toward organic and ecologically sustainable alternative, have long been institutionalized into dormancy. Consequently, the presence of public extension services in the field, both globally and locally, is completely eclipsed by the aggressive marketing campaigns of commercial sales agents, institutional distributors, and corporate agrochemical giants that aggressively promise instant, short term yields (Kinniburgh et al., 2023). Furthermore, the existing legal framework fails to provide concrete economic safeguards for farmers intending to transition to sustainable practices, undergoing this ecological shift inherently exposes farmers to severe risks of crop failure during the initial transitional phases. Due to a regulatory vacuum regarding fair price guarantees or specialized crop insurance for ecologically sound agriculture, farmers make a calculated, rational choice to maintain their reliance on chemical pesticides as an indispensable mechanism for economic survival.

This systemic crisis cannot be resolved by merely amending a few isolated articles currently subject to public debate rather, the protection of the ecosystem and public welfare necessitates a comprehensive legal reconstruction that pivots the orientation of the law away from corporate chemical industries toward environmental sustainability and ecological justice. Concurrently, while an expanding population demands scaled up agricultural productivity to ensure food security, this growth must be harmonized with a structural overhaul of pesticide regulations specifically targeting hazardous chemical compositions and redefining the state's proactive duty to protect its citizens from long term bio risks (Carvalho, 2017). This legal reconstruction must be operationalized by codifying disparate regulations into a unified, specialized statute, such as an act on agricultural chemical governance. Under this statutory framework, the burden of proof must be strictly reversed, legally compelling agrochemical corporations to scientifically demonstrate that their products cause no long-term ecological degradation prior to the issuance of any marketing authorization. Furthermore, this regulation must institute a progressive national production quota system that systematically decreases annually, thereby establishing a definitive, binding timeline for Indonesia to completely eliminate its dependency on chemical pesticides.

This structural reconstruction necessitates a comprehensive overhaul of the existing institutional enforcement architecture it requires either drastically strengthening the currently deficient Indonesian Fertilizer and Pesticide Supervisory Commission (KP3) through a fundamental paradigm shift in chemical risks governance, or alternatively, establishing an independent national agrochemical authority. This newly proposed regulatory body must operate autonomously to oversee the lifecycle of chemical pesticides, free from inter ministerial conflicts of interest, and be placed directly under the administrative auspices of the president.

To effectively combat environmental crimes within the agricultural sector, this high authority agency must be equipped with its own specialized investigative unit, enabling direct and immediate enforcement actions. Furthermore, this institutional framework must rigorously enforce the principle of strict liability against agrochemical corporations consequently, if their products are proven to cause soil degradation or jeopardize public health, these entities are legally compelled to fully finance environmental remediation and public medical care. These expenditures must be drawn from a mandatory environmental guarantee fund deposited by the corporations from the inception of their operations, maintained under a transparent, publicly accountable auditing system to ensure explicit tracking of disbursements for community welfare.

The concept of justice embedded within this precautionary based legal reconstruction fundamentally operationalizes the principle of intergenerational equality, thereby guaranteeing that the current generation's agricultural activities do not compromise the ecological integrity, soil fertility, and public health of future generations (Kabasenche & Skinner, 2014). This concept emphasizes that the present generation bears a fiduciary duty to preserve environmental quality, ensuring that future generations can continue to utilize and inherit a healthy ecosystem. Conversely, the unrestrained deployment of chemical pesticides threatens to inflict irreversible ecological degradation, thereby depriving future populations of their constitutional right to a safe and secure living environment. Consequently, embedding this paradigm within the legal reconstruction of pesticide governance foster a tangible, enduring sense of eco justice and long-term environmental sustainability, specifically by establishing the precautionary principle as a mandatory, binding instrument in state decision making.

Furthermore, the legal framework for pesticides must also be integrated with policies outside the context of pesticides, such as integrated pest management (Achza et al., 2025). To date, the utilization of chemical pesticides remains the primary choice in agricultural cultivation practices due to its perception as the most rapid and effective method. Conversely, the precautionary principle dictates that the deployment of hazardous chemical substances must serve strictly as a last resort, to be exercised only after various safer alternatives have proven incapable of yielding adequate result.

This pest management approach prioritizes biological, mechanical, and agronomic cultural practices as the primary regulatory mechanisms for controlling target plant pests, thereby serving as a crucial turning point in mitigating severe ecological impacts on nontarget organisms, such as bees, arising from toxic residue accumulation (Nicolopoulou-stamati, 2016), conversely, utilization of chemical pesticides must be restricted to a selective basis, founded strictly upon a scientifically verifiable necessity. This operational shift is essential to establish an ecological equilibrium between pest management imperatives and chemical interventions, thereby mutually sustaining agricultural productivity and the surrounding natural environment.

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A tiered classification system must serve as a foundational pillar in the legal reconstruction of pesticide governance within the national regulatory framework. The contemporary regulatory framework merely categorizes pesticides based on their chemical functionality, formulation types, or specific active ingredients. Consequently, this legal reconstruction must institute a risks bases classification matrix, explicitly differentiating among low, moderate, high, and extremely high risks categories (Jepson et al., 2020). This risks-based stratification is legally paramount, as it enables the state to deploy differentiated supervisory standards that are strictly proportionate to the specific ecological and public health threats posed. Consequently, agrochemicals exhibiting high-hazard potentials must be compulsorily subjected to stringent usage restrictions, heightened surveillance, and accelerated periodic re-evaluations, contrasting sharply with the streamlined regulatory pathways permitted for lower-risk alternatives.

Environmental monitoring must be systematically incorporated into the legal reconstruction process. Pesticide oversight has thus far focused primarily on product distribution and mere administrative compliance. Instead, the primary indicator of successful pesticide control should be measured directly by its ecological impact. Therefore, it is necessary to establish a comprehensive environmental monitoring framework to conduct systematic testing for pesticide residues in soil, water, and agricultural product. The data obtained from this formulation of strict usage standards, and the determination of product license renewals. Consequently, state decision making will no longer rely solely on producer generated data, but will be firmly grounded in actual environmental conditions (Hudha et al., 2019).

This legal reconstruction must address the state budgetary system by restructuring existing subsidies. The government must possess the political courage to eliminate subsidies for chemical pesticides that fail to guarantee ecological sustainability and instead merely enrich large scale industries, thereby redirecting those vital public funds toward a direct green subsidy framework for farmers. Furthermore, the regulations must guarantee that farmers utilizing biopesticides or implementing natural pest control systems receive more adequate assistance, including productivity support and fair price guarantees. If feasible, this framework should also provide technological access and product modernization to significantly expand their market outreach.

The law must mandate the establishment of a specialized market for eco-friendly products to ensure that. Sustainable farmers are legally protected. Through this legal reconstruction model which combines strict corporate sanctions with tangible incentives for local farmers the law in Indonesia will no longer merely serve as a handmaiden to the chemical industry. Instead, it will transform into a powerful instrument for social engineering, capable of safeguarding our planet and preserving the livelihoods of our farmers for future generations.

CONCLUSIONS

The application of the precautionary principle within the regulatory framework governing chemical pesticide utilization in Indonesia's sustainable agricultural cultivation systems has not been optimally realized. Although various statutory instruments such as law No. 32 of 2009 on Environmental Protection and Management, law No. 22 of 2019 on Sustainable Agricultural Cultivation Systems, and Law No. 18 of 2012 on Food have established a baseline legal foundation for pesticide control, the precautionary principle has yet to be stringently integrated as the core pillar off policy making. The contemporary regulatory framework disproportionately prioritizes short term productivity and food security over ecological risk prevention, resulting in reactive and fragmented regulatory pesticide governance must be directed toward institutionalizing the precautionary principle as the primary norm, spanning from initial policy formulation and economic balancing to environmental protection, external monitoring mechanisms, and natural resource sustainability.

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