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Reforming Indonesia's agricultural subsidies through the WTO Green Box: Legal pathways for trade, environment, and climate smart agricultural

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Abstract. Indonesia continues to rely on input-based agricultural subsidies, particularly for chemical fertilizers, to maintain food production. However, this approach poses several challenges, including potential environmental impacts from excessive chemical use, trade distortions, and the slow adoption of more sustainable agricultural practices that support Indonesia's climate change adaptation and mitigation goals. Under the WTO Agreement on Agriculture (AoA), subsidies are classified based on their trade-distorting effects, with Green Box subsidies recognized as having minimal impact on trade. This research reveals significant regulatory and implementation gaps between current input subsidy policies, as stipulated in Presidential Regulation No. 6/2025, and the WTO Green Box standards, as well as the Climate Smart Agriculture (CSA) targets mandated by Indonesia's National Determined Contribution (NDC). Therefore, this paper argues that reforming subsidies toward Green Box-compatible instruments by supporting public services, environmental program payments for low-carbon agriculture, and structural adjustment assistance for smart agriculture investments is an important legal reform pathway.

1 Introduction

Indonesia possesses a significant agrarian sector that contributes to national food security, gross domestic product, and poverty reduction. Despite this, the agricultural sector continues to rely on traditional methods passed down through generations, resulting in a high dependence on natural conditions. Consequently, there is a pressing need for transformation within Indonesia's agricultural practices [1]. The government continues to subsidize environmentally harmful fertilizers through fertilizer management programs. Chemical fertilizer subsidy policies not only contribute to greenhouse gas emissions but also causing harmful impacts on the soil in the long term; therefore, farmer reform is not only in terms of fertilizer subsidies but also ensures that Indonesian farmers can switch to the Climate Smart Agriculture (CSA) system to support efficiency, productivity, and sustainability [2].

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Indonesia's latest National Determined Contribution (NDC) report states that agriculture is included among the sectors with mitigation and adaptation targets. Indonesia's NDC targets stipulate that adaptation strategies in the agricultural sector include implementing best practices to promote the economic empowerment of farmers, developing knowledge management for the application of appropriate technologies for commodity-based strategic adaptation, and strengthening climate finance and regional resilience schemes [3]. Agricultural vulnerability is a priority for both the NDC and the most recent Indonesia National Long-Term Development Plan (RPJPN). According to RPJPN, Indonesia's agricultural productivity remains vulnerable to pressure, which creates uncertainty about food price volatility. This problem is driven by farmers' slow development, inadequate training, and limited technology. The reliance on input subsidies has led to a negative trend, despite their intended effect of enhancing productivity and reducing poverty. As a result, a comprehensive examination of its legal and economic structure is required [4].

One of the provisions regulated by the World Trade Organization regarding international trade arrangements in the agricultural sector is the Agreement of Agriculture (AoA). This agreement aims to reform agrarian trade policy to establish a fair and market-oriented system. It requires state parties' commitments to reduce domestic subsidies, export subsidies, and advance market access through the creation of strong and effective regulations and disciplines [5]. Several studies have analyzed Indonesian fertilizer subsidies from the perspectives of implementation and distribution, and their impact on farmer productivity, such as the study by Fatimah et al., which highlights bureaucratic weaknesses and the misallocation of fertilizer subsidies [6]. Moreover, the working paper on the WTO Green Box is also discussed in Banga's research (2016) which reveals the potential for production distortions but does not analysing further in the context of developing countries such as Indonesia, with its dependence on input subsidies [5]. Consequently, this study will fill the gap through a normative approach that reflects the legal pathway for reforming Indonesian fertilizer subsidies to be compatible with the Green Box, supporting the transition to CSA, environmental support, and national food restrictions. This study aims to analyze the current legal structure and policy of Indonesian agricultural subsidies with gaps between regulations and implementation, then outlines a legal pathway for subsidy transition that allows reform of subsidy schemes compatible with developing countries through the WTO Green Box, such as support for General Services, Environmental Programs, and Structural Adjustment Assistance. In addition, this study proposes detailed operational and institutional arrangements to create significant fiscal space to advance the national CSA system and support Indonesia's climate program in accordance with the NDC mandate, demonstrating its relevance for Indonesia's food security and climate commitments.

2 Research Methods

The research utilizes normative legal analysis to scrutinize Indonesia's input-based agricultural subsidy policy, particularly for chemical fertilizers, in relation to the standards of the WTO Agreement, specifically the non-trade-distorting Green Box instrument detailed in Annex 2. This methodology involves examining WTO documents, relevant Indonesian regulations, such as Presidential Regulation No. 6/2025, and academic sources to identify significant legal and implementation gaps between current practice and the implementation gap for Climate Smart Agriculture. The study then uses these findings to argue for and propose concrete legal pathways for reforming subsidies for focusing on instruments that promote sustainable practices, innovation, and climate-resilient infrastructure, thereby strengthening trade compliance while advancing the goals of CSA as mandated by Indonesia's NDC, therefore the operational and institutional reforms needed, including the critical role of digital platforms such as the Farmer Card, to ensure that the new payment mechanism meets the performance-based criteria necessary for WTO compliance and optimal climate demand.

3 Result

3.1 Legal Framework of WTO Green Box Subsidies

The WTO AoA classifies domestic support into several categories based on perceptions of trade and production distortions. The Green box is an action detailed in Annex 2 of the AoA that is considered to have minimal or no impact on trade distortions and is therefore excluded from reduction commitments, allowing countries to provide unlimited support. For an action to be eligible for a Green Box, it must meet the three fundamental criteria outlined in Annex 2, first, there should be no impact, or at the very least, an effect that disrupts trade or impacts on production, secondly, must provide publicly funded government programs, and thirdly it must not involve transfers from consumers or have the effect of providing price support to manufacturer [7]. The Green Box Category provisions in the WTO Agreement on Agriculture have generated much debate if fully applied in Indonesia because the provision of subsidies defined as 'assistance that has no or minimal trade-distorting impact' may threaten the sovereignty of farmers through the possibility of domination of global market mechanisms that ignore the subsistence and small-scale agricultural structure in Indonesia who still relies on fertilizier subsidies, Furthermore, given the reliance of Indonesian farmers, who are still reliant on subsidy support in Indonesia, farmer subsidies cannot be removed [8]. However, Green Box also has development measures to encourage agricultural development through assistance subsidies. This assistance can be provided directly or indirectly as an integral part of the country's development program [9]. The following are key Green Box categories that might be optimized in Indonesia, primarily to support CSA:

1. General Service: Funding public goods such as agricultural research, extension, training, and infrastructure outside of agriculture.
2. Payments based on the Environment Program: Conditional payment of funds on specific production methods that protect the environment (low-carbon agriculture).
3. Structural Adjustment Assistance: Supporting the financial or physical restructuring of the producer's operations in response to objectively proven structural losses [7].

The current Agreement on Agriculture rules allow significant flexibility for the provision of public goods and support for adaptation initiatives within the Public Services category. These include research on environmental programs, early warning systems for pest and disease control, and infrastructure services related to water management [7]. While certain obstacles exist for implementing these goals in Indonesia as a developing country, it remains feasible to support Green Box objectives without compromising food sovereignty. Section 4 will provide further explanation.

3.2 Legal Framework of Indonesia Fertilizer Subsidies

Fertilizer subsidies is distributed in accordance with the seven ideal concept, which includes the right target, appropriate type, quantity, price, time, place, and quality, in order to ensure fair and efficient distribution [10]. The regulation of agricultural subsidies is regulated in Presidential Regulation Number 6 of 2025 concerning the governance of subsidized fertilizers. This law regulates the determination of subsidized fertilizers, including the type, quantity, and target recipients; the procurement and distribution of subsidized fertilizers to farmers; billing and payment systems; the construction of an integrated subsidized fertilizer irrigation system; and supervision and evaluation [11]. The government has begun to

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demonstrate a commitment to improve, however it remains problems with systems and regulations that fail to address the underlying issues. For example, the impact of environmentally harmful fertilizer subsidies and the presidential regulation subsidy scheme is still unable to ensure that farmers may select the kind of fertilizer that optimally fulfills the conditions of their cultivated land, the variations in soil types, crops, and seasons, given to limited types of subsidized fertilizer [2].

4 Discussion

4.1 Regulatory and implementation gaps

When analyzing the impact of subsidies on the environment, according to the WTO, large subsidies such as input price subsidies and taxes will encourage the intensification and extensification of production processes, which can generally harm the environment in the form of exposure to pesticides and fertilizers, habitat damage, and land degradation [8]. Under Presidential Regulation No. 6/2025, the limited fertilizer provision still prioritizes environmentally harmful fertilizers that can degrade soil quality and contribute to greenhouse gas emissions. The excessive use of fertilizer subsidies is not only caused by the lack of guidance and training for farmers on sustainable fertilizer use, but also the current subsidy regulations that still prioritize quantity over quality or efficiency [12], especially since Indonesia has issued the latest NDC document to achieve GHG reduction targets in various sectors, including the agricultural sector [3]. Therefore, there is a gap between Presidential Regulation No. 6/2025 and Indonesia's latest NDC targets.

The second problem is the limited choice of subsidized fertilizers, despite Indonesia's significant soil and plant diversity across regions. Government fertilizer subsidies offer only limited options, covering five types of subsidized fertilizers (Urea, NPK, organic, SP 36, and ZA). As a result, fertilizer efficiency declines, and agricultural productivity is suboptimal [12]. Farmers in acidic soil types, such as in Kalimantan, need fertilizers with a different composition than farmers in volcanic lands in Java. Likewise, rice field farmers have different needs from horticultural farmers. However, the limited choice of subsidized fertilizers forces them to use types that do not always suit the specific needs of their crops and land [2]. Thus, it is suggested that Indonesia needs to shift its limited fertilizer subsidy program and switch to Green Box soil health and performance-based subsidies.

The third concern is a gap between implementation and current regulations when examining the effect of subsidies on food security. The government of Indonesia has implemented further reforms to improve food security, including the Direct Fertilizer Assistance (BLP) program, which enables farmers to obtain fertilizers at no cost rather than purchasing and distributing subsidized fertilizers through distributors. However, several earlier studies indicate that this BLP support is still poorly distributed due to target failures, preventing some small farmers from benefiting, as the subsidy's intended objectives fail to reach remote areas [12].

The fourth issue is that most Indonesian agriculture still faces limitations in implementing smart agriculture, with traditional farmers struggling to adopt digital technologies or data-based precision systems, thereby limiting efficiency, productivity, and climate adaptation. The main challenge identified is the lack of access for small farmers to training, digitalization, and modernization of agricultural tools that can support the implementation of technology-based management [1]. In fact, Indonesia's Enhanced NDC document has formulated an adaptation strategy for the agricultural sector based on digital technology, innovative management, and the provision of weather information systems and early warnings to strengthen farmers' resilience to climate change and increasingly complex production risks.

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Without accelerating the adoption of smart agriculture, the gap in Indonesian farmers' readiness for climate change could widen compared to ASEAN countries that have already digitally transformed [3].

4.2 Integrated Policy and Legal Recommendations for reforms

Research by Cici Aulia, titled "The Impact of Subsidies on Grain Prices and Farmer Welfare," indicates that input subsidy policies should be balanced with complementary measures. Green Box subsidies, which prioritize smart agriculture, may offer a viable solution, particularly given that Indonesian farmers are currently vulnerable to productivity disruptions due to limited adoption of innovative agricultural processes. Nevertheless, fertilizer subsidies remain essential for Indonesian farmers, as this ongoing program is crucial for achieving national food sovereignty [13]. Therefore, here the solution offered is the adjustment of fair input subsidies, while accompanied by subsidies offered by AoA.

4.2.1 Public Services (Paragraph 2 Annex 2)

The Indonesian government may utilize direct public services programmes, including financing for public goods such as research, extension, training, and infrastructure support for farmers, in accordance with the AoA suggestion. In addition to training, the Indonesian government has committed to strengthening the role of agricultural extension by appointing one extension specialist in each village, as provided for in Presidential Regulation Number 35 of 2022 [14]. However, this program still addresses challenges; for example, the number of extension workers does not exceed the required ratio under this Presidential Regulation. In reality, one extension worker guides an average of 2-4 villages, with several factors being a lack of funding and inadequate human resources. In addition, the implementation of Presidential Regulation No. 35/2022 demonstrates inadequate organization in task distribution. Central and regional bureaucratic institutions maintain a centralized structural framework, resulting in extension governance being closely integrated with the Department of Agricultural Services. This department is currently burdened with excessive technical and administrative responsibilities. Consequently, agricultural extension personnel devote more time to administrative tasks at the expense of field extension duties, which should remain the primary focus [15]. To overcome this issue, the Indonesian government must accelerate the equitable distribution of policy implementation while simultaneously restructuring the bureaucratic structure for Presidential Regulation No. 35/2022

4.2.2 Payment for the Environment Programme (Paragraph 12 Annex 2)

These policy recommendations include conditional assistance that may support environmental initiatives that call for specific approaches or inputs, such as low-carbon agriculture programs. However, as previously mentioned, the Indonesian government continues to subsidize environmentally harmful fertilizers. For instance, urea fertilizer has been linked to greenhouse gas emissions, such as nitrogen oxide (N2O) [2]. Therefore, low-carbon agriculture policy reform is required, as it will affect both environmental harm and farmer productivity. Additionally, this policy should provide subsidized fertilizers to both support social assistance and ensure food security.

4.2.3 Structural adjustment assistance (Paragraph 11 Annex 2)

Furthermore, Green Box-based policy recommendations in the AoA that may be improved without affecting Indonesia's agricultural sovereignty include essential restructuring and investment compensation. Reforms to smart agriculture, which previously relied solely on traditional agriculture, are the vital sustainability investment policy recommendations in this case. To achieve this target, the government must start investing in the use of Internet of Things-based technologies such as sensor-based irrigation systems that can reduce water use. This can help the efficient use of water, which can lead to water waste when using traditional methods [1]. However, the implementation of smart agriculture requires investments, therefore Indonesia's agricultural policies, such as counseling and subsidy distribution, that are yet to support smart agriculture, must provide special reforms in the form of investment to increase the quantity and quality of agricultural products.

5 Conclusion

The use of the WTO Green Box instrument is a crucial legal path for Indonesia to reform its agricultural subsidy policy, which currently still focuses on input-based chemical fertilizers, which cause trade distortions, negative environmental impacts, and hinder the adoption of sustainable agricultural practices. These reforms, which go beyond just trade compliance, open up fiscal space and provide opportunities to shift support to non-distorted instruments compatible with the Green Box, such as Public Services (research, training, and infrastructure), Environmental Program Payments for low-carbon agriculture, and Structural Adjustment Assistance for smart agriculture investment. By leveraging the Green Box category, Indonesia can strengthen its commitment to national food security and climate importance mandated in the NDC, while addressing regulatory and implementation gaps, such as limited fertilizer options and slow adoption of smart agriculture, which will ultimately drive the transition to a more efficient, productive, and climate-resilient agricultural system.

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