Chapter 1

Evaluation European Green Deal for Türkiye: Based on The Decision Tree Models

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Abstract

Sustainable Development Goal significantly indicates the clean energy, climate actions and environmental development. Especially with the European Green Deal's coverage of international trade, many countries have accelerated their efforts to reduce their emission rates. In addition, the fact that the importance to be taken differs on a sectoral basis, which requires the separation of emission rates by sector and the necessary measures to be taken.

This study discusses the possible consequences of including Turkey in the emissions trading system within the scope of the green deal and Sustainable Development Goal (SDG 13 and SDG 15) in the light of the reasons stated. For this prediction, the m5p method, one of the data mining decision tree methods, was used. The model examined. According to the data obtained, environmental taxes currently do not have any effect on emission the effects of environmental taxes on CO2 emissions and estimated the emission value for the next 5 years if taxes were increased values in Turkey.

1. Introduction

When we look at the development process of the EU climate policy, the first attempts were made in the 1980s and 1990s, and it started to be developed step by step in the 2000s and 2010s. In 2019, important steps have been taken with the European Green Deal (Delbeke & Vis, 2019; Kulovesi

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& Oberthür, 2020). At this point, it is known that the EU has an important role. It is an accepted fact that the EU has the role of an international climate leader, as it creates the most advanced climate policy framework among the world's leading actors (Jordan & Moore, 2020; Oberthür & Dupont, 2021).

Emissions resulting from human and economic activities increase the greenhouse gas concentration in the atmosphere, cause the earth to warm up and cause climate change. According to the report of The Intergovernmental Panel on Climate Change (IPCC), global warming must remain at least 1.5°C to control the negative effects of climate change. However, with the continuation of the current policies, it is estimated that the earth's temperature will be 3°C until 2050 (IPCC, 2018). For this reason, the European Union has adopted various policies to reduce greenhouse gas emissions and support energy from clean sources, while being at the forefront of global action against climate change and active in international climate negotiations. However, the EU has not been able to convincingly reduce its greenhouse gas emissions. As greenhouse gas emissions in transport increase, coal use in electricity systems continues to play a permanent role. In this case, it is known that the first steps were taken in December 2019, when Ursula Von Der Leyen, the European Commission presidential candidate, suggested that important steps should be taken to expand and strengthen the EU climate policy. The EU has proposed the European Green Deal (EGD) until 2050 and the European Climate Law, which will require climate neutrality. In order to achieve this goal, a comprehensive policy framework covering climate, energy, environment, industry, economic and social aspects, which is the main subject of the EGD, was deemed necessary. At this point, Von der Leyen's suggestions with the Constitutional Court include increasing the EU's 2030 emission reduction target from 40 percent to 55 percent, introducing a carbon limit tax, preparing a Sustainable European Investment Plan, and the European Investment Bank's proposals. (EIB) into a climate bank, expansion of the EU emissions trading system (ETS) and development of a new industrial policy for Europe (Von der Leyen, 2019).

Carbon pricing, sustainable investment, industrial policy, and a fair and competitive transformation draw attention as the most important factors here. In order to ensure a fair competition environment especially for European and foreign producers and to have a significant impact on the environmental policies of third countries, the EU wishes to apply a carbon price to all energy-intensive imports (Bochkarev, 2020). In particular, carbon dioxide, which has a rate of 70% in greenhouse gas emissions, is considered the most important gas that needs to be reduced. Although large economies, especially energy production and industrial sectors, show a development dependent on

carbon dioxide emissions, it is necessary to limit carbon emissions, which have such a negative effect on climate change (Ustun, 2021). It therefore aims to establish a meaningful carbon price for all sectors by strengthening the EU emissions trading system (ETS) and forcing EU countries to raise the price of emissions not covered by the ETS. It is essential to put a price on all emissions because pricing encourages all interested parties to reduce their greenhouse gas footprints. Without such pricing, there is no effective reduction of emissions through subsidies or other climate policy measures such as standards. Therefore, it becomes necessary to apply a reasonable price for all greenhouse gas emissions (Claeys et al., 2022). However, it is stated that such an application may produce different results. In particular, "green taxation" can create social and political problems in countries that are fragile and rely heavily on hydrocarbon revenues to finance their budgets. Such a situation may cause third countries to respond with additional tariffs or various trade barriers to equalize competition. In addition, if the US applies a carbon tax to the shale gas sector, there may be trade problems between the USA and the EU (Bochkarev, 2020). For this reason, the carbon tax applied in accordance with the WTO rules should be a protective measure for all countries (GATT, 1947). On the other hand, it is considered necessary to prepare a carbon border tax to provide a robust mechanism against carbon leakage. It is therefore necessary to introduce other tools first, including subsidies for low-carbon exports and stricter environmental standards that importers must comply with to access the EU market. On the other hand, in this context, the necessity of adopting a sustainable investment strategy and supporting green investment by shifting funds to this purpose to balance the increasing costs encountered due to high carbon prices has also manifested itself (Claeys et al., 2022). However, the EGD is not only a matter of concern to the EU, but also binds all countries that have political, social, economic, or financial relations with the EU. In particular, the EGD aims to lead the way in the transformation of greenhouse gas emissions in countries other than the EU. At this point, the necessity of making commercial agreements to reduce greenhouse gas emissions in Turkey, which has an intense trade volume with the EU, and to ensure that the carbon limit is kept in balance by aiming to minimize the risk of carbon leakage has manifested (Sahin et al., 2021).

Turkey represents 3.6% of the EU's total goods trade with the world in 2020. With this ratio, it is the 6th largest trading partner of the EU. While the EU is Turkey's largest export and import partner by far, it is also the main source of investment (European Commission, 2022).

Table 1. 2018-2021 Trade in Goods, € billions (European Commission, 2022)

Year	EU imports	EU exports	Balance
2018	66.9	69.2	2.3
2019	69.8	68.3	-1.6
2020	62.4	70.1	7.7
2021	78.0	79.3	1.3

As can be seen in Table 1, the total trade in goods between the EU and Turkey reached € 157.3 billion in 2021. Therefore, as stated in the EGD, between the EU and Turkey, which has such a high trade volume, it was necessary for the EU to reach an agreement with Turkey to prevent carbon emissions from leaking into Europe. In particular, Turkey needs to make its production structure suitable for green transformation by purifying it from pollution and carbon emissions. At this point, it is observed that the share of electricity generation in Turkey's total greenhouse gas, which is calculated as 506 million tons of CO2 equivalent in 2019, is 140 million tons (28%) (Ecer et al., 2021). On the other hand, it is concluded that it would be more correct to start green transformation in the field of energy, considering that the largest share in total greenhouse gas emissions in Turkey in 2020, with 70.2% as CO2 equivalent, is energy-based emissions (TUIK, 2022). Therefore, the changes that the European Green Deal and the European Union will implement in many sectors directly concern the countries that have trade relations with the EU. Turkey, one of these countries, needs to make the necessary arrangements in order not to disrupt its trade relations with the EU countries, which are among the most important trade partners. For all these reasons, it is estimated that estimating greenhouse gas emissions based on the decision tree model for Turkey within the framework of the European Green Deal will eliminate the gap in the literature.

In the first part of the study, information about the European Green Deal was shared and the operation of Carbon Border Adjustment Mechanism (CBAM) was explained. Then, the possible effects of the CBAM on Turkey were given. A literature review was conducted on studies examining the relationship between environmental taxes and pollution, which play an important role in reducing environmental pollution and the effects of the European Green Deal on Turkey were explained. In the last part, the findings obtained after the model and methodology were evaluated and various policy recommendations were made.

2. European Green Deal

The global warming that the world is going through and therefore climate change has damaging consequences in many areas, especially in food. In particular, the increasing trend of greenhouse gas emissions after the industrial revolution is dragging the world towards the point of no return. The map in Figure 1 shows the per capita CO2 emissions of the world's countries. Overall, countries such as Canada, the United States, Russia produce more than 10 tons of emissions per person.

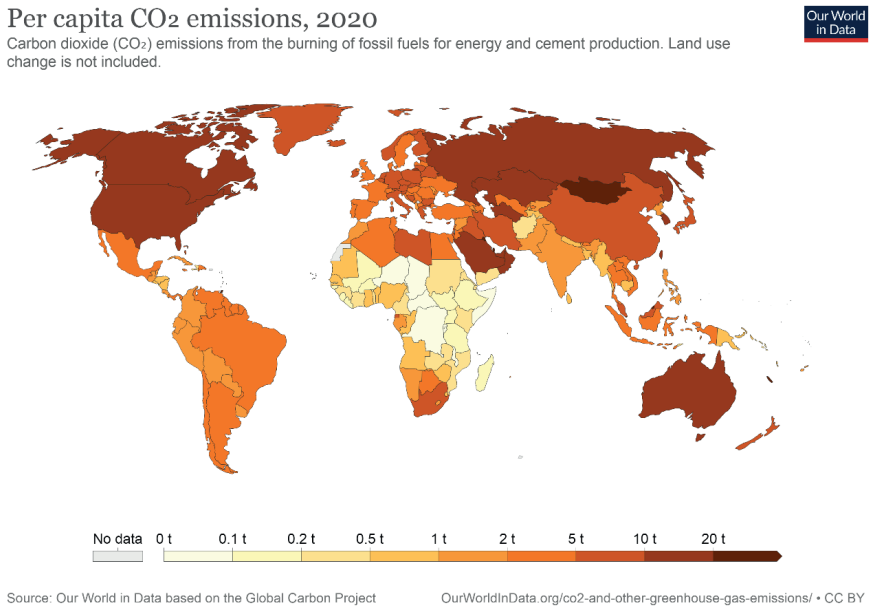

Figure 1: CO2 emissions per capita (tonnes) (https://ourworldindata.org/co2-emissions, 2022)

EU countries and Turkey are again high but have CO2 emissions of less than 10 tons per person. Environmental problems that arise because of high emission values have always been put on the second plan due to the growth concerns of developed and developing countries. However, with the negative effects of global temperature increase on human health, biodiversity, nature, climate, etc. are clearly felt, permanent plans and programs have started to be developed instead of palliative solutions. The process that started with the Kyoto protocol continued with the Paris climate agreement, to which Turkey is a party, and then expanded with the EGD, one of the most comprehensive climate programs. The EGD can be expressed as a solution to the problem of

global climate change. With a modern economic transformation that ensures competitive and efficient sourcing, it aims to reduce CO2 emissions by 55% by 2030 and to achieve climate neutrality by 2050 (EC, 2019).

European economy, social life, urban life, agricultural, energy and environmental policies contain a comprehensive change strategy. These strategies are expressed in the European Union Commission report as follows (EU, 2019):

- Within the framework of the EU neutral climate objective, despite the 61% growth rate of the economy between 1990 and 2018, it managed to reduce greenhouse gas emissions by 23%. By 2050, this rate is targeted to be 60% or more. In this context, developing carbon pricing is an important and effective strategy for reducing greenhouse gas emissions.
- Construction, use and renovation of buildings require significant amounts of energy and mineral resources. In addition, the energy consumption of buildings is over 40%. In order to reduce energy consumption and more efficient processes in construction activities, EU member states have initiated a "wave of renewals" for private and public buildings. In this context, the use of different energy sources is supported to ensure energy efficiency.
- One in 3 of the EU's greenhouse gas emissions comes from transport and the rate is steadily increasing. For a neutral climate, it is aimed to reduce greenhouse gas emissions by 90% by 2050. In this direction, it is planned to develop multimodal transportation networks.
- Agricultural activities cause water, air and soil pollution and lead to climate change and overuse, especially by reducing biodiversity. Within the scope of the farm-to-fork strategy, new opportunities have been created in the food chain. It is aimed to create awareness in the field of food chain and sustainable food, which includes technology and scientific discoveries.
- New technologies, sustainable solutions and disruptive innovation are critical to achieving the objectives of the European Green Deal. To maintain its competitive advantage in clean technologies, the EU needs to significantly increase the large-scale distribution and representation of new technologies across sectors and across the single market, creating new innovative value chains.

- National budgets play a key role in the transition. Greater use of green budgeting tools will help shift public investment, consumption, and taxation toward green priorities and away from harmful subsidies.

The EU has created an emissions trading system to reduce greenhouse gas emissions. ETS is one of the cornerstones of the EU greenhouse gas emissions reduction strategy. (EC, 2021a). This system works within the scope of the "upper limit and trade" system. The upper limit is set on the total amount of certain greenhouse gases that can be emitted by the facilities covered by the system. As the total emission rate decreases, so does the upper limit. In practice, carbon is offered to the sectors free of charge, but when the companies operating in these sectors exceed the specified upper limit rate, they buy the excess amount from the market (TUSIAD, 2020). This system, which is currently only applied with EU countries, will be expanded within the scope of international trade, and will also include countries that trade with EU countries. This system, called Carbon Border Adjustment Mechanism (CRAM), aims to reduce carbon leakage from the EU and plans to implement new taxes and non-tariff barriers in international trade in accordance with World Organization rules (TUSIAD, 2020; UNCTAD, 2021). In this context, the average carbon emissions of the companies in the EU will be determined according to the sectors and taxation will be made for the part above this average. However, the fact that this practice does not cover non-EU countries causes a problem such as "carbon leakage" (EC, 2021 b). When the studies in this field are examined, it is seen that carbon leakage does not create a significant problem for the EU industry. Since the application is only valid for EU member states and does not cover the countries that trade with these countries, the chances of success of the application are reduced. For this reason, it has been decided to introduce tax/tariff barriers in non-EU countries due to excessive carbon emissions with the CRAM. The functioning of the CRAM is shown in Table 2:

Table 2: How the CRAM Mechanism Works (Lowe, 2021)

CRAM Models	Definition
Excise Tax	Imposition of a Carbon tax on products that emit carbon during production, regardless of where the product comes from. For example, a tax of 50 euros per ton of CO2 emitted, regardless of where the product is produced. As with the application of carbon VAT, the tax will be paid at the time of importation.
Production Fee	Imposing a carbon tax on European producers. In this case, a tax occurs compared to the carbon cost covered by an average EU-based company producing a similar product. For example, the carbon tax per ton of iron (50 euros), which is determined considering the average costs in domestic production, will also apply to imported iron.
Connecting with ETS	If the de facto EU local carbon price is determined by the cost of ETS permits, CRAM importers will pay import duties compared to costs determined by the average production of EU-based firms. For example, if an average EU iron producer has 2 units of ETS permits, the same unit quantity of imported iron will also face the same tax rate.

Considering the definitions in Table 2, ETS will be moved to the international level and companies located in third countries will be subject to carbon tax as much as the tax paid by companies operating in EU countries. Therefore, countries that trade with the EU need to regulate their carbon emissions. Third countries will either introduce practices to reduce emissions or introduce taxes within the framework of the EU CRAM system.

The implementation of the CRAM will cover risky sectors in the first phase. These sectors are cement, iron and steel, aluminum, electricity, and fertilizer. Importers of these goods covered by the CRAM will apply to the institutions in their country and obtain a SG certificate. If importers declare that a carbon tax has been paid during the production of products from third countries, the CRAM tax will not be levied on these firms (EC, 2021 b). The top 20 countries engaged in foreign trade in the specified sectors with EU countries are listed in Figure 2.

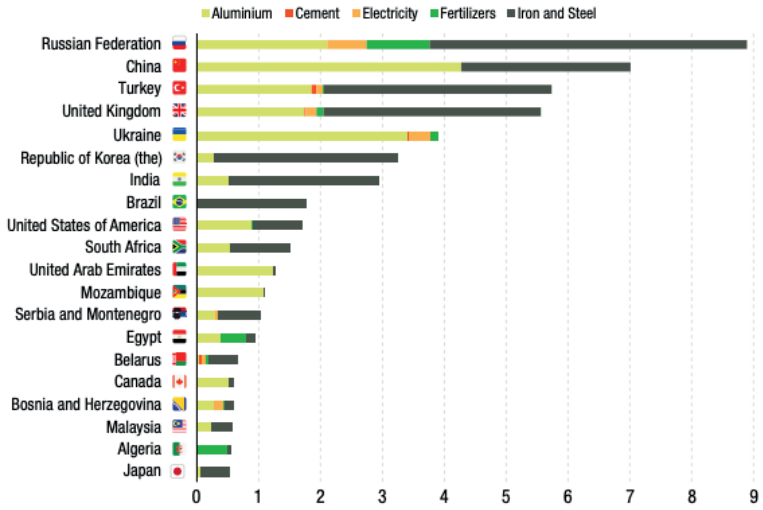

Figure 2: Top 20 Countries Where the EU Trade the Most by Risk Sectors (UNCTAD, 2021)

According to the figure, the top 3 countries that will be most affected by the CRAM system are Russia, China, and Turkey. The trade share of these countries in risky sectors is quite high. Therefore, it is important that the sectors in these countries determine the upper limit of their emission rates according to the EU level. At this stage, the impact of the CRAM depends on the trade model, the carbon intensity of the products produced by countries and the carbon policies of EU trading partners (EC, 2021b).

One of the main criticisms of carbon regulation at the border is the debate that it will reduce free trade. In this context, it is stated that carbon regulation at the border is a hidden foreign trade tax. In the country commission report submitted within the scope of the impact analysis of the European Union Carbon Regulation at the Border of the Republic of Turkey, it was stated that unilateral actions such as the carbon limit are regulations related to international trade risk that create trade barriers and are used as protectionists, and may lead to unilateral trade retaliations, especially in times of trade wars. Therefore, it is stated that the trade divergent effects of the CRAM should be eliminated. Another criticism of the implementation of the ministry is that the CRAM should be stretched according to the economic characteristics of the countries. In particular, it is stated that the special conditions of developing countries should be taken into consideration in practice. Another criticism is the effectiveness of the application. However, the effectiveness of the application and its effects

on the climate will be clearly demonstrated in the following processes.

3. Dilemma for Turkey

Turkey is a party to the Paris agreement and has signed the agreement in 2021, becoming one of the countries that take active measures against global climate change. Within the scope of this agreement, Turkey has declared its greenhouse gas emissions as a reduction from an increase of up to 21% in the "Intended National Contribution" declaration foreseen until 2030. In addition, Turkey aims for net zero emissions by 2053 (GRB, 2021). Therefore, in this respect, it is seen that Turkey has a decisive stance on climate change with the agreements to which it is a party and its domestic legal practices. However, at this stage, some economic, cultural, and legal practices should be implemented. Due to Turkey, EU membership process, Customs Union, geographical proximity, etc., EU countries trade the most. In Table 3, the trade shares of the country groups to which Turkey exports the most are included.

Table 3: Share of Turkey's export countries in all exports (%) (TÜİK, 2021)

Country Groups	2021	2020	2019	2018
A-European Union (EU 27)	41.32128983	41.27600459	42.42937729	43.70364535
B-Other countries	58.67871017	58.72399541	57.57062271	56.29635465
1-Other Europe (except EU)	23.80945449	24.50000839	23.48109108	23.98346698
2-North Africa	10.09301225	9.259424925	10.40172836	9.940968236
3-Other Africa	5.958142579	6.039680172	5.565763936	5.18738237
4-North America	12.41207518	11.23141135	9.563936607	10.43864885
5-Central America and Caribbean	1.848485504	1.458462764	1.697193732	1.652813272
6-South America	2.718969499	1.935992548	1.760774312	1.877726735
7-Near and Middle East	29.0226674	31.45328122	33.62814241	32.48750138
8-Other Asia	13.03788993	12.8245916	12.87093968	13.33675835
9-Australia and New Zealand	0.853131192	0.840498687	0.751498367	0.827174348
10-Other Countries and Regions	0.246171978	0.456648341	0.278931512	0.267559486

Note: Calculated by the authors using TURKSTAT data.

When Table 3, which contains data between 2018-2021, is examined, an average of 42% of Turkey's total exports are made to EU member countries. The share of other countries is on average about 58%. Since these data are taken into consideration, with the launch of the CRAM, Turkey 's exports will be significantly affected by the carbon tax. At this stage, it is necessary to add the advantages of Turkey 's membership in the Customs Union. The Customs Union allows the free movement of goods and services in Turkey and the EU countries. The place of the carbon tax to be introduced with the implementation of the CRAM within the scope of the Customs Union is controversial. Turkey draws attention to its rights arising from this agreement and states that the trade divergent effect of the practice should be eliminated. In addition, as mentioned before, the implementation of the CRAM according to the specific conditions of the countries is also recommended by Turkey. Looking at the emission rate in general and the countries with which the EU trades, it is clear that the CRAM will impose an additional cost on Turkey, but this cost can be reduced by the relevant regulations within the country.

4. Literature

The available literature on the European Green Deal and its implications is very limited. Even if the studies on Turkey have been intensified recently, they are mostly in the form of literature reviews. This is why the literature will be examined under two basic parts. In the first part, studies investigating the effects of environmental taxes on pollution, and the second part on the effects of EGD on Turkey are included.

The Relationship Between Environmental Taxes and Pollution

Kumbaroglu (2003), in his study discussing the effects of environmental taxes on the Turkish economy, states that taxes offer important opportunities in environmental and economic terms. Within the scope of the study, five different tax scenarios were created. The scenarios are built on assumptions of a choice to impose an emissions tax to improve environmental quality, a reduction in energy imports to accelerate economic development, and a replacement for hard coal and lignite with oil and gas to reduce pollution. The results obtained point to the importance of energy saving and indicate that the effect on national income varies according to the type of greenhouse gas emissions that are taxed. For example, in the study, it is stated that energy exports decrease with the addition of tax on NOx and that national income will increase with this effect, while a tax on SO2 reduces national income. Acar and Yeldan, (2016), in their study, state that by reducing the

incentive of Turkey's use of coal for energy, national income will decrease due to dependence on energy imports, but at the same time it will reduce CO2 emissions and improve environmental quality. Bouzaher et al. (2015) designed two different scenarios in their work. The first scenario considers environmental taxes on the energy use of households and industry, while the second scenario examines the process of introducing an additional sectoral tax on CO2 emissions and transferring these tax revenues to green innovation. Accordingly, in the first scenario, national income decreases, but in the second scenario, national income increases. Yeldan and Voyvoda (2015) state in their studies that the implementation of carbon taxes in Turkey and the redirection of the renewable energy investment fund to be created with these taxes to renewable energy sources increase energy efficiency. Ding et. al. (2019) stated that environmental taxes reduced pollution by about 28% in countries with high pollution rates. Likewise, Polat and Ergün (2021) have concluded that environmental taxes reduce pollution emissions in their studies for 21 EU countries. Hao et. In their study investigating the effects of green growth (2021), they found that environmental taxes reduced CO2 consumption. Born, meat. In their study, al. (2022) examined the effects of green growth and environmental taxes between 1994 and 2018 for 25 environmentally friendly countries. According to the results, environmental taxes are one of the key factors to reduce CO2 emissions. Ozkaya (2022) investigated the effects of economic growth and environmental taxes on pollution in terms of European Union countries. At the end of the study, while a two-way causal relationship was found between economic growth and environmental pollution, no relationship was found between pollution and environmental taxes. Similarly, Yavuz and Ergen (2022) examined environmental taxes and environmental pollution for G20 countries in their studies and concluded that environmental taxes do not influence pollution. In contrast, Damirova and Yayla (2020) examined the relationship between environmental pollution and microeconomic variables using data from 1995 to 2016 for Denmark, Hungary, İtaly, Malta, Netherlands, Portugal, Slovakia, Switzerland England and Turkey. The study also looked at the effectiveness of environmental taxes. Accordingly, environmental taxes do not have a statistically significant effect on environmental pollution.

The Impact of the European Green Deal on Turkey

When the academic studies on the effects of the CRAM on Turkey are examined, it is seen that the environmental impact is positive. In the TUSIAD (2020) report prepared by Yeldan et al., two different scenarios related to the effects of EGD were studied. In the first of these scenarios, the price per ton of carbon is calculated as 30 euros, and in the second as

50 euros. According to the data obtained, when 30 euros are taxed, GDP increases by 5.7%, while the tax application of 50 euros increases by 6.6%. As a result of taxation, greenhouse gas emissions decrease by 16.5% and 15%, respectively. Therefore, the implementation of the CRAM both offers an opportunity for environmental improvement for Turkey and triggers the increase in national income. However, unlike these studies, according to a study conducted by UNCTAD (2021), it is stated that the introduction of an additional CO2 tax in the sector will have an impact on the iron and steel sector in Turkey and that the competitiveness in this sector will decrease. In addition, it is stated that both price increase will occur in other sectors and competitiveness will be adversely affected. Turker and Aydin (2022) similarly state in their studies that environmental sustainability will be positively affected if EGD strategies are supported by national policies.

When these studies are evaluated, it is seen that the implementation of the CRAM reduces greenhouse gas emissions for Turkey, but the impact on the country's economy depends on national policies.

5. Model and Methodology

The application model of this study is to investigate the effect of tax and other variables on the emission value of Turkey and to predict the emission in the next 5 years to observe the effect of environmental tax. In practice, M5p algorithm, one of the data mining decision tree algorithms, was used. The M5p algorithm was preferred because it provides linear regression models for the past and future and estimation of values in the data set.

5.1 Data

The data used in the study were obtained by literature review. The dataset covers the period 1994-2020 and consists of environmental tax, exports, energy consumption, waste sector CO2 emissions, agricultural sector CO2 emissions, and total CO2 emissions. The data are presented in Figure 3.

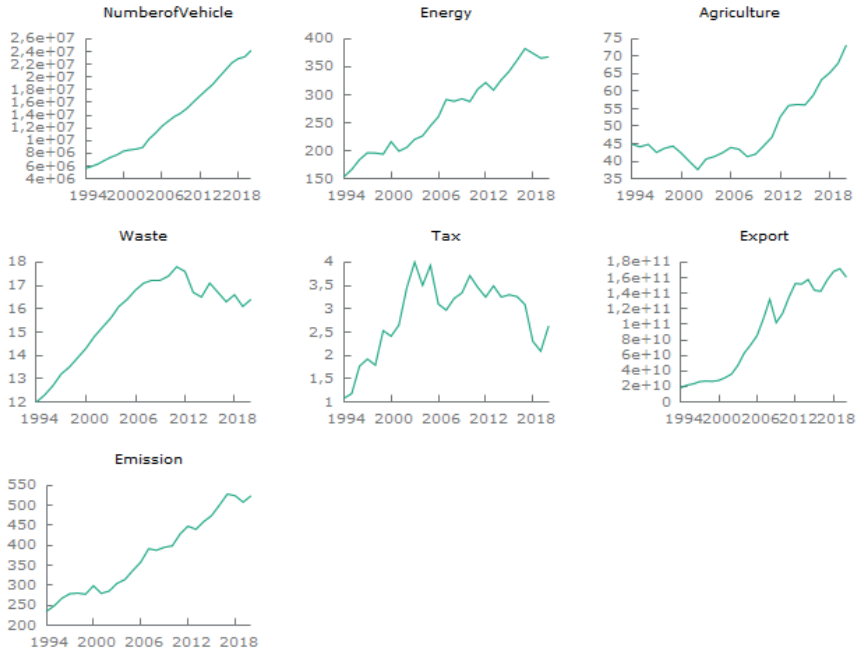

Figure 3: Data

When the time series of the variables in Figure 3 are examined, it is seen that the emission rates in Turkey have increased continuously since 1994. In addition, while exports, energy consumption and the number of vehicles increase over time, there are fluctuations in the trend of environmental taxes, and there is a decrease in environmental taxes, especially in the later period.

5.2. Decision Trees

Decision tree methods, one of the data mining methods, are a forecasting model that can be used in classification and regression problems. When a decision tree is used for classification tasks, it is referred to as a classification tree. When used for regression tasks, it is called a regression tree. Decisions trees clearly define the functional dependencies of the target feature on descriptive attributes (H. Dahan et al. 2014; Maimon, O. Z., & Rokach, L. 2014).

5.3 M5p

Model Trees (M5) was proposed by Quinlan in 1992 as a tree algorithm for predicting continuous variables. They were led by Wang and Witten (1998) to propose the M5p algorithm, which is categorical and has the

advantages of being able to deal with continuous and incomplete variables (Frank, Wang Y, Inglis, Holmes and Witten, 1998; Barros, Basgalupp; Lin, L., Wang, Q., & Sadek, A. W, 2016).

The M5P algorithm consists of four main steps. In the first step, the input space is divided into several subspaces to form a tree. Subspace variability from root to node is minimized using the division criterion. Construction of the tree is done using the standard deviation reduction (SDR) factor that maximizes the expected error reduction at the node as follows (Behnood, A., Behnood, V., Gharehveran, M. M., & Alyamac, K. E. 2017).:

$$SDR = sd(T) - \frac{\sum_{i=1}^{n} |T_i|}{|T|} * sd(T)$$

T=number of samples;

Ti=number of samples that represent the sample that have the potential rise

sd=standard deviation.

In the second step, a linear regression model is created by using the data associated with that subspace in each subspace. Here, a pruning technique is used to solve the overtraining problem. During the pruning process, smoothing is done to compensate for sharp discontinuities between adjacent linear patterns. The smoothing process combines all the patterns from leaf to root to create the final pattern of the leaf. In this process, the estimated value of the leaf is filtered out on its way back to the root. The combination of this value with the value predicted by linear regression for that node is as follows:

$$E' = \frac{ne + ka}{n + k}$$

E': is the estimated value to the next top node,

e: is the prediction passed from below to the current node,

a : is the value predicted by the model at this node,

n is the number of training samples reaching the following node and k is a constant.

5.4. Model Evaluation Criteria

In order to evaluate the model created in the study, the most common accuracy metrics of regression models: MAE (Mean Absolute Error, MAE), RMSE (Root Mean Square Error, RMSE), MAPE (Mean Absolute Percentage Error, MAPE) were used. Accuracy metrics are shown in Table 4.

Table 4: Accuracy metrics

$MAE = \frac{1}{n}\sum_{i=1}^{n}\lvert y - y' \rvert$
$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(\hat{y}_i - y_i)^2}{n}}$
$MAPE = \frac{100\%}{n}\sum_{i=1}^{n}\left\lvert\frac{e_i}{y_t}\right\rvert$

6. Empirical Results

In the data set used, the value with the highest SDR value was determined as the number of vehicles and LM1 and LM2 predictive models were created.

Table 5: Lineer Models

Number of Vehicle <= 11686609.5 : LM1 (12/2.617%)	Number of Vehicle > 11686609.5 : LM2 (15/3.999%)
LM num: 1 emissions = + 0.9457 * Energy + 67.4095	LM num: 2 emissions = + 0.8816 * Energy + 58.3739

When Table 5 is examined, it is seen that the CO2 amounts originating from the energy sector are effective in estimating the CO2 emission rate. With the number of vehicles exceeding 11686609.5, the energy coefficient in the LM2 model decreased to 0.8816.

Table 6: Model Evaluation Criteria

MAPE	0,0112
RMSE	0,015
MAE	3,8753

In Table 6, the values of the M5p model created in the study according to the performance evaluation criteria are included. When the values in Table 6 are examined, it can be said that the model is successful. In Figure 4, the realized and estimated values of the emission value in the model are included according to the years. When Figure 4 is examined, it can be said that the emission value is constantly increasing, and this value will reach 597,792 metric tons in 2025.

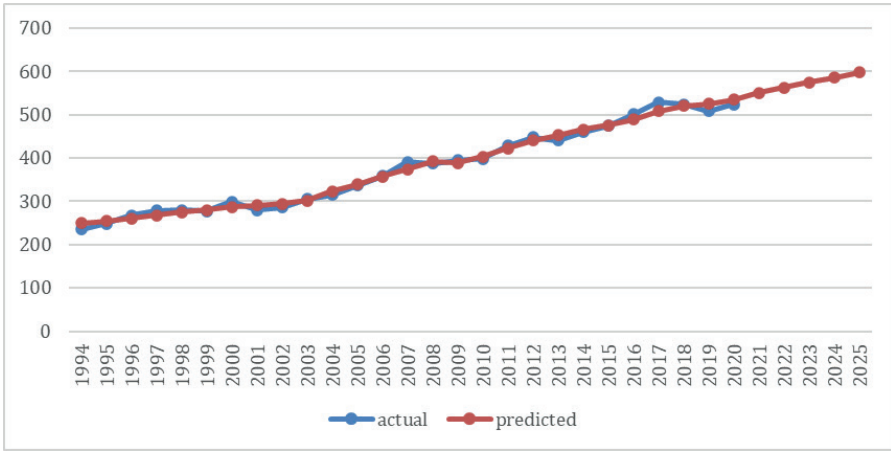

Figure 4: CO2 Emissions Actual and Prediction According to Tax

In the prospective forecast model, where the tax value created in the application increased by two times and the non-tax values in the data set were fixed, the emission value was estimated as 523,443. It can be said that the tax value does not help to reduce the emission value.

Conclusion and Policy Recommendation

The European green deal includes various arrangements both within the EU and internationally, with European countries systematizing several measures against climate change. The emissions trading system, which is primarily implemented within the borders of the EU, aims to improve and minimize emission values. In order to improve the effectiveness of this implementation, the emissions trading system will also be made available to other countries that trade with the EU, bringing it closer to the goal of minimizing CO2 emissions.

Turkey is also one of the countries that will be included in the emissions trading system because it is among the countries that trade the most with the

EU. At this stage, it makes the necessary arrangements to be included in this system with the road map (2016) prepared by the Ministry of Environment and Urbanization of Turkey. Turkey is expected to start implementing its emissions trading system by the end of 2022. However, within the framework of the EU green deal, carbon application at the border points to an important problem for Turkey. Turkey draws attention to its rights arising from the customs union regarding emission regulation (Ministry of Trade, 2020). The implementation of the application is likely to increase the costs of the companies and therefore there will be a decrease in foreign trade with the EU due to these costs.

In the study, the effects of environmental taxes on emission trading in Turkey and the future values of emission values were estimated because of increasing the effectiveness of tax application. For these predictions MAE (Mean Absolute Error, MAE), RMSE (Root Mean Square Error, RMSE), MAPE (Mean Absolute Percentage Error, MAPE) methods were used. According to the data obtained, environmental taxes currently have no effect on emission values in Turkey. This result is thought to be since environmental taxes are not effective. Especially in developing countries, taxes such as environmental taxes are seen as costs that reduce production and are not applied effectively. In addition, according to the analysis made under the assumption of increasing taxes within the scope of the emission trading system, it was concluded that the effects of taxes were limited in the next 5 years. However, it is estimated that this system, which is not effective in the short term, may reduce the emission values of the companies with R & D and innovation studies in the long term and thus the emission values will decrease. Therefore, in order to effectively implement climate change policies, it is important for Turkey to develop more effective and preventive policies, to conduct audits on a firm basis, and to direct companies to R & D and innovation studies in order to reduce emission values.

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