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THE POTENTIAL IMPACT OF CARBON TAX IMPLEMENTATION ON THE AGRICULTURE SECTOR IN INDONESIA, SPECIFICALLY THROUGH CARBON TAX IMPOSITION ON ENERGY USE

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ABSTRACT

Indonesia has agreed to comply with the Paris Agreement, which includes a commitment to restrict and control emissions of greenhouse gases (GHGs). The commitment is reinforced by the submission of the Enhanced NDC document mandating the higher emission reduction target in each scenario. The instrument of carbon pricing to implement soon is carbon tax, which is applied to emissions resulting from energy consumption. The agriculture sector, a substantial component of Indonesia's economy, is experiencing growth as a result of revitalization through mechanization revolution leading to a heightened reliance on energy consumption. These arguments indicate that although the carbon tax is a component of Indonesia's efforts to decrease greenhouse gas emissions, its impact on the agriculture sector must be cautiously controlled. The objectives of this study are to: 1. Estimate the potential revenue from carbon tax across all sectors, including agriculture; 2. Estimate the impacts of implementing carbon tax on the performance of the agriculture sector, including output, employment, and income levels. The result shows that the potential carbon tax revenue in Indonesia from all economic sectors is IDR 5,025,641,983,076.-. The agricultural sector has the potential to generate tax revenues of IDR 418,242,180.-. These are vary small compared to others' most practices. There is a potential decline in the level of agricultural sector output of IDR 16,366.3 million and employment of 17,884,082 workers. At the subsector level, the largest decline for both indicators occurred in the Non-edible crops subsector. In terms of income, there is a potential decline as much as IDR.26,656.76 million. The distribution pattern of income reduction between classes due to the tax burden tends to be progressive. On the other hand, the intensity of income decline in each class tends to be regressive. Thisresults recommend that there should be mitigation in implementing the carbon tax in Indonesia using any appropriate strategies.

Keywords: agriculture, carbon tax, output, employment, income, regressive

INTRODUCTION

In 2016, Indonesia officially approved and agreed to the terms of the Paris Agreement, which includes a commitment to restrict and control its emissions of greenhouse gases (GHGs). The country's Nationally Determined Contribution (NDC) aims to achieve a 29% decrease in greenhouse gas (GHG) emissions by 2030, in comparison to the levels that would occur under

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normal circumstances(Allen et.al., 2021). The commitment to the mandate is reinforced by the submission of the Enhanced NDC document to the UNFCCC Secretariat on 23 September 2022 (Indonesia, 2022); KLHK, 2020). The emission reduction target has been raised from 29% in the First NDC to 31.89% unconditionally, and from 41% to 43% conditionally. Unconditional reduction refers to Indonesia achieving its goals with its own resources, while conditional reduction suggests that it relies on international support to achieve those goals.

The Emissions Reduction Framework provides guidance for implementing a carbon pricing mechanism, which encompasses a cap-and-trade system and carbon taxes, in order to achieve the Nationally Determined Contribution (NDC) objective. The carbon tax will be incorporated into the broader emissions reduction framework. Indonesia had planned to commence the implementation of a carbon tax policy in 2022, specifically targeting the Coal Steam Power Plant (PLTU) sector. The tax rate was set at IDR 30 per kilogram of carbon dioxide equivalent (CO_2e)(Allen & Overy & Ginting & Reksodiputro, 2021; Gugler et al., 2020; Pandey et al., 2022). The Indonesian government made the decision to forgo the collection of carbon tax for that particular year and defer it until 2025 (katadata.co.id). Carbon taxes primarily pertain to the acquisition of items that contain carbon and actions that generate greenhouse gas emissions. The tax rate will be set to match or exceed the carbon market price per kilogram of carbon dioxide or its equivalent, with a minimum rate of Rp 30 per kilogram. In Indonesia's NDC plan, the tax is applied to emissions resulting from energy consumption, which is a major contributor to Indonesia's greenhouse gas emissions.

The agriculture sector, a substantial component of Indonesia's economy, is experiencing growth as a result of revitalization measures. The utilization of machines grows increasingly extensive, resulting in a heightened reliance on energy consumption. The agriculture sector may experience a significant impact as a result of the implementation of a carbon tax. Agricultural operations that generate carbon emissions will be liable to the carbon tax, impacting expenses for farmers and producers. The implementation of a carbon tax has the potential to impact the expenses associated with agricultural inputs and operations, which could result in increased pricing for consumers. The government should assess the economic consequences of the carbon tax in order to minimize its effects, while still upholding its commitment to implementing the carbon tax system with the goal of achieving greenhouse gas emission reduction targets.

These arguments indicate that although the carbon tax is a component of Indonesia's efforts to decrease greenhouse gas emissions, its impact on the agriculture sector must be cautiously controlled. The objectives of this study are to: 1. Estimate the potential revenue from carbon tax across all sectors, including agriculture; 2. Estimate the impacts of implementing carbon tax on the performance of the agriculture sector, including output, employment, and income levels.

LITERATURE REVIEW

The carbon tax has the potential to cause an economic shift in Indonesia's agriculture industry. Implementing a carbon price has the ability to bring about a fundamental shift in the economy, which might favourably impact elements that are more prevalent in rural and lower-income households1. Additionally, the agricultural sector may incur indirect expenses due to the use of carbon-intensive transportation and perhaps higher prices for heating and fertilizer(Yusuf & Resosudarmo, 2015). In addition, this study saw the carbon price as a beneficial factor for the economy. The implementation of a carbon tax has the potential to impact market prices and support mechanisms that play a vital role in the agriculture sector. This sector is a major employer and contributes significantly to the GDP(OECD, 2023). Carbon taxes will provide an additional advantage by promoting sustainability objectives, particularly in the long run. The implementation of a carbon price is in line with the objectives of enhancing the resilience and inclusivity of the agriculture sector, by encouraging the adoption of sustainable practices and mitigating the carbon emissions.

On the other hand, agricultural groups strongly oppose the carbon price, as documented by Skolrud (2019). The study demonstrates that Canadian farmers face difficulties in transferring the supplementary expenses resulting from a carbon tax, mostly due to their limited authority over product price within the global market. The federal backstop policy grants farmers an exemption from the majority of direct expenses, but does not extend this exemption to indirect costs like as transportation and heating, which have the potential to raise overall expenses.

The Prairie provinces are strongly opposed to the carbon price, and Saskatchewan is disputing the federal government's jurisdiction to enforce it. Nitrous oxide and methane, rather than carbon dioxide, are the primary contributors to greenhouse gas emissions in agriculture.The primary concern lies in the economic repercussions that farmers encounter while grappling with the expenses associated with the carbon price within a fiercely competitive global market. This issue is essential to the discussion on the efficacy and equity of the carbon price policy in the agricultural industry.

Carbon Pricing is an economic approach designed to decrease the release of greenhouse gas (GHG) emissions by using market mechanisms. The process entails attributing a specific monetary worth to every metric ton of greenhouse gas (GHG) emissions, so incorporating the external expenses linked to these emissions. The external costs may encompass harm to crops, healthcare expenses resulting from heatwaves and droughts, and property damage caused by flooding and rising sea levels(Dolphin & Xiahou, 2022; World Bank, 2021, 2023).The concept of carbon pricing is to transfer the responsibility for these expenses back to the individuals or entities accountable for the emissions and capable of implementing measures to mitigate them1. Carbon pricing establishes a financial motivation for polluters to modify their practices, reduce their emissions, or alternatively, continue emitting while compensating for their emissions by increasing the cost of environmentally harmful fuels, products, and services(World Bank, 2023).

Carbon pricing encompasses various modalities, with the most prevalent being carbon tax and emission trading system. A carbon tax is a charge imposed on the production of greenhouse gas emissions directly or on fuels that release these gases when they are consumed(Rosado & Ritchie, 2022). The Emissions Trading System (ETS), commonly referred to as a 'cap and trade' system, establishes a predetermined limit (or 'cap') on pollution levels, requiring manufacturers to get licenses in order to release greenhouse gases (GHGs). Implementing carbon pricing is an essential policy measure to effectively tackle the issue of climate change. The absence of a financial value results in an inequitable distribution of the burden of emissions, disproportionately affecting those who are least accountable for them. Carbon pricing is a highly effective strategy for decreasing emissions by increasing the cost of carbon-intensive products and promoting low-carbon alternatives. This approach not only helps to mitigate climate change but also has the potential to stimulate economic growth. By implementing carbon pricing, a system is established where individuals or entities that emit higher levels of carbon dioxide are required to pay a greater amount. This approach aims to rectify the existing unfairness, where the most economically disadvantaged individuals, who contribute the least to carbon emissions, bear the brunt of the negative impacts of climate change(Max Roser, 2021).

Implementing carbon pricing is essential for encouraging low-emission actions on a global scale. Implementing a carbon pricing mechanism incentivizes both enterprises and individuals to embrace more environmentally friendly behaviours. In order to accomplish the objectives established by the Paris Agreement, it is imperative to enforce ambitious carbon pricing measures. These prices should accurately represent the actual expense of carbon emissions and effectively stimulate significant transformation. In addition to implementing carbon pricing, it is essential to have complementary policies in place. These policies may encompass financial assistance for renewable energy, allocation of funds towards environmentally friendly infrastructure, and implementation of rules that encourage sustainable behaviour.

Regarding its implementation in different countries, numerous nations have embraced carbon pricing mechanisms. Indonesia has implemented a carbon pricing mechanism in its national programs to fulfil its Nationally Determined Contribution (NDC) objectives. Additional global regions that have implemented carbon pricing mechanisms include the European Union, China, California, and a consortium of states in the Northeast United States known as the Regional Greenhouse Gas Initiative (Roser, 2021).Carbon taxes are being implemented by countries worldwide to provide incentives for reducing greenhouse gas emissions. Sweden now has the highest carbon taxes globally, amounting to US$139 per metric ton of CO_2. Since the implementation of the Swedish carbon tax in 1991, the Swedish economy has experienced a 60% growth, while carbon emissions have witnessed a reduction of 25%1. Carbon costs have reached unprecedented levels in various other areas, like Canada, which enforces a carbon tax that is scheduled to increase to CAD 50 per metric ton of CO_2 by 2022. The European Union has implemented a comprehensive Emissions Trading System (ETS) that includes fluctuating prices. Switzerland now implements a carbon tax, which is modified according to environmental objectives. Additionally, there are other prosperous countries and regions worth mentioning, such as California, New Zealand, and the Republic of Korea(World Bank, 2021, 2023).

Carbon pricing implementation exhibits significant variation across countries, encompassing disparities in the industries it encompasses, the magnitude of the price, and the utilization of generated revenue. Economists should generally reach a consensus on the efficacy of carbon pricing and the necessity of political backing to ensure its successful implementation. Supplementing carbon pricing with other policies is necessary for a comprehensive strategy in combating climate change(2021)(World Bank, 2021;Roser, 2021).

Canada employs a Revenue Recycling process to ensure that tax revenue is returned to the jurisdiction where it was collected. Up to 90% of the funds are allocated to providing support to families through Canada Carbon Rebates, while the remaining portion is dedicated to assisting businesses, farmers, and Indigenous groups. Industrial polluters are subject to pricing systems that are depending on their performance. Farmers are given exemptions and tax credits to incentivize the adoption of farming practices that result in reduced carbon emissions. Additionally, starting in 2024, there will be a 20% increase in financial support for rural areas. This strategy guarantees that the financial impact of pollution is taken into consideration, encouraging the adoption of low-carbon alternatives and facilitating the shift towards a more environmentally friendly economy(Canada.ca). According to this method, it is projected that carbon pollution pricing will account for up to one-third of Canada's emissions reductions in 2030(He & Huang, 2008; McKitrick & Aliakbari, 2021; Office of the Auditor General of Canada, 2022).

The implementation of a carbon price has the potential to cause economic harm and create a burden that disproportionately affects lower-income individuals. Hence, it is imperative to allocate the cash generated from carbon taxes towards mitigating the resulting impacts. Nevertheless, the implementation of carbon taxes will result in reduced revenue when technological advancements and the emergence of cleaner-burning fuels occur. Therefore, if carbon taxes are employed as a budgetary instrument, the tax revenue of the government will gradually decline, putting at risk the programs that rely on those taxes for funding(Prasad, 2022).

Energy consumption in agricultural activities can occur in two unique ways. It consists of both direct and indirect usage. Indirect energy consumption encompasses inputs such as fertilizer, pesticide, and agricultural film, whereas direct energy consumption includes diesel and electricity(Ma et al., 2022). A tractor is an essential tool in agricultural mechanization. Farm tractors commonly run on three fuel options: diesel fuel, gasoline, or liquefied petroleum gas (LPG)(Downs & Hansen, n.d.).

Agricultural mechanization is seen as a crucial element in the process of modernizing Indonesian agriculture, aiming to enhance efficiency and competitiveness. The government has offered substantial aid in the form of agricultural equipment and machinery (alsintan), which has resulted in enhanced production and decreased reliance on manual labor. Mechanization facilitates the shift towards contemporary agricultural practices by employing advanced technologies. The number and variety of agricultural machinery (alsintan) given to farmers has experienced a significant surge, with a growth rate of 2,175 percent between 2014 and 2017. The utilization of machine tools has resulted in a reduction in labor by 70-80 percent and production costs by 30-40 percent, while also increasing production by 10-20 percent. The implementation of a carbon price may provide a challenge to the agricultural sector in Indonesia(Sulaiman et al., 2018; Wijaya & Nurcahyo, 2023).

The objective of climate mitigation policy in agriculture might have various outcomes. If strict global climate change mitigation strategies are implemented consistently in all sectors and areas, they might potentially have a greater adverse effect on world hunger and food consumption by 2050 than the direct consequences of climate change. The detrimental consequences of these policies would be particularly evident in vulnerable, impoverished regions such as sub-Saharan Africa and South Asia, where the existing food security concerns are already severe. The results indicate the necessity of maintaining a delicate equilibrium in climate policies to prevent unexpected repercussions that may worsen food insecurity in the most susceptible areas of the globe(Tomoko Hasegawa, Shinichiro Fujimori, Petr Havlík, Hugo Valin et al., 2018) (Hasegawa et.al, 2018).

Aresearch uses the Input Output methodology of the Miyazawa model to examine the interplay between sectors that contribute to economic output and those that do not. The Miyazawa IO analysis reveals the interplay between different sectors, specifically indicating a rise in the reliance of productive sectors on unproductive sectors, accompanied by a growth in the number of unproductive markets within the economy(Morrone et al., 2022). It can also demonstrate the prioritization of one sector over the other in their relationship. Another study examines the effects of a carbon tax on household welfare in the Asia-Pacific area, with the goal of evaluating its effectiveness. The findings of this study indicate that there is no decline in prosperity within the range of 2% to 10% of the initial level of consumption(Alonso & Kilpatrick, 2022). This study employs a blend of analytical techniques, including Input–Output Tables, Household Surveys, Labor Income Channels, and Compensation Schemes. An essential discovery from this study is the occurrence of Carbon Tax

Regressiveness, which refers to the implementation of a carbon tax that could potentially intensify the financial strain on lower income brackets.

The U.S. energy tax study indicates that measures designed to decrease greenhouse gas emissions may result in increased energy prices, impacting different agricultural expenses. This might result in increased expenses for farmers in terms of diesel, gasoline, irrigation water, farm chemicals, and grain drying. Market adjustments ensure that the majority of higher fossil fuel prices are passed on to consumers, rather than placing a significant burden on farmers. Industries that are strongly connected to energy derived from fossil fuels, such as transportation, iron and steel production, and power generated from coal, may see negative consequences, with their production decreasing compared to a scenario where no changes are made (Schneider, 2005). It is crucial to meticulously construct these levies in order to avoid adverse effects, particularly on susceptible industries and regions. Another study in U.S. shows the impact of carbon tax is resulted in higher prices. Corn and soybean production costs increased by a maximum of 32.6% and 22.4%, respectively on a carbon tax of $144 per ton CO2-e. The increase in production costs was partially compensated by rising commodity prices (Dumortier & Elobeid, 2021).

RESEARCH METHOD

The research approach utilized in this investigation is quantitative in style. The data employed in this research comes from secondary sources. The Miyazawa Energy Input-Output Table, a composite of the 2016 Indonesian Input-Output Table(BPS, 2021), is the primary resource and analysis tool utilized in this research. A legitimation for using this table is that it is the most recent IO table published as of 2021. The table presents the fundamental information and variables. Further substantiating evidence consists of informational documents and anticipated carbon tax rates as much as IDR 30,000. - that are specified in the state gazette under Tax Harmonization Law No. 7 of 2021(Badan Pusat Statistik, 2018).

Furthermore, this research utilizes an expansion of the 2016 Indonesian Input Output table,namelyMiyazawa Energy I-O that incorporates CO2 emission dataderived from household structure and energy consumption. Ten distinct categories are used to classify household by income levels; further divided into the rural and urban regions according to regional classification. This addition was constructed in the same year that secondary data processed from SAKERNAS and SUSENAS raw data was utilized.

By utilizing the I-O analysis instrument that Miyazawa devised, the potential effects of a carbon tax implementation to agriculture sectors will be illustrated. Within this theoretical framework, the introduction of the carbon tax can be traced to a "shock" that initially impacts economic input and output before reverberating indirectly and directly across numerous sectors. Consequently, employment opportunities and household income are affected across income classes in both urban and rural areas.

In this study, business fields are categorized into 73 sectors in accordance with the 2016 Miyazawa Energy I-O Table. In classifying household institutions based on their ultimate demand and income beneficiaries, ten income classes or group are employed: Household 1 (HH1) denotes the lowest income group, while Household 10 (HH10) signifies the highest. Furthermore, these residential establishments are further categorized according to region, namely rural households (HHR) and urban households (HHU).

The Miyazawa I-O table utilized in this research consists of the subsequent matrices: intermediate demand (quadrant I), primary input matrix (quadrant III), and final demand matrix (quadrant II). Seventy-three sectors conduct input-output transactions between economic sectors in quadrant I using products referred to as intermediate inputs. Quadrant II signifies demand through indicators such as exports, investment, consumption, and inventory fluctuations. On the other hand, the primary input or value-added component is located in quadrant III and consists of the subsequent elements: imports, business surplus, labor compensation, and product and production taxation.

In alignment with the stated research objectives, the results will consist of a projected aggregate carbon tax levy, with a specific emphasis on its application within the agricultural industry. Following this, a comprehensive examination of the possible economic consequences will be presented. The economic scope that will be delineated will encompass various factors comprise output production, employment opportunities, household income, and community income (which in this instance is sectoral income).

RESULT AND DISCUSSION

The Estimation of Carbon Tax Values The assumptions used in determining the carbon tax level are based on the Indonesian policy scenario determined through an agreement between the Ministry of Finance and stakeholders including the legislative body. The agreed amount of carbon tax for Indonesia is IDR 30 per kilogram of CO2e. By determining the estimated total CO2 emissions, we can calculate the value of the potential carbon tax.

From the table it can be seen that the total potential value of carbon tax that can be collected is IDR 5.03 trillion. This value is very small because it only covers around 0.0219 percent of the total output value. The value of the carbon tax that can be collected from the agricultural sector is IDR 2.04 billion or 0.000105 of the value of agricultural output.

Table 1. Estimated Total Value of Carbon Tax Per Sector and Subsector of the Indonesian Economy Based on the 2016 IO Table

No	Sector/ Subsector	CO2Emission		Carbon Tax (Rp)	Rasio CT
		Kg	%	Rp30/Kg	CT/Q (%)
1	Paddy	5274	0.01	158,234	0.000000067
2	Fruits	28,925	0.04	867,747	0.000000651
3	Dairy farming and Livestock raising	36,112,158	53.14	1,083,364,740	0.000362235
4	Other edible crops	4,575,047	6.73	137,251,395	0.000032367
5	Non-edible crops	2,422,369	3.56	72,671,070	0.000022096
6	Agricultural services	1,233,647	1.82	37,009,422	0.000152350
7	Forestry (Inc. Hunting)	9,639,327	14.18	289,179,813	0.000255830
8	Fishing	13,941,406	20.51	418,242,180	0.000123115
A	Agriculture	67,958,153	0.04	2,038,744,601	0.000107408
B	Mining	1,993,333,769	1.19	59,800,013,061	0.005115130
C	Manufacture	150,484,455,478	89.83	4,514,533,664,337	0.062286663
D	Services	1,4975,652,036	8.94	449,269,561,077	0.003552809
	Total	167,521,399,436	100	5,025,641,983,076	0.021888027

Source: Data processing

Among the agricultural subsectors, the livestock subsector has a potential carbon tax of IDR 1.08 billion. The potential carbon tax from rice farming is very small, namely Rp. 158,234, -. This is in line with the carbon emission level of rice farming which is also the smallest, so the total potential carbon tax is only that large. By being able to predict the potential for carbon tax collection at the announced rates, it is possible for the government to assess the appropriate rate to be applied. Based on various opinions on the carbon tax rates agreed to date, many people think the value is too low.

The Estimation of the Carbon Tax Impact on Agriculture Output Values

To see the impact of the carbon tax on the agricultural sector, the shock of the carbon tax to the economy is created in two scenarios, namely scenario I: carbon tax is imposed only on the agricultural sector; scenario II: taxes are imposed on all sectors of the economy.

The results of the analysis show that if the tax is applied according to scenario I, namely in the agricultural sector alone, the total output in the agricultural sector will decrease by Rp. 2.17 billion rupiah. If the tax is applied to all economic sectors, namely with scenario II, the decline in agricultural sector output will reach Rp. 16.37 billion rupiah, or there is a difference of 653.50%. This shows that the indirect impact of carbon taxes through agricultural input-output interactions with other sectors is very large. The reduction in output borne by the agricultural sector resulting from the imposition of carbon taxes on other sectors is much greater than that resulting from the impact of taxes imposed directly on the agricultural sector itself.

Table2.The Estimation of Agricultural Output Decline by Scenarios Based on Indonesia IO Table of 2016

Sector/ Subsector	Scenario-I		Scenario-II		Gap (%)
	IDR. million	%	IDR. million	%	
(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)=((d)-(b))/(b)*
Paddy	-5.02	0.23	-2,040.64	12.47	40,582.66
Fruits	-2.21	0.10	-306.532	1.87	13,745.17
Dairy farming and Livestock raising	-1,092.85	50.31	-1,866.50	11.40	70.79
Other edible crops	-210.37	9.68	-2,686.75	16.42	1,177.16
Non-edible crops	-81.00	3.73	-4,053.98	24.77	4,905.22
Agricultural services	-44.05	2.03	-281.672	1.72	539.41
Forestry (Inc. Hunting)	-305.68	14.07	-3,726.55	22.77	1,119.09
Fishing	-430.96	19.84	-1,403.63	8.58	225.69
Agriculture	-2,172.15	100.00	-16,366.3	100.00	653.45

Source: Data Processing

Analysis per subsector shows that in scenario I the livestock subsector experienced the largest share of output decline, namely IDR1,092.85 million (50.31%) of the entire decline in agricultural sector output. The fishing and forestry subsectors followed with shares of 19.84% and 14.07%. Other subsectors are much lower, namely below 10%. In scenario II, the non-food crops subsector and the forestry subsector containing hunting experienced the largest decline in output, respectively IDR.4,053.98 million (24.77%) and IDR.3,726.55 million (22.77%) of the entire decline in output in the agricultural sector. The impact of decreasing output levels through scenario-I appears to be more widespread.

The Paddy subsector and the Fruits subsector experienced the most drastic spike in output decline in scenario II. Compared to the decrease that occurred in scenario I, the decrease in paddy output through scenario II increased by 40,582.66% while fruit increased by 13,745.17%. This shows that there is a very striking difference between scenario II and scenario I. The subsectors that are greatly impacted in scenario II are those that have high interaction with the non-agricultural sector so that the imposition of taxes on non-agricultural sectors greatly affects these subsectors.

The intensity of the effect of the carbon tax, measured by the percentage reduction in output relative to the original output level, appears to vary greatly among all subsectors. By using the Scenario II, where carbon tax is imposed to all sectors/ subsectors, the most likely to be implemented, it shows the Forestry (Incl. Hunting) subsector experienced the highest intensity of output decline and was ranked 1st, namely 0.0000330%. The non-edible crops subsector experienced a decline with the second highest intensity at 0.0000123%. Not much different from the Subsector Non-edible crops, the Subsector Agricultural services experienced a decline with the third largest intensity, namely 0.0000116%.

Table 3 The Share of Carbon Tax and Agricultural Output Decline and The Decline Intensity

Sector/ Subsector	Carbon Tax Share		Decline Share		Decline Intensity	
	%	Rank	%	Rank	%	Rank
(a)	*(b)*		*(c)*		*(c)*	
Paddy	0,01	8	12,47	4	-0,0000087	4
Fruits	0,04	7	1,87	7	-0,0000023	8
Dairy farming and Livestock raising	53,14	1	11,40	5	-0,0000062	6
Other edible crops	6,73	4	16,42	3	-0,0000063	5
Non-edible crops	3,56	5	24,77	1	-0,0000123	2
Agricultural services	1,82	6	1,72	8	-0,0000116	3
Forestry (Inc. Hunting)	14,18	3	22,77	2	-0,0000330	1
Fishing	20,51	2	8,58	6	-0,0000041	7
Agriculture	100,00		100,00		-0,0000086	

Source: Data Processing

When compared with the share ranking of the total carbon tax, the composition of roles in other parameters differs from one to another. The forestry subsector (Incl. Hunting), which is in first place in terms of intensity of output reduction, is in third place in terms of the amount of tax borne, namely 14.18%. Meanwhile, its share in the decline in total output in the agricultural sector places the Forestry (Incl. Hunting) subsector in second place with 22.77%. It appears that the Forestry (Incl. Hunting) subsector is consistently in the top ranking both in terms of the intensity of output decline and also in the share of output decline and the level of carbon tax borne.

The opposite was experienced by the Paddy subsector which was ranked fourth in intensity of output decline with an amount of 0.0000087%. This subsector is in eighth place in terms of share of the amount of tax borne, namely 0.01% and is in fourth place in terms of share of the total decline in agricultural sector output, namely 12.47%. The Fruits subsector consistently ranks at the lower levels where it is ranked eighth in terms of intensity of output decline with 0.0000023%, while in ranking the level of carbon tax borne and the share of the total decline in output in the agricultural sector, it is both ranked seventh.

The Dairy farming and livestock raising subsector is ranked sixth in intensity of output decline and is ranked fifth in share of the total decline in agricultural sector output. The Dairy farming and livestock raising subsector is ranked first in terms of the level of carbon tax value it covers. This shows that even though this subsector is burdened with the largest tax value, its impact does not make it the largest in terms of output reduction. The amount of tax borne by each subsector depends on the amount or volume of CO_2e emissions it produces. Meanwhile, the impact felt by each subsector, especially in reducing output, depends on the intensity and dependence or interaction of input-output transactions in the economic production structure.

Estimated Impact on Employment Levels in the Agricultural Sector

The negative consequence of implementing a carbon tax is a decrease in employment in the business sector. This also happens in the agricultural sector with the implementation of the carbon tax. The results of the analysis show that as many as 30,056 workers will lose their jobs when taxes are applied to the agricultural sector. This number increases to 17,884,082 people who lose their jobs when taxes are applied to all economic sectors (scenario-II). When compared between scenario one and scenario two, there is a difference of 59,402.92%. This shows the same phenomenon as that which occurs at the output level, where the impact of tax implementation on all business fields adds multiple negative consequences to Agriculture Sector. This is because the agricultural sector is very much influenced by the existence of other sectors which, if they experience changes, will be absorbed very intensively by the agricultural sector.

Table 4. The Estimation of Agricultural Employment Decline by Scenarios Based on Indonesia IO Table of 2016

Sector/ Subsector	Scenario-I		Scenario-II		Gap (%)
	Person	%	Person	%	
(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)=((d)-(b))/(b)*
Paddy	-1,470	4.89	-4,936,353	27.60	335,742.89
Fruits	-203	0.68	-655,476	3.67	322,868.45
Dairy farming and Livestock raising	-15,015	49.96	-1,298,076	7.26	8,545.13
Other edible crops	-6,229	20.73	-4,253,374	23.78	68,182.04
Non-edible crops	-2,304	7.67	-5,656,805	31.63	245,442.74
Agricultural services	-509	1.69	-161,699	0.90	31,654.77
Forestry (Inc. Hunting)	-1,515	5.04	-113,114	0.63	7,365.47
Fishing	-2,811	9.35	-809,185	4.52	28,690.46
Total	-30,056	100.00	-17,884,082	100.00	59,402.92

Source: Data Processing

The tax shock with scenario one pattern resulted in the farming and livestock raising subsector being hit the hardest, with 15,015 job opportunities lost. This is 49.96% of the entire decline in employment in the agricultural sector. The subsector that was also heavily impacted was the Other edible crops subsector which lost 6,229 job opportunities or 20.73% of the total decline in the agricultural sector. On the other hand, the fruits subsector lost the lowest number of job opportunities, namely 203 people or 0.68%

With the implementation of taxes in all sectors, namely the second scenario, the non-edible crops subsector is ranked first to be hit. This subsector lost 5,656,805 jobs or covered 23.78% of all job losses. Agricultural Sector. The situation is not much different, the Paddy subsector also experienced a very large decline, namely 4,936,353 job opportunities or the equivalent of 27.60% of the entire decline in employment in the agricultural sector.

The Paddy subsector experienced the largest addition in employment reduction through scenario two. Job losses in the Paddy subsector increased by 335,742.89% as experienced in scenario one. The next biggest jump was in the Fruit Subsector with additional losses of 322,868.45%. This illustrates that the influence of other sectors is very large in providing employment opportunities or job creation which occurs in most agricultural subsectors.

The intensity of the effect of the carbon tax, measured by the percentage reduction in employment relative to the original employment level, appears to be more similarly among all subsectors. The gaps between ranks are relatively close. By using the Scenario II, where carbon tax is imposed to all sectors/ subsectors, the most likely to be implemented, it shows the non-edible crops subsector experienced the highest intensity of employment decline and was ranked 1st, namely 0.0007712%. The Agricultural services subsector experienced a decline with the second highest intensity at 0.0006100%. Not much different from this, the Subsector Other edible crops experienced a decline with the third largest intensity, namely 0.0004300%.

Table 5. The Share of Carbon Tax and Agricultural Employment Decline and The Decline Intensity Based on the 2016 IO Indonesia Table

Sector/ Subsector	Carbon Tax Share		Decline Share		Decline Intensity	
	%	Rank	%	Rank	%	Rank
(a)	*(b)*		*(c)*		*(c)*	
Paddy	0.01	8	27.60	2	-0.0004115	4
Fruits	0.04	7	3.67	6	-0.0003997	5
Dairy farming and Livestock raising	53.14	1	7.26	4	-0.0003210	7
Other edible crops	6.73	4	23.78	3	-0.0004300	3
Non-edible crops	3.56	5	31.63	1	-0.0007712	1
Agricultural services	1.82	6	0.90	7	-0.0006100	2
Forestry (Inc. Hunting)	14.18	3	0.63	8	-0.0001960	8
Fishing	20.51	2	4.52	5	-0.0003994	6
Agriculture	100.00		100.00		-0.0004735	

Source: Data Processing

In contrast to the proportional distribution of the overall carbon tax, the role composition in alternative parameters varies. The Non-edible crops Subsector ranks fifth in terms of the proportion of taxes borne, at 3.56%, despite being first in terms of the intensity of employment reduction (0.0007712%). In line with a 31.63% contribution to the overall decrease in agricultural employment, the Non-edible crops subsector ranks first. The non-edible crops subsector appears to maintain a consistent position at the top of the rankings for output decline intensity and output decline proportion even though it is not for carbon tax burden.

On the contrary, the Forestry (Incl. Hunting) subsector encountered the exact opposite, ranking eighth in terms of employment decline share and employment decline intensity with a consecutive magnitude of 0.63% and 0.0001960%. With a share of 14.18% of the total tax burden, this subsector ranks third. Similarly, Dairy farming and livestock raising subsector accounts for 53.14% of the overall tax borne in agricultural sector, which places it in first place. Contrarily ranked seventh in terms of intensity of employment decline (0.0003210%), the Dairy farming and livestock raising subsector is positioned fourth in the agricultural sector with regard to the proportion of the total decline in employment.

Fishing subsector ranks fifth in terms of its proportion of the overall decline in agricultural sector employment and sixth in terms of the intensity of employment decline. The Fishing subsector holds among the highest ranking with respect to the magnitude of carbon tax value it encompasses. This demonstrates that despite bearing the highest tax burden, this subsector does not experience the most significant decrease in employment. The tax burden imposed on a given subsector is proportional to the quantity or magnitude of CO_2e emissions it generates. In the context of the economic production structure, the degree to which each subsector is affected, particularly in terms of employment reduction, is determined by the interdependence or interaction of input-output transactions and their intensity.

Estimated Impact on Rural Household Income Levels

Analysis of the impact of carbon taxes on the economy, especially on people's income, is the most important part. This is related to the essence of development which is to achieve community welfare. Growth on the one hand is a strategy, while prosperity, including income and environmental sustainability on the other hand, is the goal. This is why the most important part that also needs to be considered is the impact of carbon taxes on people's income.

In this research, community income measured as a proxy is household income based on tenth or decile income classes. The division of community income classes into ten groups has been constructed in the Miyazawa Input Output model which is operationalized. To see the impact that occurs, especially in the agricultural sector, the community income analyzed as a proxy is the income of rural communities. Rural community income is considered to represent community income in the agricultural sector even though not all people living in villages are farmers.

From the results of the analysis, a comparison can be seen between the impact of tax imposition on the agricultural sector (scenario-I) and imposition on all economic sectors (scenario-II). With the implementation of taxes using the scenario-I pattern, there will be a decrease in people's income by IDR. 249.30 million. The class of society that experienced the largest decline in income was the highest income class. Meanwhile, the class of society that experienced the least decline in income was the one with the lowest income. It can be seen that the absolute level of decline in income is in the same direction as the income class of society. The greater the income level, the greater the impact of the income decline due to the implementation of the carbon tax.

By implementing taxes through scenario-II, the decline in income will multiply. Theincome decreased from IDR.249.30 million to IDR.26,656.76 million or greater by 10,592.73%. This could be an indication that the non-agricultural sector greatly influences the phenomenon of decreasing income that occurs in farming communities.

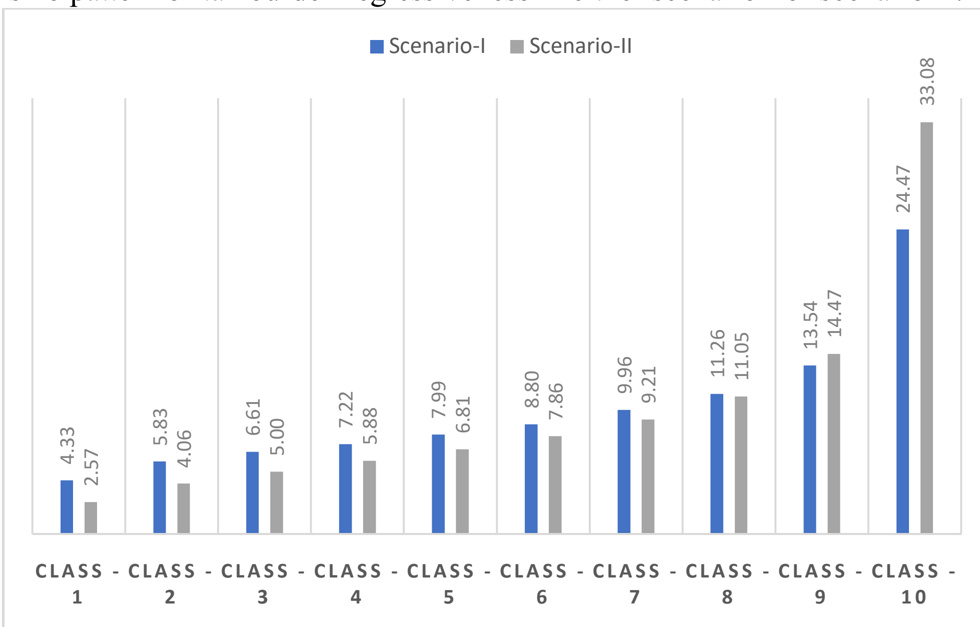
Table 6 The Estimation of Carbon Tax Impacts on Rural Households' Income Per Scenario Based on the 2016 IO Indonesia Table

Income class	Scenario-I		Scenario-II		Gap (%)
	IDR. milion	%	IDR. milion	%	
(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)=((d)-(b))/(b)*
Class - 1	-10.78	4.33	-685.41	2.57	6,256.43
Class - 2	-14.54	5.83	-1,082.27	4.06	7,345.44
Class - 3	-16.48	6.61	-1,333.52	5.00	7,993.21
Class - 4	-17.99	7.22	-1,568.20	5.88	8,618.04
Class - 5	-19.92	7.99	-1,815.78	6.81	9,014.47
Class - 6	-21.95	8.80	-2,096.23	7.86	9,451.31
Class - 7	-24.83	9.96	-2,455.20	9.21	9,790.01
Class - 8	-28.06	11.26	-2,944.73	11.05	10,394.42
Class - 9	-33.75	13.54	-3,856.28	14.47	11,326.71
Class - 10	-61.01	24.47	-8,819.13	33.08	14,354.75
Total	-249.30	100.00	-26,656.76	100.00	10,592.73

Source: Data Processing

The distribution pattern of the impact of the carbon tax on decreasing income in each income class is similar between the first and second scenarios. Lower income classes of society experienced lower levels of decline in income, while classes of society with higher incomes experienced higher income declines in absolute terms. The decrease in income that occurred ranged from IDR.685.41 million in the lowest income class (Class-1), to IDR.8,819.13 million in the highest income class (Class-10).

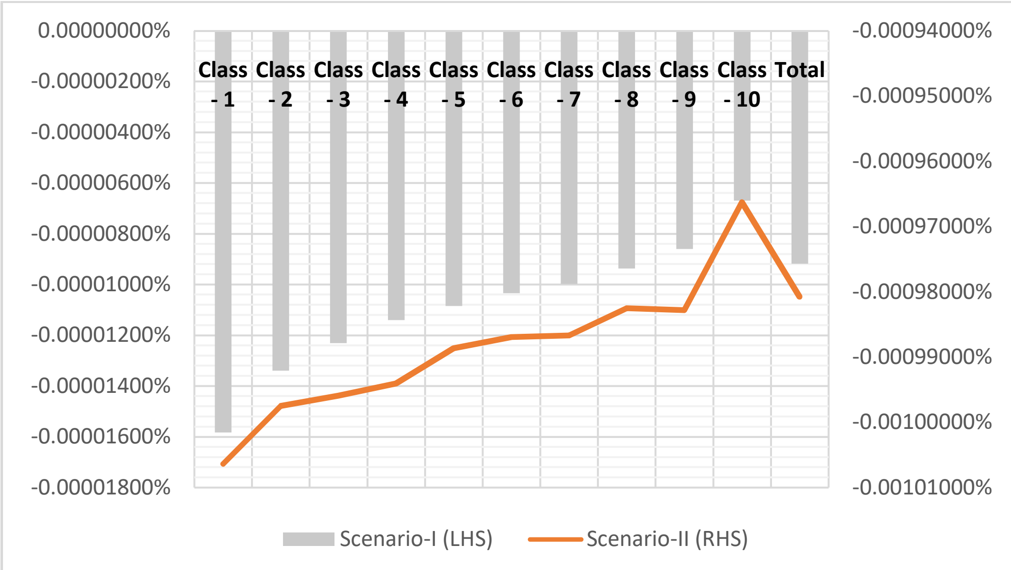
To see whether the phenomenon of regressiveness of the tax burden on income is occurring or not, it is necessary to pay attention to the trend in the portion of the impact in the direction of the order of income classes. From the results of the graphic analysis, it can be seen that there is no pattern of tax burden regressiveness in either scenario I or scenario II.



Grafik 1 The Pattern of Tax Burden to Rural Households' Income Per Scenario
Source: Data Processing

The graph shows the percentage decrease in income experienced by each class based on the tax determination scenario. In the lowest income household class (Calss-1), the portion of income decline experienced through scenario-I was 4.33% of the entire decline in rural household income. Class-1 experienced an even lower share through the second scenario, namely only 2.57%. The portion of income decline continues to increase in line with the increase in income class with different intensities between scenarios. Up to the eighth household income class (Class-8), the portion of the decline that occurs in the second scenario-II is always lower than in scenario-I. In Class-8, the portion of income reduction through scenario-I is 11.26% while through scenario-II is 11.05%. Starting from Class-9 to Class-10, the portion of income reduction through scenario-II is higher than in scenario-I. In the highest income class (Class-10), the portion of income reduction through scenario-I is 24.47%, while through scenario-II it is much higher, namely 33.08%. This comparison shows that the scenario-I pattern is more progressive than regressive in the tax burden.

If we dig deeper, the impact of taxes can not only be explained through the tax burden on income but also from the intensity of the decline in income. The intensity of the impact of the carbon tax on reducing income is measured by the percentage decrease in income from the original income. The results of the analysis can be seen from this graph.



Grafik 1 The Pattern of Income Decline Intensity of Rural Households' Income
Source: Data Processing

Based on the graph, it can be seen that the percentage decrease in rural household income is in the opposite direction to the order of income class. In lower income classes, the percentage decline in income experienced is greater or higher. On the other hand, the higher the income class, the lower the percentage decline in income experienced. This happens in both scenarios, both scenario-I and scenario-II.

The lowest income household (Class-1) experienced a decrease in income of 0.00100639% in scenario-II, and 0.00001583% in scenario-I. Middle income rural households (Class-5) experienced a decline in income of 0.00098867% in scenario-II and 0.00001085% in scenario-I. Households with the highest income (Class-10) experienced a decline in income with the lowest percentage, namely only 0.00096627% in scenario-I and 0.00000917% in scenario-II.

From the results of the analysis so far it can be seen that both in terms of impact on output and employment opportunities in the agricultural sector, it is greatly influenced by non-agricultural sectors. This is because the effect of taxes on energy use tends to be an increase in costs, including transportation, use of machinery, and specifically an increase in the prices of fertilizers, medicines, tools and other agricultural equipment. Further impacts range from increasing production costs to increasing agricultural commodity prices and decreasing demand levels. This can lead to a reduction in business scale at various levels in the agricultural sector in the form of a contraction in output and employment opportunities. All of these risks can become obstacles to expansion through decreasing investment interest in the agricultural sector.

By comparing the results of the impact intensity analysis and the tax burden analysis on income, it can be seen that there are striking differences between the two. From the tax burden analysis, it was found that the decline in the portion of income per class for the entire value of the decline in income for all classes moved in the same direction as their income level. In simple terms, it can be said that the burden of decreasing income moves in the same direction as the amount of income, or is progressive. However, from the analysis of the intensity of the impact on income, it was found that the percentage value of the decline in income for each household income borne by each class moved in the opposite direction to their income level or was regressive. This is an important consideration in policy making regarding the implementation of a carbon tax. If the benchmark taken is only based on the tax burden, then the carbon tax and carbon tax burden fulfill the principle of justice. However, on the other hand, if we look more deeply at the intensity of income decline in each class, we can see the risk of injustice.

For policy direction, of course policy makers cannot only focus on the risks or negative consequences of a carbon tax. Many economic losses occur as short-term or medium-term consequences, while in the long term there is growth, as occurred in Europe(Metcalf & Stock, 2020). Many benefits will accumulate from implementing a carbon tax, for example through better environmental quality and environmentally friendly practices that support sustainable economic progress(Jaelani et al., 2024; Prasad, 2022).

What Indonesia needs to mitigate is to reduce the shock to those parties who are hit harder. This includes ensuring that tax revenues can be returned to facilitate the parties most affected and encourage environmentally friendly practices, including green technology innovation. Meanwhile, the tax rates imposed must be appropriate and effective in reducing carbon emissions. Scotland can achieve emission reduction target more rapidly due to the appropriate tax rate (Allan et al., 2014). Based on practice in successful countries, the strategy of tax cuts and exemptions for objects with certain criteria is also often implemented in various countries. However, tax revenue as an instrument for mitigation contains risks because over time its value will decrease (Prasad, 2022).

CONCLUSION

The potential carbon tax revenue in Indonesia from all economic sectors is IDR 5,025,641,983,076.-. The agricultural sector has the potential to generate tax revenues of IDR 418,242,180.-. When compared with the level of output or production in the economy, this value is still very small. With the very small portion of tax revenue and the burden borne by sectoral economic actors, it is suspected that its effectiveness will not be optimal. The prevailing tax rates in many successful countries are much higher.

The implementation of the carbon tax in Indonesia creates a potential decline in the level of agricultural sector output of IDR 16,366.3 million. At the subsector level, the largest decline occurred in the Non-edible crops subsector. The decline in output in the agricultural sector as a result of the implementation of the carbon tax is more influenced by changes that occur in other sectors. This is because the agricultural sector is very closely linked to other sectors in the input-output structure, especially regarding energy use.

The level of job opportunities that are potentially lost due to the implementation of the carbon tax in the agricultural sector is 17,884,082 people. The subsector that experienced the largest decline in employment opportunities was the non-edible crop subsector. As with the decline in output, the decline in employment opportunities was further exacerbated by the influence of the non-agricultural sector. This is shown by a comparison of the simulation results between scenario-I (taxes on the agricultural sector only) and scenario-II (taxes on all sectors). The tax value borne by a subsector does not fully determine the intensity of the impact experienced.

The income of people in rural areas in all classes, both low and high income, has experienced a decline. The total level of decline in income was IDR.26,656.76 million. The distribution pattern of income reduction between classes due to the tax burden tends to be progressive. On the other hand, the intensity of income decline in each class tends to be regressive.

The results of the analysis of several aspects of the impact of the carbon tax recommend that there should be mitigation in implementing the carbon tax in Indonesia. Carbon tax revenues can be recycled to help relatively large classes of society affected. Tax strategies in the form of deductions, exceptions and incentives need to be arranged in an appropriate design to ensure the carbon pricing system runs effectively.

REFERENCES

Allan, G., Lecca, P., McGregor, P., & Swales, K. (2014). The economic and environmental impact of a carbon tax for Scotland: A computable general equilibrium analysis. *Ecological Economics*, *100*, 40–50. https://doi.org/10.1016/j.ecolecon.2014.01.012

Allen & Overy, & Ginting & Reksodiputro. (2021). *Indonesia ' s DPR passes carbon tax as part of proposed cap-and-trade system*. 4. https://www.allenovery.com/en-gb/global/news-and-insights/publications/indonesia-passes-carbon-tax-bill-as-part-of-ghg-regulation-effort

Alonso, C., & Kilpatrick, J. (2022). The Distributional Impact of a Carbon Tax in Asia and the Pacific. *IMF Working Papers*, *2022*(116), 1. https://doi.org/10.5089/9798400212383.001

Badan Pusat Statistik. (2018). Statistik Lingkungan Hidup Indonesia (SLHI) 2018. In *Badan Pusat Statistik*. https://doi.org/3305001

BPS. (2021). *Tabel input-output indonesia 2016*.

Dolphin, G., & Xiahou, Q. (2022). World carbon pricing database: sources and methods. *Scientific Data*, *9*(1), 1–7. https://doi.org/10.1038/s41597-022-01659-x

Downs, H. W., & Hansen, R. W. (n.d.). *Fact Sheet No. Farm and Ranch Series|Equipment*. www.ext.colostate.edu

Dumortier, J., & Elobeid, A. (2021). Effects of a carbon tax in the United States on agricultural markets and carbon emissions from land-use change. *Land Use Policy*, *103*(January), 105320. https://doi.org/10.1016/j.landusepol.2021.105320

Gugler, K., Haxhimusa, A., & Leibensteiner, M. (2020). Carbon Pricing and Emissions : Causal Effects of Britain ' s Carbon Tax. *JEL*, 1–34.

He, L., & Huang, G. H. (2008). Optimization of regional waste management systems based on inexact semi-infinite programming. *Canadian Journal of Civil Engineering*, *35*(9), 987–998. https://doi.org/10.1139/L08-037

Indonesia. (2022). *Enhanched Nationally Determined Contribution Republic Of Indonesia* (Issue 23 September). UNFCCC Secretariate.

Jaelani, A. K., Luthviati, R. D., Hayat, M. J., Kusumaningtyas, R. O., & Aini, F. N. (2024). Indonesia carbon tax policy: A key role in sustainable development goals. *AIP Conference Proceedings*, *3048*(1), 4–10. https://doi.org/10.1063/5.0202042

KLHK. (2020). *Roadmap Nationally Determined Contribution (NDC) Adaptasi Perubahan Iklim*. Kementerian Lingkungan Hidup dan Kehutanan Republik Indonesia.

Ma, Y., Zhang, L., Song, S., & Yu, S. (2022). Impacts of Energy Price on Agricultural Production, Energy Consumption, and Carbon Emission in China: A Price Endogenous Partial Equilibrium Model Analysis. *Sustainability (Switzerland)*, *14*(5).

https://doi.org/10.3390/su14053002

Max Roser (2021) "The argument for a carbon price" Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/carbon-price' [Online Resource]

McKitrick, R., & Aliakbari, E. (2021). Estimated Impacts of a $170 Carbon Tax in Canada. *Fraser Institute*, 46.

Metcalf, G. E., & Stock, J. H. (2020). Measuring the Macroeconomic Impact of Carbon Taxes. *AEA Papers and Proceedings*, *110*(April), 101–106. https://doi.org/10.1257/pandp.20201081

Morrone, H., Marquetti, A. ., & Miebach, A. D. (2022). Productive and Unproductive Sectors' Interactions in Brazil: A Miyazawa Analysis. *Review of Radical Political Economics*. https://doi.org/10.1177/04866134221118653

OECD (2023), *Agricultural Policy Monitoring and Evaluation 2023: Adapting Agriculture to Climate Change*, OECD Publishing, Paris, https://doi.org/10.1787/b14de474-en.)

Office of the Auditor General of Canada. (2022). *Reports of the Commissioner of the Environment and Sustainable Development to the Parliament of Canada. Just Transition to a Low-Carbon Economy*. https://www.oag-bvg.gc.ca/internet/docs/parl_cesd_202204_01_e.pdf

Pandey, F., Dwi Kuntjoro, Y., Uksan, A., & Sundari, S. (2022). The Carbon Tax Implementation Plan in Indonesia. *International Journal of Research and Scientific Innovation*, *9*(8), 46–49. www.rsisinternational.org

Prasad, M. (2022). Hidden benefits and dangers of carbon tax. *PLOS Climate*, *1*(7), e0000052. https://doi.org/10.1371/journal.pclm.0000052

Rosado, P., & Ritchie, H. (2022). Which countries have put a price on carbon? . In *Our World in Data*. https://ourworldindata.org/carbon-pricing

Schneider UA, McCarl BA. Implications of a Carbon-Based Energy Tax for U.S. Agriculture. *Agricultural and Resource Economics Review*. 2005;34(2):265-279. doi:10.1017/S1068280500008418

Sulaiman, A. A., Herodian, S., Hendriadi, A., Jamal, E., Prabowo, A., Prabowo, A., Mulyantara, L. T., Budihartim Uning, Syahyuti, & Hoerudin. (2018). Revolusi Mekanisasi Pertanian Indonesia. In *Iaard Press*.

Tomoko Hasegawa, Shinichiro Fujimori, Petr Havlík, Hugo Valin, B. L. B., Jonathan C. Doelman, Thomas Fellmann, Page Kyle, Jason F. L. Koopman, H. L.-, & Campen, Daniel Mason-D'Croz, Yuki Ochi, Ignacio Pérez Domínguez, Elke Stehfest, Timothy B. Sulser, Andrzej Tabeau, Kiyoshi Takahashi1, Jun'ya Takakura, Hans van Meijl8, Willem-Jan van Zeist, Keith Wiebe, P. W. (2018). *Introductory paragraph (150 words)*. 1–19.

Wijaya, A., & Nurcahyo, R. (2023). *Agricultural Mechanization in Indonesia and Comparison to Southeast Asia Countries*. 346–352. https://doi.org/10.46254/an12.20220067

World Bank. (2021). State and Trends of Carbon Pricing 2021. In *State and Trends of Carbon Pricing 2021*. https://doi.org/10.1596/978-1-4648-1728-1

World Bank. (2023). State and Trends of Carbon Pricing 2023. In *State and Trends of Carbon*

Pricing 2023. https://doi.org/10.1596/39796

Yusuf, A. A., & Resosudarmo, B. P. (2015). On the distributional impact of a carbon tax in developing countries: the case of Indonesia. *Environmental Economics and Policy Studies*, *17*(1), 131–156. https://doi.org/10.1007/s10018-014-0093-y

(2021). State and Trends of Carbon Pricing 2021. In *State and Trends of Carbon Pricing 2021*. https://doi.org/10.1596/978-1-4648-1728-1

Webpage Resource:

(Indonesia to Implement Carbon Tax by 2025 | D-Insights (katadata.co.id)).

Why agricultural groups fiercely oppose the carbon tax (theconversation.com)

Tristan Skolrud, Assistant Professor, University of Saskatchewan

(How carbon pricing works - Canada.ca)

Attachment:

l1The ce ofIndonesia -y Colum/RowSame AmountNote***Row***Rowtocc sectorsproducing and supplying intermediate input to other sectorsRowRural household income classesrowRowUrban household income classesrowbusiness surplusdepreciationnet indirect taxRowtotal input***Column***Columntocc sectorsutilizing and demanding intermediate input from other sectorsColumnRural household consumption classesColumnUrban household consumption classesGovernment Expendituregross inventory accumulationchange inytotal export

Tabel 2 Output and Employmentin Agricultural SectorsBasedon Indonesia IO Table 2016

Source: BPS, 2021 (processed data)

l3Household income by region and income class Based on Indonesia IO Table 16

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