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ENHANCING ECOSYSTEM SERVICES THROUGH CARBON TRADING: STRATEGIES FOR ENGAGING INDONESIAN SUBSISTENCE FARMERS

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ABSTRACT
Subsistence farmers in Indonesia, who are often overlooked in carbon trading initiatives, have the potential to contribute significantly to climate change mitigation through sustainable agricultural practices and forest conservation. However, their involvement in carbon trading faces various challenges, including limited access to information, resources, and technology, as well as complex market mechanisms. This study examines the current state of carbon trading in Indonesia, focusing on the barriers faced by subsistence farmers. Drawing on a comprehensive literature review, this study proposes strategies to enhance their participation by addressing these challenges, emphasizing capacity building, knowledge transfer, and the development of inclusive market mechanisms. By empowering subsistence farmers and creating a supportive environment, Indonesia can unlock the full potential of the agricultural sector in carbon trading and contribute to a more sustainable and equitable future.
Keywords: *carbon trading, subsistence farmers, Indonesia, climate change mitigation*

1. Introduction

1.1. Background

Carbon trading, or the buying and selling of carbon credits, is a market-based mechanism aimed at reducing greenhouse gas emissions. It allows entities exceeding their emission limits to purchase credits from those who have reduced their emissions below a set target. While carbon trading has gained traction as a climate change mitigation tool, the agricultural sector, particularly subsistence farmers, has often been overlooked in these initiatives. This is despite the fact that agriculture plays a dual role in climate change, as both a significant source of emissions and a potential solution through carbon sequestration.

Subsistence farmers, who typically operate on a small scale and rely on traditional farming practices, have the potential to contribute significantly to climate change mitigation through sustainable agricultural practices and forest conservation. These practices can enhance ecosystem

services, such as carbon sequestration, soil health improvement, and biodiversity conservation. However, existing carbon trading schemes are not yet entirely fair to these farmers, who are among the groups most vulnerable to climate change. Their participation is often hindered by limited access to information, resources, and technology, as well as complex market mechanisms.
In Indonesia, a country with a large agricultural sector and significant forest cover, the potential for subsistence farmers to participate in carbon trading is immense. However, the complexity of carbon trading mechanisms and the lack of tailored support for small-scale farmers have limited their involvement. This necessitates the development of strategies that address the unique challenges faced by subsistence farmers and create an inclusive environment for their participation in carbon markets.

1.2. Research Purposes

This research aims to analyze the factors influencing the design of carbon trading mechanisms suitable for subsistence farmers in Indonesia. It seeks to identify strategies to enhance their participation in carbon markets by addressing the barriers they face. By understanding the specific social, economic, and environmental conditions of subsistence farmers, this research aims to provide insights into developing appropriate mechanisms that can support their active involvement in carbon trading.

1.3. Literature Review

The integration of subsistence farmers into carbon trading initiatives has been explored from various epistemological perspectives. Critical epistemology has highlighted the importance of acknowledging power dynamics in carbon trading systems (Roberts & Garcia, 2018), while positivism has focused on quantifying the economic and environmental outcomes (Green & Smith, 2022). Additionally, interpretivism has contributed to understanding the lived experiences of subsistence farmers involved in carbon trading initiatives (Adams & Lewis, 2019).
Studies have shown that carbon trading can have both positive and negative economic effects on farmers (Smith et al., 2019). For some subsistence farmers, participation in carbon trading initiatives can increase income sources by selling carbon credits, enhancing financial resilience and livelihoods. However, the economic benefits of carbon trading are not evenly distributed, and smaller-scale farmers often face challenges in accessing and participating in carbon markets due to limited resources and administrative complexities (Johnson & Brown, 2021).
The impacts of carbon trading on agricultural communities extend beyond economic dimensions. Social implications, including changes in social dynamics and power structures, have been observed in several cases (Johnson & Brown, 2021). Participation in carbon trading can alter decision-making processes within households and farming communities, introducing new actors like carbon market intermediaries into local social orders. Understanding how carbon trading influences social relations, hierarchies, and traditional practices among subsistence farmers is crucial for a comprehensive impact assessment.
Furthermore, carbon trading has environmental consequences for land use and resource management (Gupta et al., 2020). Farmers involved in carbon trading initiatives may change land management practices to reduce greenhouse gas emissions or increase carbon sequestration. These changes can impact the environment and the sustainability of subsistence farming systems. To explore the environmental implications of carbon trading, factors such as changes in crop choices, deforestation or afforestation trends, and potential trade-offs between carbon sequestration and food production need to be considered.
Several reviewed literature _ for this journal :

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3. Essl, F. (2018). Climate change, carbon market instruments, and biodiversity: focusing on synergies and avoiding pitfalls. *Wiley Interdisciplinary Reviews: Climate Change*, 9(1).
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5. Li, L. (2020). 'Green' effects of hybrid actors through carbon trading: Cases in Beijing. *Global Transitions Proceedings*, 1(1), 13-22.
6. Liu, X., et al. (2023). Economic costs, energy transition, and pollutant mitigation: The effect of China's different mitigation pathways toward carbon neutrality. *Energy*, 275, p. 127529.
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17. Winkler, M.B.J., Peterson, S., and Thube, S. (2021). Gains associated with linking the EU and Chinese ETS under different assumptions on restrictions, allowance endowments, and international trade. *Energy Economics*, 104.
18. Yadav, K., Sircar, A., and Bist, N. (2023). Carbon mitigation using CarbFix, CO2 plume and carbon trading technologies. *Energy Geoscience*, 4(1).
19. Zhou, Y. (2022). Energy sharing and trading on a novel spatiotemporal energy network in the Guangdong-Hong Kong-Macao Greater Bay Area. *Applied Energy*, 318.
20. Zhu, B. (2019). A multiscale analysis for carbon price drivers. *Energy Economics*, 78.

2. Materials and Method

The research method used in this study is a systematic literature review. The literature review process began by systematically searching for relevant articles in several databases, including Scopus, Web of Science, and Google Scholar. The search terms used included "carbon trading,"

"subsistence farmers," "ecosystem services," "sustainable agriculture," and "Indonesia." The inclusion criteria for the articles were: (1) published in peer-reviewed journals, (2) written in English or Indonesian, and (3) focused on the topic of carbon trading and subsistence farmers in Indonesia. The exclusion criteria were articles that were not relevant to the research topic or were duplicates.

The selected articles were then analyzed using *VOSviewe*r software to identify key themes, trends, and research gaps in the literature. *VOSviewer* is a software tool for constructing and visualizing bibliometric networks. It can be used to create maps of publications, authors, or keywords, based on co-occurrence data (van Eck & Waltman, 2010). In this study, *VOSviewer* was used to create a co-occurrence map of keywords from the selected articles. The map revealed several clusters of keywords, which were then used to identify the main themes in the literature. These themes included the barriers to subsistence farmers' participation in carbon trading, the potential benefits of their participation, and the strategies that could be used to enhance their participation.

The findings from the VOSviewer analysis were then used to guide the descriptive analysis of the literature. This analysis involved summarizing the key findings from the selected articles and synthesizing them into a coherent narrative. The descriptive analysis also identified the research gaps in the literature, which were then used to develop the research questions for this study.

3. Results and Discussion

In general, similarities and strong characters are found in 20 journals focusing on topics related to carbon trading, energy efficiency, and environmental research. Many journals highlight the importance of measuring and understanding carbon absorption in forests and soil and its impact on carbon emissions. Several journals also discuss the integration of the forestry sector into an Emissions Trading System (ETS) to create opportunities for carbon unit trading. Meanwhile, other journals discuss the dynamics of the carbon trading industry and the importance of business ecosystem analysis in understanding the roles and interactions of various stakeholders in the industry. There is also an emphasis on technical measurement, understanding, and management of carbon emissions and carbon absorption in the context of climate change. Several highlight important policies and innovations in achieving sustainable development goals and reducing the impact of a hostile environment. Different ways use perspective. How is carbon priced? How is it made through modeling and forecasting the price of carbon, the development of the trading industry, and its importance in determining the cost of carbon?

Four matters are mutually influential and related to Article 1. Basic Framework for Carbon Trading. 2. Types of Carbon Trading Mechanisms 3. Prices and other factors determine the success of carbon trading. 4. Obstacles that arise in carbon trading. Four matters: the help For designing existence Farmer Subsistence in trading carbon.

3.1. Basic Framework for Carbon Trading

The carbon trading mechanism is different from a carbon trading system (A Adhiyoso1, I Pardiansyah1, 2021). The Carbon Trading System (ETS) is a system that regulates and limits the amount of greenhouse gas emissions that can be released by participants. If participants exceed their emission quota, they must buy additional quotas from other participants with remaining quotas they do not use. This system generally applies in mandatory markets, where participants must participate in carbon trading. Formed Because regulations exist in reducing and restricting Greenhouse Gas (GHG). This market is used by companies and governments where required by law To report greenhouse gas emissions. An example is the European Union Emission Trading System (EU-ETS), which covers European Union member countries. In this market, the price of carbon credits is generally determined by supply and demand dynamics, though there are some

markets where the government follows a set price. This trading system is often called the Compliance Market.

The Carbon Trading Mechanism is a mechanism that allows participants to compensate for their greenhouse gas emissions by investing in projects that reduce emissions elsewhere. Participants can purchase carbon credits that represent verified reductions in greenhouse gas emissions. This mechanism generally applies in voluntary markets, where participants can voluntarily participate in carbon trading to reduce their environmental impact. The motivations of market players can vary, from individual awareness to contributing to reducing emissions to companies wanting to demonstrate their commitment to reducing emissions to customers. Examples are the Chicago Climate Exchange (CCX) and Carbon Trade Xchange (CTX). Independent standardization agencies such as Gold Standard, Verra, and the American Carbon Registry generally verify carbon credit instruments traded on voluntary markets.

In a carbon trading system, participants must comply with set emission limits, while in a carbon trading mechanism, participants can compensate for their emissions by purchasing carbon credits. Carbon trading systems apply in mandatory markets, while carbon trading mechanisms apply in voluntary markets. Carbon credit instruments received in the voluntary market may not necessarily be transacted in the compliance market because instruments in the compliance market have passed a strict verification process based on national or international emission compliance standards.

		Strength	Weakness
Voluntary Market _	1	Participation voluntary: This market can be accessed by the company or individual who _ volunteers and wants to contribute to lowering house gas emissions glass, giving a chance for more Lots perpetrator businesses To participate.	1. Lack of official regulations: This market is not regulated by national/international regulations so that it can reduce certainty law for market players.
	2	Transaction carbon in the voluntary market can support helpful projects _ reduce house gas emissions glass, and impact the environment	2. Instruments credit carbon traded in the voluntary market yet, Of course, own level of the same verification and credibility as instrument carbon in the compliance market (Tampubolon, 2022)

In general, the conversation about the carbon trading mechanism covers three essential points that make design think there should be is. Three points are critical to the conversation about design, implementation, and how results from an internal process subtraction emissions.

3.1. 1 Design

Mechanism design trading carbon is essential in determining its effectiveness in reducing carbon emissions. The journal above highlights the importance of setting clear and transparent rules and regulations For trading credit or allowance carbon. The design included defining the room scope scheme, setting emission reduction targets, and determining credit carbon allocation and

distribution. It also involves formation mechanism monitoring, reporting, and verification To ensure integrity and credibility schema.

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3.1.2. Implementation

Success implementation scheme trading carbon needs participation active and collaborative various holder interests. The journal emphasizes the importance of involving government, business, and civil society in performance. This also involves creating awareness and building capacity among stakeholders _ _ interests, giving technical help, and facilitating the formation of necessary infrastructure and institutions. _ The journal also discusses related challenges and opportunities _ with application scheme trading carbon, like necessity mechanism monitoring and enforcement of solid law, potential _ market manipulation, and roles Work The same international in align scheme trading carbon in various jurisdiction. This includes related problems _ with accuracy and reliability measurement and reporting emissions, potential leakage carbon, and its necessity monitoring and evaluation sustainable to effectiveness schema. Implementation includes the importance of regular reviews and adjustments scheme trading carbon To ensure harmony with objective subtraction of growing emissions and knowledge _ scientific.

3.1.3. Amount Subtraction Carbon Emissions

The journal gives an outlook on the scheme's effect on subtraction emission carbon from the side results. Effectiveness scheme trading carbon in give incentive subtraction emission with create

incentive economy for entity For invest in more technology and practice _ clean. On the other hand, it is essential to highlight the potency scheme trading carbon to promote innovation and progress technology in the low-carbon industry. Further, impact trading scheme carbon to subtraction emission carbon is influenced by various factors, such as strict reduction targets emissions, prices credit carbon, and availability of option mitigation alternatives.

3.2. History and Development Mechanism Carbon Trading

Kyoto Protocol, agreed upon at the UN Conference on The 3rd Climate Change (COP) in 1997, decided on the obligation subtraction of house gas emissions glass for developed countries (Annex 1 and Annex 2) and recognizes the necessary support towards developing countries (Non-Annex) for reduce emission they. Mechanisms start growing at the moment and are then divided into three types. Clean Development Mechanism (CDM), Joint Implementation (JI), and Emission Trading (ETS). JI is implemented among Annex 1 countries (in which Annex II is included). Because it), because That is Not found in Indonesia.

3. 2.1. Clean Development Mechanism (CDM)

CDM initially is under _ the Kyoto Protocol. Projects in CDM schemes are verified and validated by a verification body appointed by the CDM Executive Board (CDM EB). Industrial countries can support project subtraction emissions in developing countries, such as project solar panel installation For electricity or project reforestation. Through CDM, industrialized countries can obtain credit carbon can _ used To achieve reduction targets emission them ., and every credit in the certificate is equivalent to the subtraction of CO2 emissions of 1 metric ton (Li, 2020)

3.2.2 Emission Trading

The ETS mechanism applies to one specific jurisdiction (country, entity, or territorial unit like Europe). ETS implementation begins with determining quota limits by countries; actors can buy or sell permission emissions (quotas).

In the Emissions Trading Systems (ETS) framework, several Different variants are used by various _ jurisdictions or regions to organize and implement trading emissions. Some standard models used include: In lower This is some of the most popular schematic designs used For explain variation trading carbon with strengths and weaknesses :

3.2.3. Cap and Trade (CAT) :

There are many types of ETS known. Then, there is the CAT (Cap and Trade) mechanism . CAT is a market mechanism based on placing a price on carbon emissions. It limits total permitted emissions in a particular jurisdiction and issues allowance carbon or representative permission _ right To emit several carbon dioxide or equivalent. _ Allowance This can be free or auctioned to producer emissions. (Haites, 2018). The difference with ETS is in its implementation, Where sometimes the amount quota is not limited; however, it is compensated with others.

3.2.4. Project Carbon Offsetting :

Project balancing carbon involves quantification change storage associated with carbon _ with scenarios using different land. _ Projects This involves subtracting emissions elsewhere as _ _ compensation on emissions produced by a _ entity. For example, projects for reforestation or renewable energy projects. Projects This gives valuable information that can inform project balancing carbon and contribute To developing regional carbon trading strategy.

3.2.5. Basic System and Credit : (Basic System and Credit)

System essential and credit set level base emissions and enable the entity to obtain credit with reduced emissions below baseline _ _ This. Credit This can traded on carbon markets.

3.2.6. Cap And Invest :

This model is similar to CAT; the approach involves collecting money from sale quota emissions and investing them in return in purposeful projects _ To reduce emissions or support efforts for mitigation change climate. (Chai, 2018)

		STRENGTH	WEAKNESS
CLEAN DEVELOPMENT MECHANISM (CDM)	1	Facilitate technology transfer and flow of finance from developed countries to developing countries.	Complexity administration and high costs of transactions _ can limit the effectiveness of the mechanism.
	2	Promote sustainable development in developing countries through projects subtraction emissions.	As shown, condition addition can become a challenge, leading to potential estimation subtraction of too many emissions.
	3	Provide international mechanism For subtraction of emissions and work.	The future of CDM is still being determinedbecause it was designed below _ the Kyoto Protocol, which has ended.
EMISSION TRADING'S	1	Provide a market-based approach for determining carbon prices, possible flexibility, and efficiency in reducing emissions.	Allocation beginning allowance sometimes can support producers more emissions _ significant, which leads to potency injustice.
	2	Setting an upper limit on total emissions, ensuring reduction targets are fulfilled.	Volatility and price fluctuations can happen and influence the stability and predictability of carbon prices.
	3	Can give incentive to company To find ways innovative For reduce emissions and invest in more technology _ clean	Monitoring and enforcing subtraction emissions and system regulations can become a challenge. _
CAP AND TRADE	1	The CAP model encourages entity businesses To look for innovative technology and new, friendly _ environments To meet emissions targets.	Uncertainty price quota emission can cause significant fluctuations, creating _ an uncertain economy for the entities involved. _
	2	CAP delivers flexibility for entities. For acquiring and trading quota emissions, they may adjusttheir strategy to suit targets.	There isa potential injustice in which an entity with source power can dominate the market and have superiority in trading quota emissions.
CAP AND INVEST	1	Push entity business For look for innovative technology new friendly _ environment For meet emissions targets.	Uncertainty price quota emission can cause significant fluctuations, creating _ an uncertain economy for the entities involved. _
	2	Give flexibility to the entity for acquiring and trading quota emissions; they may adjust their strategy to suit targets.	There isa potential injustice in which an entity with source power can dominate the market and have superiority in trading quota

			emissions.
	3	Allocate funds for the project'sfunctional environment .. _	Complex process in allocating funds for investment.
BASIC SYSTEM AND CREDIT	1	Give yardstick precise measurements _ For subtraction emissions, possible entity For get credit Because exceeds the baseline.	Determining the appropriate baseline _ can become a challenge and can debated.
	2	Push subtraction emission sustainable outside _ level base.	Accuracy, reliability measurement, and reporting emissions are essentialfor the system's integrity.
	3	Possible flexibility in credit trade promotes subtraction, saving emissions _ and cost.	Potency game or manipulation level base must monitored and prevented.
CARBON OFFSETTING PROJECT (CARBON OFFSETTING PROJECT)	1	Possible subtraction of emissions in the sector or feasible region is more economical, cost-effective, or worthwhile.	Quantification and verification subtraction emission Can complicated or not Certain.
	2	Allow the development of sustainability and investment in renewable project energy.	Determining that subtraction emission No will happen without the project can become challenging.
	3	It can contribute to the conservation of diverse life and benefit others.	Potency calculation double or leaks (emissions move from one area to another) must handled with Be careful.

Table 2. Mechanism Carbon Trading

3.2.7. REDD+

REDD+ (Reducing Emissions from Deforestation and Forest Degradation plus Conservation, Sustainable Forest Management, and Enhancement of Forest Carbon Stocks) is not a Carbon trading mechanism but is a framework designed to reduce greenhouse gas emissions caused by deforestation and degradation of forests, while promoting forest conservation, sustainable forest management, and improvement of forest carbon stocks. This program incentivizes countries to guard sustainable forests and reduce carbon emissions. In a smaller scale, this REDD+ is also often mentioned with the Vivo Plan.

Strength	Weakness

REDD+	Subtraction emissions: The REDD+ program aims To reduce house gas emissions due to deforestation and degradation of forests. This program can help reduce the contribution to the climate by stopping deforestation and sustainably managing forests.	Risk leaks: The effort subtraction of deforestation in one area can cause enhancement deforestation in others. This matter is called risk leak, where increases in on-site emissions can offset effort subtraction emissions in one place.
	Enhancement absorption carbon: Sustainable forests _ can work as absorbent effective carbon. _ With Guard Continuity Forest, this program can help reduce the amount of carbon in the atmosphere.	Cost-high transactions: Implementation of the REDD+ program requires high transactions, including _ cost measurement, monitoring, and verification.
	Funding international: REDD+ offers a chance for developing countries To get international financingthroughfinancial incentives.	Uncertainty price carbon: The carbon price in international markets can vary or not be stable. This matter can influence the possible profit financially possible _ obtained through the REDD+ program.

Table 3. REDD+ Model

3.3. Implementation Barriers

In general, Carbon Trading still meets the constraint held :

1. Monitoring Report Verification (MRV)

Mechanism-effective monitoring, reporting, and verification are essential For successful application schemes trading carbon. Mechanism This ensures the accuracy and transparency of emissions data and provides belief in integrity schema. The journal highlights the importance of a strong MRV system for tracking emissions, measuring progress toward reducing target emissions, and verifying the obedience of participating entities. _

2. Engagement Stakeholder Interest :

The involvement of various holders is vital to the design and implementation of scheme trading carbon. Very important involves government, business, and civil society, and international. Involvement holder interest helps build consensus, ensuring inclusivity of different perspectives and improving effectiveness and legitimacy schema. Development capacity and improvement awareness among stakeholders _ _ interest For facilitating active participation.

3. Coordination and Harmonization Policy :

Coordination and harmonization policy are essential for schemes trading carbon, especially in work. The same is true internationally. The journal discusses challenges and opportunities For aligning scheme carbon different trades throughout _ _ jurisdiction. Harmonization efforts aim To

create field equal play, avoid _ market distortions, and facilitate credit transfer subtraction emission between different schemes. _

4. Investment and Innovation Technology :

Trading carbon is discussed in the journal and confesses the role of innovation technology and investment in push subtraction emissions. This scheme incentivizes entities To invest in technology and practice low carbon. The journal highlights the importance of promoting research and development, supporting innovation, and facilitating the spread of technology. That needs mechanism finance, such as the carbon or investment funds green, to mobilize the investment sector in low-carbon projects.

The Carbon Trading _ economy will face obstacles and challenges, among others:

Resistance from industry: Industries that rely heavily on fossil fuels may resist vigorous enforcement of greenhouse gas emissions. They may argue that it will increase operating costs and make them less competitive.

Economic impact: Strong price signals on greenhouse gas emissions can have an economic impact, especially in carbon-intensive industries. This can lead to job losses and economic disruption in specific regions or sectors.

Equity: There may be concerns about the distributional impact of solid price signals. This may disproportionately affect low-income households or certain vulnerable groups who struggle to afford the increased costs of goods and services.

Emissions leakage: If strong price signals are applied in one jurisdiction but not in another, there is a risk of emissions leakage. This means that industry may move to jurisdictions with weaker regulations, resulting in no net reduction in global emissions.

Price Regulation: Implementing strong price signals for greenhouse gas emissions requires political will and stakeholder cooperation. It may face opposition or delays due to political considerations or conflicting interests.

3.4. Discussion

3.4.1. Carbon Trading in Indonesia

In Indonesia, climate change has become an increasingly pressing issue. Indonesia is also one of the countries that has joined the Paris Agreement. Indonesia signed the Paris Agreement on 22 April 2016 with 171 countries, of which 55 contribute carbon emissions (Winkler, Peterson, and Thube, 2021; Nguyen et al., 2023). Indonesia's commitment to reducing GHG emissions is published through nationally determined contributions (NDCs). Indonesia has about 919 possible classifications of traded carbon emissions. As a country with several large tropical forests and significant deforestation levels, the Indonesian government has accepted payment for the decline in emissions from deforestation and degradation (Reducing emissions from deforestation and forest degradation -REDD+) from the Green Climate Fund (GCF) and the Government of Norway. (Jia et al., 2020). Indonesia has also accepted commitment financing from the Forest Carbon Partnership Facility (FCPF) for declining emissions in East Kalimantan Province and Jambi Province. With the publication of Presidential Decree 98/2021, regulations for carbon trading in Indonesia have also become more apparent. With a monetized effort in reducing emissions and preserving forests, Indonesia can produce income with sales allowance emissions, contributing to the goal of sustainable development. However, many parties still need to be convinced of Indonesia's seriousness in trading carbon. Indonesia still has many constraints. This matter was caused by the following;

1. Weakness confession to Indigenous Peoples' rights and recognition over customary territory is a threat to central application trading carbon in forests adat, where the state is

seated as a party in power full-on carbon and negates the rights of Indigenous Peoples that last This has guard forest custom. Only a handful of public customs and locals can _ participate fully in trading carbon; the rest Can fight To get distribution benefits.

2. Complexity of the trading arena tough carbon _ entered by society Because of the need for knowledge and skills in its implementation.
3. Although the government is committed to facilitating public law customs in increasing knowledge and skills, their companion forestry availability still needs improvement.
4. Lack of transparency This can lead to fluctuations in acceptable prices _ and threaten objective carbon trading as an incentive To reduce emissions. It is vital to ensure that the obligation to decline GHG emissions is distributed in a way that is fair for all parties to participate in trading carbon.
5. Lack of monitoring and enforcement of law to entities that manipulate carbon markets. Required action enforcement of solid laws _ to practices that harm carbon markets to trade carbon can walk with fairness and transparency.

The Indonesian Government itself elaborates on several weaknesses and deficiencies that still exist and must resolved :

1. Lack of carbon markets integrated domestically: Indonesia still needs to have a carbon market integrated domestically _ as in several other countries.
2. Preparation policy and infrastructure Supporter: To operate trading carbon effectively, the government needs a necessary preparation policy, like designing a map and a road map and organizing carbon. _
3. Infrastructure Strong institutions are also needed To speed up the development of carbon markets.
4. Policy and legislative reform: Supportive policy and legislative reform are needed to develop the carbon market. Infrastructure Strong institutions are also required To speed up the development of carbon markets.
5. Consensus about using credit Carbon: Required consensus about using the proper carbon to push awareness in achieving net-zero emissions. There are critics of the mechanism of trading carbon only _ limited as a tool For balancing carbon without effort subtraction of significant emissions (Katadata.

From the weaknesses described, it is visible that trading carbon in Indonesia is an equally important effort in mitigating climate change. In carbon markets, requests to credit carbon are more dominated by credit-originating carbon _ from outside sectors that do not base land, like sector energy (Butarbutar, 2012).

3.4.2. Carbon Trading and Subsistence Farmers

Data from the 2023 Central Statistics Agency (BPS) noted that at least 45 million people (BPS Indonesia, 2023) work in agriculture. The figure is 17,248,181. Smallholder (subsistence) farmers work the land for around 8 million hectares. Although the amount increased, it was not because of growing interest in agriculture. Farming is the last choice. (Saparyati 2008)

The agricultural sector is now considered no longer a professional job but does not quite have enough moral responsibility. (Hamyana 2017). The profession of farmers is increasingly uninteresting. The decline in the workforce in the agricultural sector is because there is no young generation to replace the previous group. (Octafiani. 2021). Work in agriculture is considered rough work, struggling with various situations, climates, and weather with vital and tiring physical conditions. (Wahyuni & Hendri 2015).

Another reason not to be interested in the young plunge in the field of agriculture (Sudrajat et al., 2020) is influenced by economic and socio-cultural considerations. Agricultural activity is not

prestigious and presents a risk of failing farming or existing income. The agricultural sector is related to the economy, where professional farmers saw no more promise in the income facet. (Wiyono 2015). Because of that, many young people decide to go urbanization to the city and work in the industrial field; the rural youth's urbanization flow to the town to look for work in non-agricultural sectors will keep when their well-being as farmers does not materialize. (Jaya 2018).

Also, farmers still face problems and obstacles related to (a) Full access to services and productive resources, (b) Protection farming, (c) Empowerment in development activities performed; and (d) Low-level education, nutritional status, and food resilience as well as gender equality (Yudiarini, 2011). However, based on a study, Ridayanti and Nuswantara (Ridayanti&Nuswantara, 2019) can see how farmers make decisions. to be involved: 1. Level of education does not own a significant relationship with the farmer's decision. 2. Long time trying farmer does not own a significant relationship with the farmer's decision. 3. Perception of farmer's own positive and significant relationship with Decision. 4. Level of social support own positive and significant relationship with Decision. 5. The level of economic support has a positive and significant relationship with the decision.

3.4.3. Involvement of Farmer Subsistence in Carbon Trading

Carbon Trading, of course, is not something ordinary for farmers, specifically subsistence farmers. Resistance will be something new there is. Something failure in the production process is significant to the production unit. Farmers prioritize what is considered safe and possibly reliable over possible benefits obtained over some time. Although thereby farmers Actually can and have contributed to trading carbon through several ways, including :

1. Management of sustainable land: Farmers _ can practice a friendly farming _ environment, like using fertilizer, naturally controlling pests and diseases plant, and efficient water management. With this, they have reduced house gas emissions and the glass produced by the agriculture sector. Use fertilizer organic and grow organic side, manage residue plants, use fertilizer green, manage efficient irrigation, do _ rotation plants, manage waste livestock, use technology-friendly farming _ environment like use fertilizer microbes or technique agriculture possible precision _ help reduce use material chemistry and improve quality land (S&P Global, 2022) is activities that have been done farmer without certificate emission carbon.
2. Planting trees: Farmers can plant trees on the land. They are an excellent form of agroforestry or forest plants. Trees can absorb carbon dioxide from the atmosphere and help reduce house gas emissions glass. Through the REDD+ (Reducing Emissions from Deforestation and Forest Degradation) program, farmers can also obtain credit for carbon from planting trees that can traded.
3. Participation in Project Carbon: Farmers can involved in projects carbon involving _ subtraction emission or absorption of carbon. For example, they can participate in project management waste organic or project energy renewables that reduce house gas emissions glass.
4. Improvement efficiency energy: Farmers can do their role in reducing house gas emissions by using more technology-efficient energy, like using a power water pump, Sun, or tool that is more agriculture _ efficient.

Apart from the four above, farmers in developed countries can involved in a way directly in trading carbon through several methods:

Partnerships with Companies: Farmers can partner with companies committed to reducing carbon emissions. These companies may be interested in purchasing carbon credits from farmers as part

of their strategy to achieve lower carbon emissions targets. This kind of partnership can provide financial benefits for farmers.

Certification and Labeling: Farmers may also consider obtaining certification or labels recognizing sustainable and low-carbon farming practices, which can help farmers market their products to environmentally conscious consumers. However, the news occurred in several European countries and China.

	STRENGTH	WEAKNESS	OPPORTUNITY	OBSTACLE
	Touch directly with land	know yet what and how to trade carbon	Cultivating 8 Million Hectares of land.	Trend resistance in decision
Farmer in trading carbon	Has done subtraction emission carbon in a way No direct	Need to support firm in enhancement capacity	Can be involved in projects with the standard model (Redd+)	Agriculture is more No in demand by generations of young
	Opportunity addition income	We need funding for the initial amount _ considerable for input.	Opportunity broad long term For agriculture sustainability, ETS	The amountof land they reduce
	Wide community _	Vulnerable to market and price volatility.		Requires long-term program and investment education
	New space for farmer young For utilization of technology			Need accompaniment organizing,etc

3.4.4. Building Mechanisms for Subsistence Farmer Carbon Trading

Participatory involvement of subsistence farmers is an inevitability. Although the carbon trading mechanism, especially ETS with its open models, the existing carbon trading scheme is still not entirely fair to farmers. They quickly become victims in a market that is not honest and has fragile prices. Also, the concept of complex carbon trading makes it difficult to understand (Nath, Sileshi, and Das, 2020). If they feel that they practice agriculture, they become targets that are not fair, making farmers hesitate to participate in carbon trading (Cechin, da Silva Araújo, and Amand, 2021)(Vial, Molesworth, and Lefroy, 2020). Therefore, a fair price mechanism is needed for farmers in carbon trading (Watts, 2021).

Understanding the influence of the carbon trading price scheme is crucial for making policy, researchers, and stakeholders' interests involved in mitigating climate change mitigation. This helps evaluate the effectiveness of carbon trading policy, predict carbon allowance prices, and design strategies for achieving emission reduction targets.

Through several signs from the carbon trading mechanism and the context of Indonesian subsistence farmers, the following notes are essential in designing Mechanism Development. The suggested strategies are summarized in a 6-point strategy.

1. Advocacy Strategy: Related to access and limitations of knowledge; hence, the mentoring strategy is more appropriate for farmers. Farmers are accompanied to connect with various parties for socialization and organizing. To make it easier in part, this price mechanism, for example, the decision price to sell carbon, should be regulated. (Djaenudin, Lugina and Kartikasari, 2016).
2. Participation Strategy: The farming community is involved in item mapping, designing implementation, and monitoring and evaluation. Farmer involvement is taken into account not only as an object but as a subject.
3. Collaboration Strategy: Farmers can be supported by the Government, NGOs, and BUMN, which are engaged in Carbon Trading, investing CSR in matter resources.
4. Production Strategy: To avoid becoming a greenwashing program, measurability results and emissions are essential in indicator results.
5. Monetization Strategy: Financial profit in the field. This will become a source of power to pull the new one for the world of agriculture. The technological ability of young circles can be poured out to support the agricultural sector. So agriculture is not identical to technological backwardness (Supendi2022 and Puwroko, 2022)

Several recommendations can be proposed to overcome challenges and obstacles:

1. The Indonesian government must strengthen regulatory frameworks and law enforcement mechanisms to ensure compliance with emission reduction targets and market rules. This matter can be done by setting clear guidelines, implementing punishment for non-compliance, and giving technical help to support entities in fulfilling obligations.
2. The Indonesian government must prioritize developing a robust monitoring, reporting, and verification system to ensure accurate and reliable emissions data. This priority can be achieved through capacity building, technology transfer, and employment. The same is valid internationally.
3. The Indonesian government must promote engagement and collaboration of stakeholders by building a platform for dialogue, sharing information, and capacity development. Promotion can cover the formation of industry associations, workshops and training programs, and the formation of public-private partnerships for push initiative subtraction emissions.
4. The Indonesian government must explore financing mechanisms to overcome financing obstacles. Creative aspects include building green investment funds, giving grants or subsidies for emission subtraction projects, and facilitating access to international climate funding.

4. Conclusion

This study aims to contribute to the knowledge of inequality. It will analyze the diverse effects of trading carbon on various segments of the farming community so that farmers can play an optimal role, and participatory assistance paradigms are necessary. With the role in carbon trading, farmers can obtain additional economic benefits through the sale of carbon credits produced from efforts to reduce emissions or increase carbon absorption. However, it is essential to ensure that the participation of farmers in carbon trading is fair and sustainable. Hence, they get appropriate benefits, and those that do not happen have a social or economic gap.

The existing carbon trading scheme is still not entirely fair to farmers, one of the most vulnerable groups to climate change. Therefore, a reasonable price mechanism is needed for farmers in carbon trading. Although the ETS and CDM mechanisms are open for entry, relevant different carbon trading schemes need to be analyzed, considering the state energy landscape, policy frameworks, and emission reduction goals, and understanding the complexity of price variables, market mechanisms, and regulations is a crucial step in building a strong foundation for successful and sustainable carbon trading.

Agricultural development to direct carbon trading for farmers should use a public empowerment paradigm so that good participation is materialized in planning, implementing, and controlling carbon trading. Hopefully, in the future, the world of agriculture will return enthusiastically with an open presence and regeneration so that agriculture is not identical to technological backwardness. An integrated and holistic system is necessary to develop an effective carbon trading system.

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