

Promoting Inclusive Green Growth and Sustainable Finance through Environmental Tax: A System Dynamics Model for Ethiopia

Demessie Dea (Ph.D.)

Addis Ababa University, Department of Economics
demessiedea@gmail.com Mobile: +2510942397253

Abstract

Ethiopia's homegrown economic policy aspires to build a climate-resilient green economy through environment-friendly policies. The target is to build an economy that can absorb carbon emissions by 64% and achieve a carbon-neutral economy in the long run. This study applied a system dynamics model to examine the nexus between environmental tax, inclusive green growth, and sustainable finance. It is built on three sub-systems: economic growth, environmental sustainability, and social equity. Four idiosyncratic policy scenarios were simulated to show the various policy implications of introducing ecotax in the Ethiopian tax system including, a zero ecotax policy, imposing ecotax and investing in a green economy, investing all the taxes from pollution into the economy and an equal split of ecotax revenue between green investment and economic growth. The implication of each policy on growth, environmental sustainability, and income equality has also been examined. The findings showed that introducing ecotax and putting all into GDP resulted in non-sustainable growth and distributing ecotax revenue between growth and green investment was found to be a better mechanism to reduce pollution emissions and maintain environmental sustainability and also promote sustainable growth. The novelty of this study lies in its examination of the relationship between environmental tax, inclusive green growth, and sustainable finance within the context of Ethiopia's homegrown economic policy. By exploring these policy implications and their effects on various dimensions, this study contributes to the understanding of how ecotax implementation and revenue distribution can align with Ethiopia's aspirations for a climate-resilient, green economy.

Keywords: Inclusive Green growth, Ecotax, Sustainable Finance, Green Economy, System Dynamic

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1. Introduction

One of the critical issues driving the sustainable development goals and agenda for 2030 is building an environmentally friendly economy. This requires minimizing the activities that harm the environment. Among many mechanisms that are available in correcting environmentally friendly activities, environmental tax is found to be significant. The introduction of an environmental or green tax protects the environment in different ways including discouraging activities that contribute to environmental pollution by bringing behavior changes among customers. In addition, the introduction of an environmental tax is a way to raise revenue to achieve sustainable development goals.

Environmental taxes play a vital role in attaining environmental effectiveness, and economic efficiency and they are helping tools in raising public revenue and transparency. Protagonists of green taxes contend that green taxes tend to correct market failure by reducing the distortionary effects of other taxes and ensuring that the costs of externalities are institutionalized in the price of the product (Cottrell et al., 2015). Many countries across the globe are implemented environmental taxes for various mechanisms. As evidence, in France, ecotax is used among other things to reduce the impact of road freight transport on the environment and encourage other means of transport. The introduction of eco-tax has raised nearly 1.2 billion euros per year and distributed for rebuilding infrastructure, levy charges, and local authorities. This has contributed to an increase in government revenue and support expenditures. This by no means comes at a free cost; it has strained the relationship between the transport industry and the public and also the forwarder. The passing-on effect requires the transport service providers to pass their costs to those who benefit from the transport which intern motivates other means of transport besides road fright (French Ecotax-pvt group, 2013).

In addition, in the study conducted by Canis (2013), the United States government offers a \$7500 tax credit to encourage the production of electric cars as a means to reduce carbon emissions. To support this, the study conducted by Pigou (1920) argued that taxes on carbon emissions are the most productive approach to reducing and mitigating carbon emissions and their impact on the environment. The study conducted by Giljum et al., (2010) on the Global implications of a European environmental tax reform also shows unilateral action on implementing environmental tax reforms (ETR) results in a reduction of global material extraction by approximately 5% and a significant decrease in global CO₂ emissions of over 15%. Surprisingly, while these

environmental gains are notable, the impact on world GDP decreased by 1.4%. Though the economic and environmental outcome of Ecotax is dubious, it gives consumers and businesses the flexibility to determine how best to minimize the environmental issues. It pushes for low-cost solutions paves the way for innovation and minimizes the need for the government to attempt to “pick winners”.

In the context of Ethiopia, in response to Agenda 2063, Ethiopia introduced climate resilient green economy in 2011 and designed the strategy to be one of the middle-income countries by the year 2025 and build an economy resilient to climate change and no net increase in greenhouse gas emission by the year 2010 (*ECRGE*, 2015). The introduction of a Climate Resilient Green economy is to tackle the severity of climate change and its impact on weather-dependent agriculture which is highly exposed to the variability of climate change. And hence the government has shifted from a carbon-intensive approach to low a carbon, sustainable, and climate-resilient pathway. This is expected to reduce the per capita emission by 64% and ensure a resilient economic transformation to a carbon-neutral economy. (The Federal Democratic Republic of Ethiopia Ministry of Environment, Forest, and Climate Change, 2018).

Despite the introduction of a Climate-resilient green economy strategy, Ethiopia has seen an increasing level of carbon emissions to the air. As reported in Ethiopia’s Third National Communication to the United Nations (2020) between 1994 and 2018 due to various economic forces the Ethiopian emission increased from 108333 Gg of CO₂e to 368,835 Gg of CO₂e showing an increase of 240%. The majority of the emission comes from agriculture, forestry, and land use followed by the energy sector (7%). Numerous factors have played a role in a notable rise in carbon emissions, but the primary factor can be attributed to the inadequate availability of funds to support investments that prioritize environmental sustainability.

The Ethiopian government has made efforts to promote the CRGE strategy by allocating a portion of the government budget to sustainable development initiatives. However, these initiative funds are found insufficient to aspire to the CRGE objectives. Unless the economy generates funds to build the intended economy, there is less chance that we achieve what we aspire to as a nation only through foreign support. The government states the need for domestic savings which is just under 20% of the GDP, to be used as means of financing the climate-resilient economy.

To overcome the financial limitation and boost the support for an environmentally friendly economy, looking for alternative strategies is essential. Among the many other strategies, a well-structured Ecotax can have a significant effect on broadening the financial base and help sustainable finance to help the cause and leads to inclusive sustainable growth. Inclusive Green Growth (IGG) addresses the issue of sustainable development goals (SDGs) better than GDP and most countries have calibrated their development goals in line with SDGs but the indicators for measuring the status of sustainable development goals have yet to be designed and may only be ready by the year 2025 (Jha et al., 2018). The main purpose of this study is to examine how the introduction of green tax (Ecotax) can be used as a tool to support sustainable finances that can promote inclusive green growth in Ethiopia and create a platform for an economy to develop its capacity to support the cause without being solely dependent on external finance.

2. Literature Review

There haven’t been many studies in Ethiopia that focused on the introduction of ecotax but there were attempts directed towards attaining a sustainable environment. Desalegn et al. (2021) studied greening through taxation: the potential challenges and opportunities of plastic products in Ethiopia. His study was primarily qualitative study based on interviews exploring the opinions and ideas of respondents. The findings suggested that taxing plastic products could provide more opportunities for the country than banning them. More specifically, taxing plastic products will be more appropriate for the generation of government revenue. On the other hand, the study sites lack proper collection systems, separation of the source of disposal, a poorly designed operating system, limited organizational capacity, and unreliable collection services as challenges to plastic products.

Habtamu (2015), on the other hand, studied climate change finance in Ethiopia to gain an understanding of climate-related aid and policy frameworks which are defining the delivery of climate finance in Ethiopia. The study findings showed that even though there has been inspiring progress in the development of climate policy frameworks, funding mechanisms, and institutional arrangements, the actual implementation of the policy and functionality of the institutional arrangements has been trapped by many challenges that affect the effective delivery of climate change finance to the implementing and executing entities in the country. The study also identified that the effective delivery of climate change finance to the implementing/executing entities at local levels is challenged by various issues/impediments including inadequate capacity, lack of shared understanding about the climate change policy framework, and weak coordination across sectors and actors at all levels.

Birtukan (2020) tried to examine the need for an environmental pollution tax in Ethiopia using qualitative research based on interviews and desk reviews. Her finding showed a lack of specific tax levied on the environment and she also tried to recommend activities that require the application of environmental tax to support climate finance in Ethiopia. Though excise tax and customs duties play partial roles in protecting the

environment, the tax laws specific to pollution such as water, air, and soil are non-existent and this has failed to discourage pollutants and resulted in lost revenue for the government.

Lalu (2013) also studied the environmental taxation practice and revenue performance in Ethiopia using surveys, structured interviews, and document analysis. The result of the study showed that there is no explicit environmental tax in Ethiopia but he claimed that there is an environmental tax base that categorizes the taxes as environmental taxes. The result also suggests the role of environmental taxes and the taxes can be used as a funding source for the government. In 2018, Geregiorgis examined the administrative feasibility of the environmental tax system in Ethiopia focusing on Addis Ababa city administration, and reaffirmed the findings of other researchers. He claimed that lack of effective collection systems to direct emission tax, the municipal waste disposal systems are less environmentally friendly, and concluded that solid waste; landfill and sewer taxes are administratively feasible in Ethiopia, but effluent and emission taxes are not.

Gebregiorgis (2018) added another research on the instrumental role of the introduction of the environmental tax in the realization of the polluter pays principle in Ethiopia based on single country case-oriented comparative research design and data triangulation. The finding revealed that polluter pays principles to restore water resource degradation, carbon taxes restore air degradation and royalties encourage reasonable use of scarce resources.

Verma (2016) compared different forms of ecotaxes implemented in India and China to address carbon emissions and other environmental issues. The study provided a comprehensive definition of ecotaxes and analyzed their implementation status in the two countries. It highlighted governance-related challenges in managing funds generated from ecotaxes in India, while in China, the consumption tax was found to increase total fuel consumption and decrease social welfare.

Jiuli Yin et al (2019) tried to analyze the impact of an environmental tax on green development using a non-linear dynamic analysis using four dimensions among economic development, pollution emissions, resources consumption, and environmental tax, where the roles of environmental tax are reflected by the linear parameters. Their finding indicated a significant contribution of an environmental tax on green development. They have strongly recommended that introducing a firm government control will enhance green growth in addition to customer awareness and advancement in technology.

Guo et al. (2016) employed a system dynamics approach to analyze the pathway toward green growth in Chinese industrial regions. Their study focused on the Liaoning province and investigated the relationship between green GDP, energy consumption, and CO₂ emissions. The results indicated that a comprehensive optimization path scenario was the most effective in achieving green growth.

Musango K. et al. (2014) developed a model to analyze the transition to a green economy in South Africa. The study examined the contributions of technology policies to green economy transitions and highlighted the positive impacts of green economy interventions on sustainable resource utilization and resilient economic growth.

Gupta M et al. (2019) tried to measure the effectiveness of carbon tax on Indian road passengers' transport using a system dynamics approach. Their main objective was to examine where the carbon tax as a mitigation instrument could be effective in reducing CO₂ emissions from road passenger transport in India. Using simulation to draw various scenarios on the carbon tax on fuel based on the 2000 to 2011 major variables. The findings showed that using different tax rates has reduced CO₂ emissions in the range of 26 to 40% as compared to a baseline scenario in 2050.

Yuzhu (2010) examined the implication of green tax measures in addressing environmental problems in Hongkong using primary data through interviews and tries to make comparisons among other countries. The findings suggested mechanisms to tackle pollution from various sectors. These include restricting the number of motor vehicles, imposing excise taxes on motor fuel, and providing tax incentives to encourage energy-efficient vehicles. They also introduced a sewage charging system to reduce water pollution and to reduce waste they have introduced a plastic bag tax.

This research tries to address two basic limitations of past studies; first, it introduces ecotax to examine how it can reduce pollution emissions and enhance economic growth by sustaining income equality. Second, it has tried to connect the sustainable development goals with the pillars of inclusive green growth such as economic growth, social equity, and environmental sustainability through internally generated funds from ecotax.

3. Materials and Methods

System dynamics focuses on conceptualization, formulation, and simulation and it follows a mixed design and addresses both qualitative and quantitative methods. At first, the model identifies system descriptions for problem development and frames qualitative analysis. It also prompts the knowledge of people to understand the context of the problem or build stories based on real scenarios. Subsequently, the conceptualization will be simulated to develop a quantitative argument. The research topic requires a comprehensive view of economic growth, inclusive growth, and sustainable finance which is used to address the nexus between economic growth,

environmental sustainability, and social equity through the introduction of ecotax.

As with most taxes, Ecotax can involve a multitude of political and economic challenges, it can impose a burden on low-income households. Therefore, this study applies a more inclusive system dynamics model in addition to the previous model (Block 2013) which focused on the relationships and forces between gross domestic product, consumer debt, and income inequality within the national economy. The current model used in this study has been customized to create more familiarity with the Ethiopian economy and address the research objective based on the available data for the period 2010-2019.

The study heavily applied Desk reviews to understand the context of the problem from the data obtained from UNDP, NBE, IMF, and past studies as the primary requirement to develop a system story. The study used a qualitative approach to narrate the design and understanding of the problem and issue quantitative solutions for real-life scenarios. The model used environmental tax (Ecotax) as a policy variable to reduce pollution emissions and enhance the revenue from this tax to improve economic growth and address social equity by improving per capita income. The study identified pollution intensity as the driver of ecotax and examines the effect of these taxes on reducing emissions, enhancing economic prosperity, and maintaining environmental sustainability

3.1 The system dynamics model

System dynamics allows for the contextualization of the model to fit the real problem and in line with this, the study made significant changes to the previous models. This includes the stock and flow variables and auxiliary and exogenous variables.

This study assumes GDP as a stock variable driven by the annual growth rate and the share of ecotax revenue. The unit of measurement for GDP is birr which is translated from dollar-reported GDP based on the currency conversion rate of the reporting period in this case 2010 and the annual GDP growth rate of 11.2 percent is used for simulation.

The ecotax rate is defined as the rate of tax imposed on the level of pollution at the macro level. The emission data was calculated based on emission intensity obtained from the World Bank multiplied by GDP. This explains the level of pollution emission caused to produce one unit of output measured in birr. The new model takes into account the effect of ecotax as a sustainable economy doesn't necessarily result in a green economy. Ecotax promotes environmental behavior and it is charged on the resources that have non-renewable traits. Ecotax plays a significant role in promoting investors to invest in green technologies and systems of production (green investment) instead of classical capacity which intern preserves non-renewable resources and decreases pressure on the environment.

The tax base used to levy the tax is the aggregate pollution emission in the economy discussed in the above paragraph. The tax revenue levied on the pollution will be redistributed partly on green investment and the remaining amount will be added to the GDP to improve the per capita income and support social equity as well.

Among the proxies used to capture social equity is per capita income, which is measured as the percentage of GDP to the population. The study assumes that the tax collected from emissions will be recycled to the households in the form of GDP and which intern will intern improve their welfare. The study has also tried to see if taxes imposed on emissions affect energy consumption and force the government to invest more in climate change and direct households and businesses to use less polluting technologies.

3.1.1 Causal Loop Diagram

The critical step in the system dynamics model is to draw a feedback system through a causal loop diagram. CLD captures the causes of the dynamics and mental model; it also structures and communicates the key feedback processes to assume to cause of the problem (Sterman, 2000).

3.1.2 Feedback loops

Ecotax revenues can be reinvested in sustainable projects, leading to green growth and job creation. Higher ecotax rates can incentivize businesses and individuals to adopt greener practices, leading to reduced emissions and pollution. Green financing availability can stimulate investment in sustainable industries, further promoting inclusive green growth. Sustainable practices and technologies can lead to productivity improvements, economic competitiveness, and increased financial support. The figure below shows the causal flow diagram of ecotax and pollution emission and economic growth.

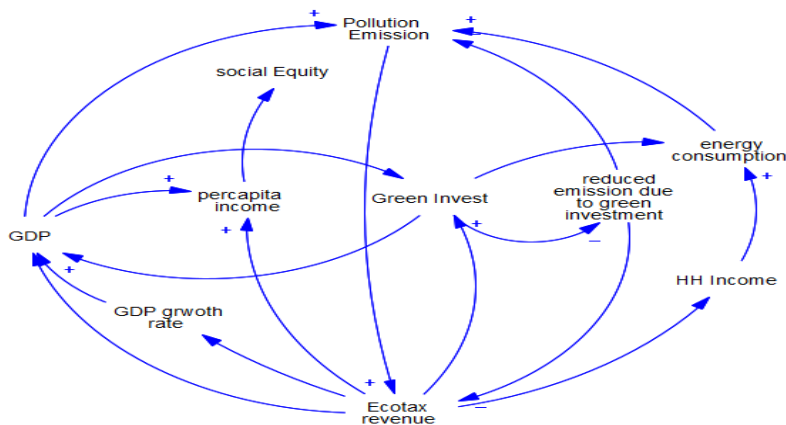


Fig 1: Forester Diagram for Ecotax

4. Results

4.1 Business as Usual (BAU)

The existing data on pollution shows an increasing pattern that coincides with economic activity and increased human interaction. The chart below shows the actual emission trends since 1990 which is the reflection of the study's basic idea that economic growth drives pollution. The actual graph here the study assumes business as usual as can be recalled from previous discussions there are no environmental taxes (ecotax) in Ethiopia. Therefore, there won't be any tax collected from pollution as the result of the socioeconomic damages assumed to endure continues.

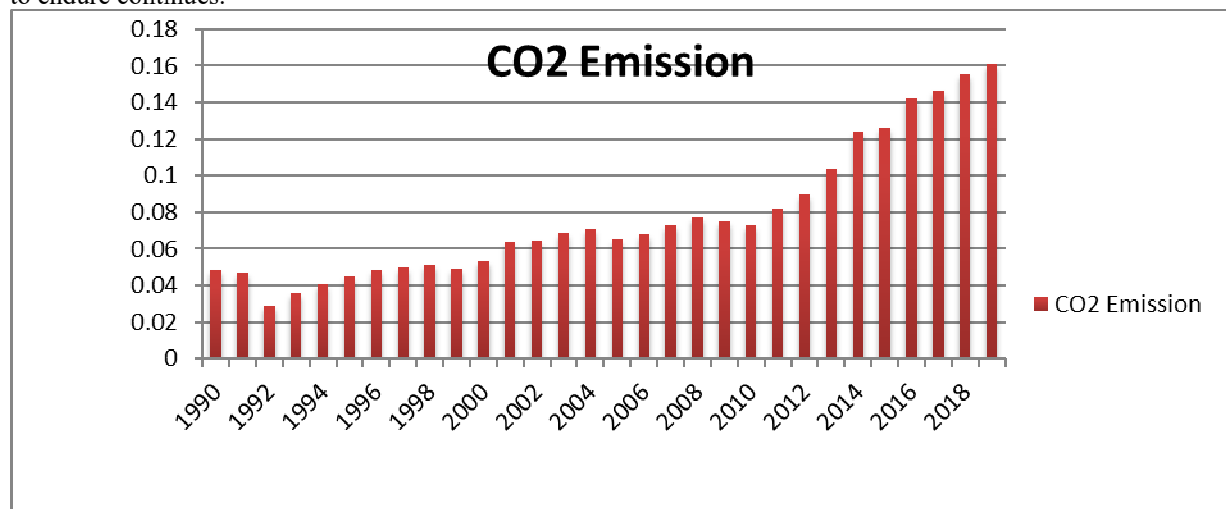


Figure 2: Actual Trend in Emission (1990-2019)

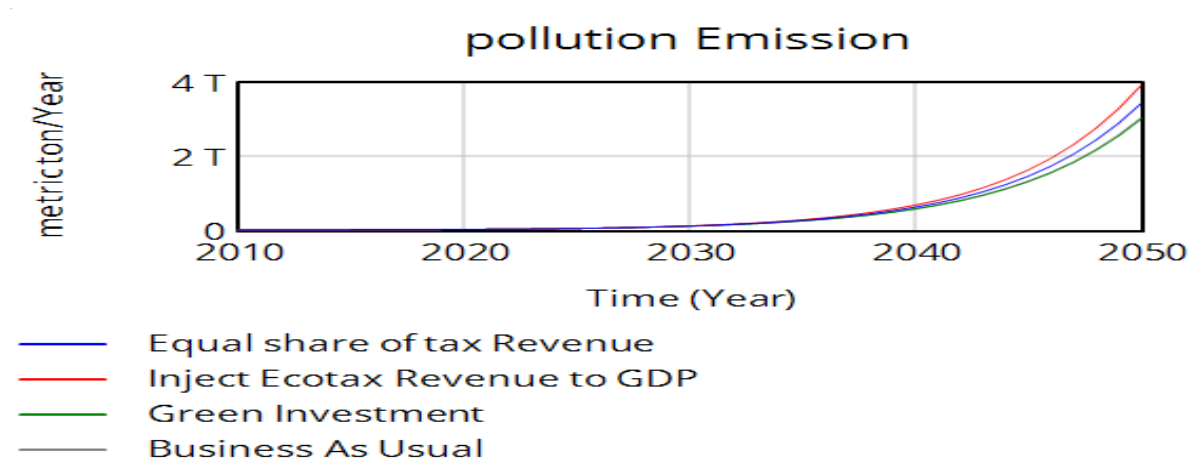


Figure 3: Business as Usual

It is quite obvious that GDP has long been criticized for its lack of inclusiveness and its limitation to show the quality of life. The main target of this study is to incorporate these dimensions into the model and show that economic growth should entertain inclusiveness and work for a sustainable environment. The baseline scenario does exactly that and shows an economy with no due diligence to the environment and social equity. The drive for the study was economic growth initiates pollution which comes from an increased use of resources and higher human activity. And as can be seen from the charts, a prospering economy almost equally yields a high level of emission. This increase in economic growth for obvious reasons increased per capita income with it. This increase in per capita income is unsustainable as it comes with environmental costs, which intern enforces household income to be used for health and other damages caused by pollution. These findings are similar to the findings of Block et al (2013) where they have stated the economy with no Ecotax reports unsustainable growth which will not address the environmental and social consequences. It would be valuable to consider the goal conflict that arises between environmental sustainability and economic growth. Sustainable growth entails considering all facets of the economy, environment, and social dynamics. However, achieving this objective is particularly challenging in countries like Ethiopia, where a significant portion of the population is heavily dependent on natural resources for their livelihood and struggles with inadequate income to meet their basic needs. Consequently, there is a heightened risk that these individuals may exploit natural resources without due consideration for the environmental consequences.

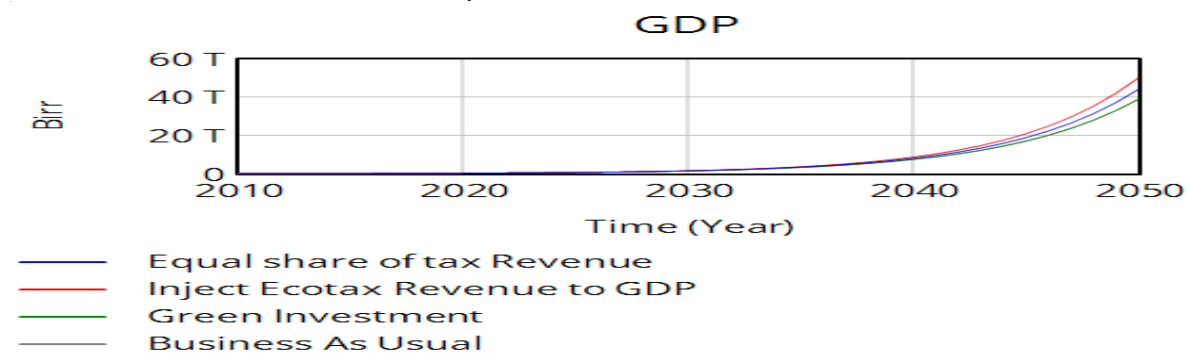


Figure 4: Simulation of GDP for share of Ecotax Revenue

4.2 Sustainable Finance through Ecotax

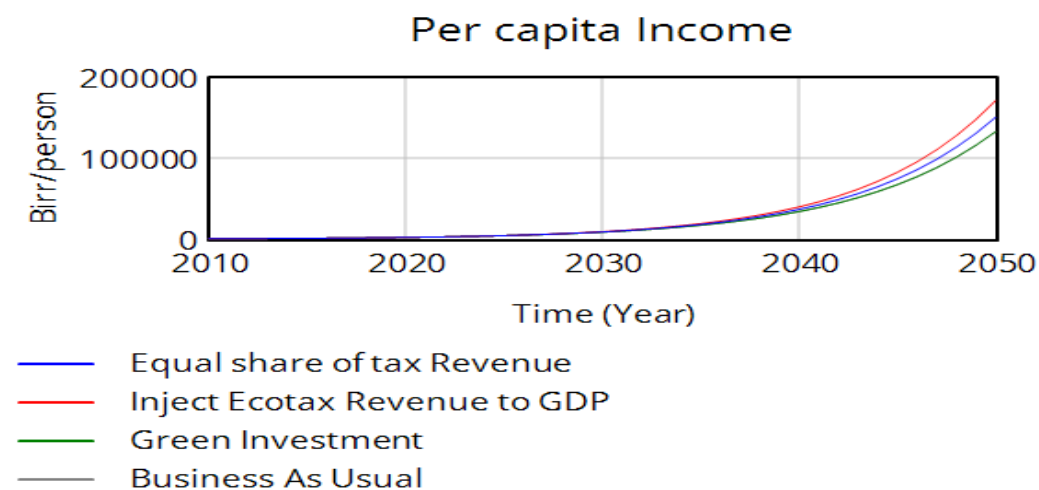


Figure 5: Sustainable Finance through Ecotax

The second scenario introduces ecotax as a means of sustainable finance but the revenue generated from pollution emissions is entirely injected into the economy to minimize income inequality. As a result of this policy, the study showed an increase in income per capita which will promote social welfare. The most noticeable result is as the revenue generated from the environment is added to the existing GDP, it will drive pollution higher but due to the non-investment of revenue generated from pollution in green investment, reduced emission due to green investment is almost nonexistent as a result pollution and per capita pollution increases. Ecotaxes have short-term negative economic effects; however, their redistributive trait will contribute to sustainable long-run economic development. This scenario rather has a minimal ecological impact as the entire revenue generated is added to economic growth and no reinvestment is made on pollution reduction.

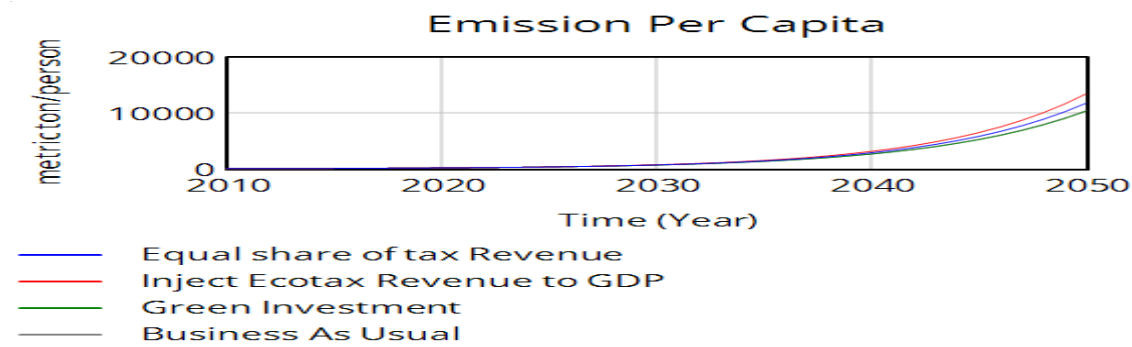


Figure 6: Simulation of Emission per capita

4.3 Green Investment and Its Implication

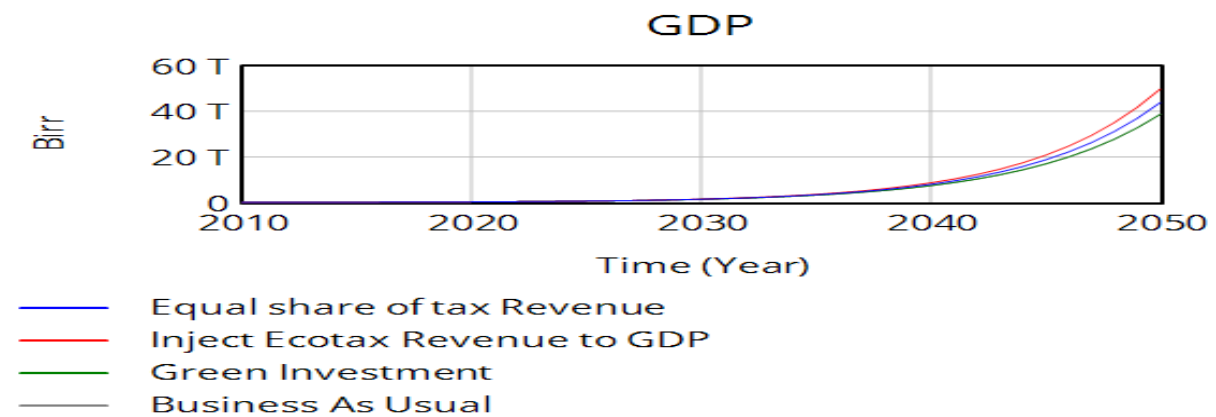


Figure 7: Green Investment and Its implication

The expected result from this scenario is whether the green investment can reduce pollution and the simulation result showed that if the revenue generated from pollution is put into a green investment, the reduced pollution from a green investment will be significantly high. Interestingly the economy will be able to grow equally with the first baseline scenario without costing the environment and disrupting the existing income inequality.

International studies showed environmental tax to be a real policy variable for a green economy. This study tried to show the relationship between pollution emission, economic growth, green investment, and per capita income when imposing ecotax. This paper confirms the view in the literature mathematically that imposing environmental tax plays an active part in green development. The role of an environmental tax on green development is reflected in this study by the comparison of the evolution of green development indicators between different scenarios. On one hand, when an environmental tax has been levied, some indicators deviate away from their null case without environmental tax. The relative indicators show that environmental tax can promote economic growth, and save resources. To make Ecotax more effective, the revenue collected from pollution needs to be recycled through investment in green technologies, infrastructures, and subsidies to e-vehicles.

4.4 The Role of Ecotax in Reducing Greenhouse Gas Emissions

Based on the three scenarios the study clearly showed the relevance of introducing environmental tax in the economy. Without ecotax, the extent of economic, social, and environmental damages is severely high. Drought, lack of agricultural productivity, and health crises will be imminent.

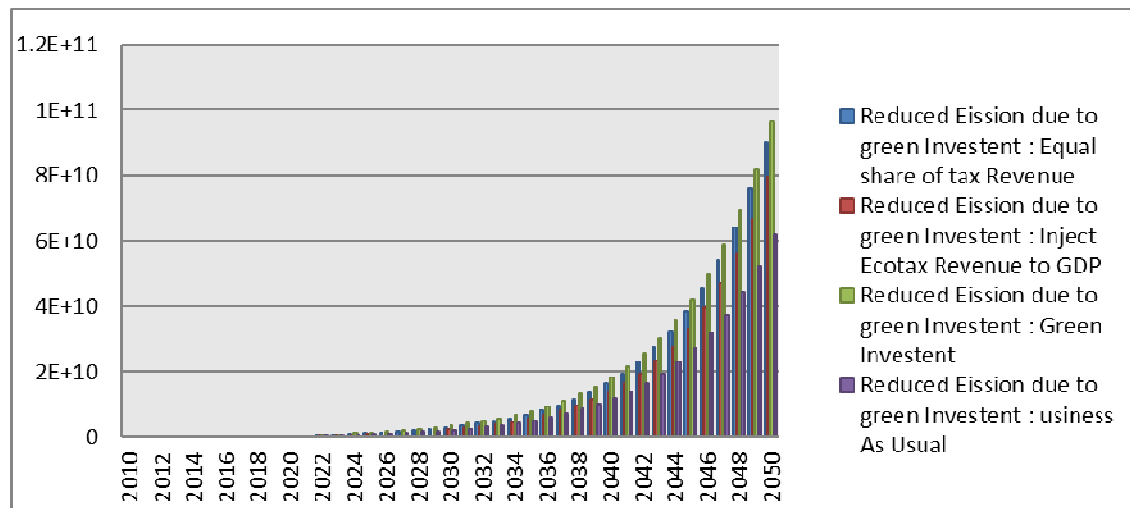


Figure 8: The Simulation Result of Various Policies on Emission Control

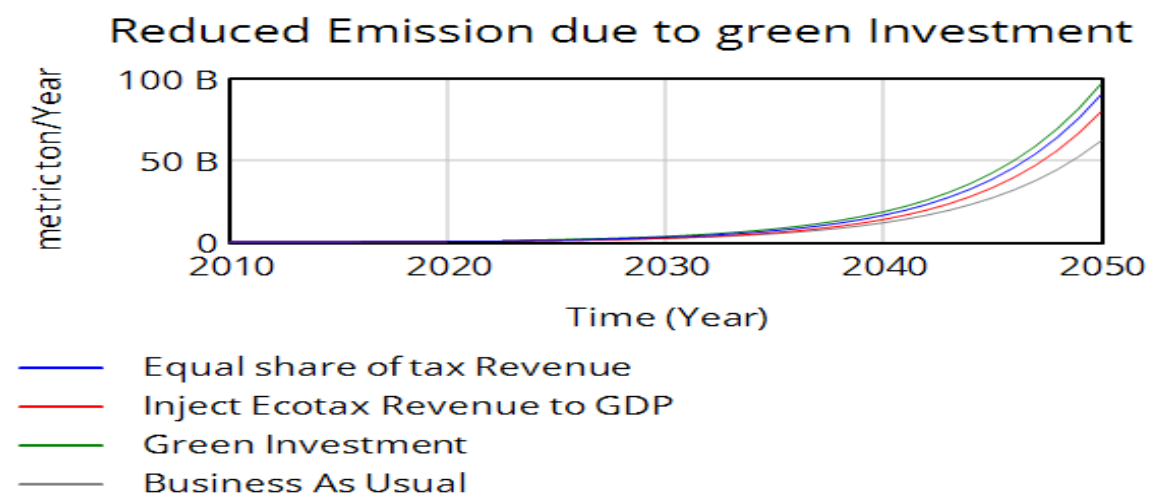


Figure 9: Reduced Greenhouse Gas Emissions

The study tried to show the economy in various scenarios: scenario one being there are no environmental taxes, scenario two imposes Ecotax and invests all the revenue generated into the economy, and scenario three uses all the Ecotax revenues for green investment. Where the investment in a green environment is minimal pollution disrupts the economy. Having no ecotax yields relatively less reduced emissions due to green investment than imposing ecotax on pollution and using all the revenues on non-sustainable growth. That is because the economy uses the revenue generated to sustain the environment to a non-sustainable growth. Whereas, if the revenues generated from ecotax are reinvested into a green investment, the reduced pollution from the scenario will be higher.

4.5 Environmental Tax and Income Inequality

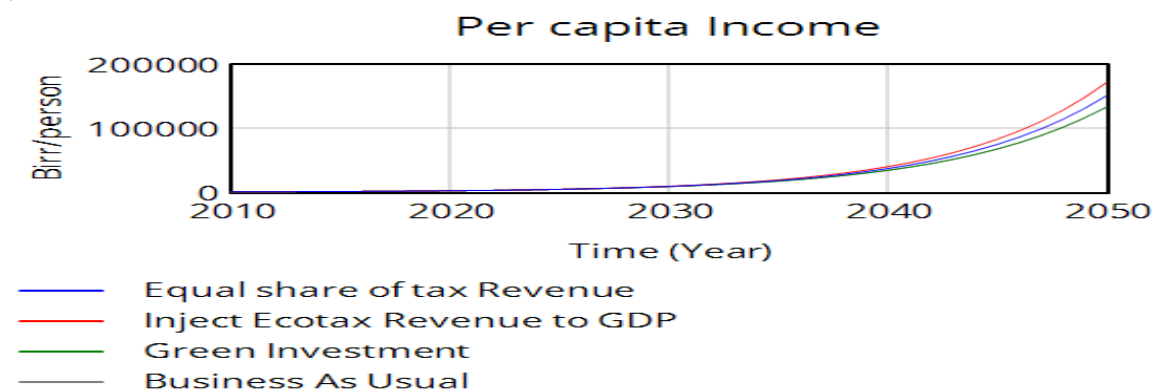


Figure 10: Simulation of changes in per capita income for different policy measures

One of the primary goals of this study was to see the implication of imposing ecotax on social welfare. Based on the three scenarios observed, imposing an environmental tax will indeed contribute to sustainable growth and maintain social income equality in the process of meeting the very need for inclusive green growth. The household per capita income reported minimal progress when there was no ecotax in place. The result of imposing ecotax and reinvesting the entire revenue on green investment has shifted the per capita income significantly. The more non-sustainable change in per capita is reported when the revenue generated from pollution is injected into economic growth in its entirety pushing the per capita income line higher.

4.6 Impact of Ecotax on Trade Openness

The most obvious role that ecotax can play in trade openness is through imports and exports. Environmental taxes both affect the location production to the extent of emission release and imports based on the content of the material purchased to climate change. The study also confirmed that trade openness reported higher values in the absence of ecotax due to the price effect on exports and imports.

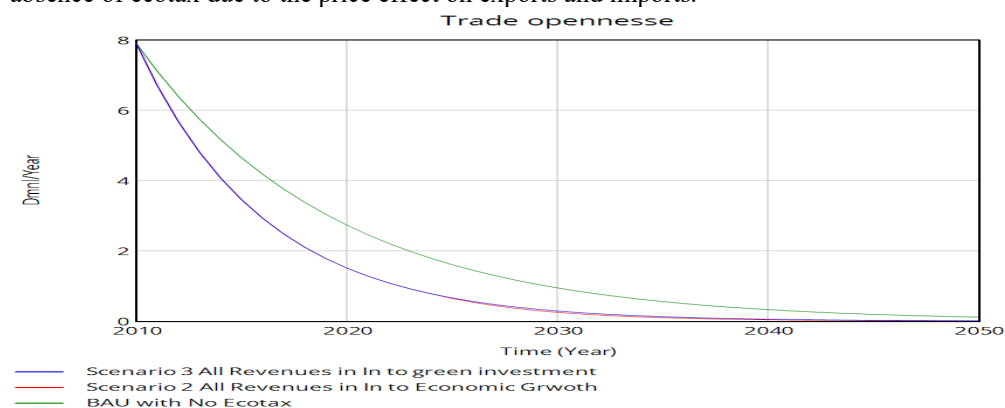


Fig 11: Ecotax and Trade Openness

The effect of ecotax on trade openness can vary depending on several factors, including the design and implementation of the ecotax, the specific industries and products affected, and the response of trading partners. Ecotaxes imposed on certain goods or industries can increase the cost of production or importation, which may make imports more expensive compared to domestically produced goods. As can be seen from the data, can lead to reduced imports and potentially restrict trade openness. As policy options ecotaxes can incentivize the shift towards more sustainable and environmentally friendly products or production methods. This shift in consumer preferences and industry practices may result in changes in trade patterns, with an increase in demand for certain types of goods such as electric cars, and a decrease in demand for others.

4. Discussions

A sustainable environment has been the key instrument in the design of Ethiopia's home-grown economic policy. And the government has taken significant efforts to mitigate climate change by promoting a green legacy and the import of electric cars. Though it has not been specifically introduced the issue of environment and social protection has been addressed in the Ethiopian tax system in the form of excise tax and customs duties. The issue of introducing ecotax is a new concept and other than its administrative feasibility, there has not been a study conducted on the matter.

The macro-level studies by Block et al (2013) have primarily argued for the introduction of ecotax to promote a sustainable environment, improve social welfare and promote economic growth. The results identified in this study particularly showed a growing trend in pollution emissions since 1994 based on business as usual scenario. The simulation result only confirmed what has been seen in the reports of the Ministry of Planning (MOP).

Over the last decades, Ethiopia has taken a significant hit in terms of economic and environmental damages and there exists no evidence which will lessen the future of this damage. The consistent economic growth has only been non-sustainable as the growth in the economy has been washed away by climate change. Destitute social welfare, increased income inequality, and recurring draught have been one of the main traits of the Ethiopian economy. Ethiopia does not contribute much to global pollution but has been severely affected by the damage due to pollution. Though the contribution to the global emission is lower, the trends show an increasing pattern from the past. All four scenarios from the simulation showed an increase in emission but the reduced emission from green investment is higher when the portion of ecotax revenue is invested in green technologies. The result aligns with Gupta (2019), and Guo (2016).

The variable representing economic growth (GDP) has shown a significant increase as the result of ecotax revenue being injected into the economy and this has also shown an increase in pollution and per capita income.

The growth is non-sustainable as it comes with environmental costs and consequences on social welfare.

The above results also showed the importance of environmental tax in minimizing emissions and income inequality and also promoting economic growth. Fan et al.(2019) discussed that imposing environmental tax creates a new path to economic development which addresses pollution intensity and resource consumption. They have also argued that ecotaxes can promote innovation and efficient utilization of resources which also substantiates the findings in this particular study in Ethiopia.

5. Conclusion

The study tried to provide valuable insight into the complex dynamics and interdependence of ecotax policies, environmental factors, economic growth indicators, and social factors. by incorporating feedback loops and simulating the model over time, it becomes possible to understand the long-term effects of ecotax policies on inclusive green growth and sustainable finance. The study result also showed how the introduction of ecotax can influence economic growth, guide a sustainable environment and maintain social equity. Through the research it was also possible to see investment in green share can limit the extent of pollution and reduce the amount of revenue generated from ecotax. Ecotax also showed a negative impact on trade openness due to its price effect on imports and export.

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