A Possible Link Between Forest Exploitation and Greenhouse Gases in Romania Between 2008-2020

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Abstract

The increasingly obvious impact of climate change, in recent decades, has produced numerous negative effects and a series of measures have been imposed for reducing the emissions and for adaption to climate change. Forestry activities try to find a balance between adapting forest regeneration practices to the needs imposed by climate change. Two important economic activities: Forestry and logging and the second one the Wood processing and manufacturing play an important role on the quality of environmental factors in general and on greenhouse gas emissions in particular. CO_2, CH_4, N_2O resulting from wood processing activities were used in this paper to evaluate the possible correlation between these emissions and the volume of extracted wood. The data were collected by the National Institute of Statistics during 2008-2020. The volume of extracted wood varies between 16,704 thousand cubic meters in 2008 and 19,652 thousand cubic meters in 2020, the analyzed period average being 18,218 thousand cubic meters. The CO_2 emissions from Wood processing and manufacturing are significantly higher than the CO_2 emissions from Forestry and logging, for example in 2008 the emissions from the first source were 230 thousand cubic meters compared to only 28 thousand cubic meters from the second source. The analysis of CH_4 and N_2O emissions shows that the two activities have relatively the same impact on air quality. Until now, there have been extensive studies on Romanian forestry activities from a qualitative and quantitative perspective, but it is important to observe the link between the volume of wood extracted and the emissions of greenhouse gases.

Keywords: greenhouse gases, forestry and logging, wood processing and manufacturing

Introduction

Environmental protection, economic development and social aspect are the three key elements of sustainable development of a society. Mostly, the forest industry has an essential role in national economies but should not be omitted the negative environmental consequences of the production process of goods and the but also other related services resulting from silvicultural activities [1]. Referring to the significance of the ecological repercussion of forestry the effects are differentiated, the most affected being biodiversity [2,3], air [4,5], soil [6,7] and water [8,9]. In recent decades were brought into the foreground the key-role of forestry in the climate change. Forests play a crucial position in mitigating climate change and its effects, in addition to ensure the sustainable consumption and production patterns.

The greenhouse gas emissions (GHG) tend result in a growing yearly mean of air and surface temperature, abundant rainfall in short periods, extreme weather, food supply disruptions and respiratory disease and what is more significant the negative effects will be visible in all types of ecosystems [10].

Climate change, the decrease in the utilization of natural resources, the attempt to find renewable sources of energy, the recycle of waste constituents and the innovations created to conserve the earth are targets of considerable concern to provide sustainable development in a protected living condition. For climate change mitigation, Romania aims to reduce GHG emissions by 43.9% until 2030 compared to the level in 2005 [11]. It is an assumed target for the achievement of which a series of steps and strict measures are necessary, but also a permanent monitoring with clear reporting of the stages achieved and those that must be accomplished. The increasingly obvious impact of climate change, in recent decades, has produced numerous negative effects and a series of measures have been imposed for reducing the emissions and for adaption to climate change [12].

As stated by the National Forest Inventory the forestry fund in Romania is around 7,037,606 hectares of which 6,929,047 are trees-covered land and 56,652 are lands for afforestation [13]. If we refer in percentages to the national area, we notice that the forested area is 29% and although it seems a significant percentage, Romania is below the European Union (EU) average of 39%. Given that Romania is the only state in the EU on whose area there are five biogeographical regions and an exceptional bio-diversity of flora and fauna, having the whole trophic pyramid (notably by reason of the existence of populations of large carnivores, extinct in several European countries), national forests representing a reservoir of biodiversity for the whole European continent. Simultaneously, Romania in addition has significant forest regions with primary structures, wherefore exist a legislative demand for rigorous identification and protection.

According to the national forest accounting plan for Romania, for the first period of employment (2021-2025) the large majority of Romania's forests are among 40 and 80 years old which indicates that, at present, it is in the most valuable moment to be exploited. Despite that, the exploited quantity did not outstrip the increase of the forests, the volume of wood extracted being less compared with the potential estimated by the forestry facilities and approved at the national level [14, 15]. The forestry

arrangements are the documents that establish the maximum harvest level in accordance with the ecological and socio-economic objectives, with the main objective being the conservation of biodiversity and the sustainable use of natural resources.

Notwithstanding the fact that in the most recent 30 years there have been important socio-economic transformations, the administrative system of the forestry sector has persisted controlled by the pattern of an inflexible, normative legislative framework, indistinguishable regarding the type of proprietorship, established practically completely on authority instruments and control. Considering the actual scheme does not provide the predictable efficiency, there is an evident social pressure including all communities involved in and impacted by forest management: private landowners, state and private forestry authority, forest exploitation and timber manufacture corporations, eco-friendly protection associations, civil society etc. [16].

The lately adopted National Forest Strategy 2030 approaches the target to encourage the viable circular forest bioeconomy using durable wood outputs and by means of reinforcing the function of the forest-based industry encouraging the commercial expansion of regional associations. It is also mentioned in the same strategy the idea that the functional zoning of the state forests provides, currently, to the primacy supply of water management, anti-erosion and climate protection ecosystem services, in the case of 42% of the forests in the national forest fund [17].

Materials and Methods

The data underlying this study were collected between 2000 and 2020 by the National Institute of Statistics using the methodology for carrying out statistical research in forestry approved in 2010.

The forest statistical indicators inserted in the statistical study in forestry consider the characteristics of the Romanian forest resource management framework, with the purpose of adjusting and coordinating them with ones included in the statistical procedure of the European Union having concomitantly the objective of sustainable and integral management, in compliance with the requirements forestry agreements and the legislation of the forestry management, of the forest fund public possessions of the state and private ownership, for the purpose of growing the contribution of forests to the amendment of environmental factors and to provide the requirements of the national economy with timber, with other forest products and with specific forestry services.

The annual questionnaire through which the data was collected at the county level contains information about the gross volume of wood per foot from the lots related to the year of production for which the statistical research is being prepared, collected until December 31 of the respective year by certified legal entities or by private individuals.

The second group of information included in the questionnaire refers to the area covered with cuttings and their type (regeneration cuttings, conservation cuttings, accidental product cuttings, hygiene cuttings, Care cuttings in young forests, cuttings for the transformation of wooded pastures, etc.).

For the forest fund that is public property of the state, the questionnaires were collected by the State Forestry Departments, through the Forestry Directorates of the National Forest Management - Romsilva and other institutions, and for the forest fund and/or forest vegetation of private owners by the Private Forestry Departments. At the National Institute of Statistics level, the verification, correction, validation of the data and the obtaining of the tables are carried out using IT applications made in Visual FoxPro 6.0.

The indicators deriving from data management include information about the area of the forest fund by categories of use, species and forms of proprietorship, by counties, development regions, macro-regions and at the national level; turnover of forestry units by product category at national level; harvested wood by species and forms of ownership, by counties, development regions, macro-regions and at the national level; the surface covered with cuttings by types of cuttings and forms of ownership by counties, development regions, macro-regions and at the national level; forest regeneration works carried out in the forest fund, degraded lands and other lands outside the forest fund by land categories, species and forms of ownership, by counties, development regions, macro-regions and at the national level.

The Air Emission Accounts (AEA) methodology developed by Eurostat was implemented by the National Institute of Statistics in Romania and data were collected on different sectors of economic activities. Emissions of the main greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) were collected based on annual questionnaires at national level, on economic activities.

Results and Discussions

In order to get an overall picture, we created a map of Romania in which the volume of wood harvested by counties for the period 2008-2020 was graphically (see Fig. 1). Depending on the amount of wood collected, we have colored each county in different shades of green, dark green being the counties with the largest amounts of wood harvested and in shades of light green the counties with the smallest amounts of wood harvested, the quantities being measured in thousands of cubic meters.
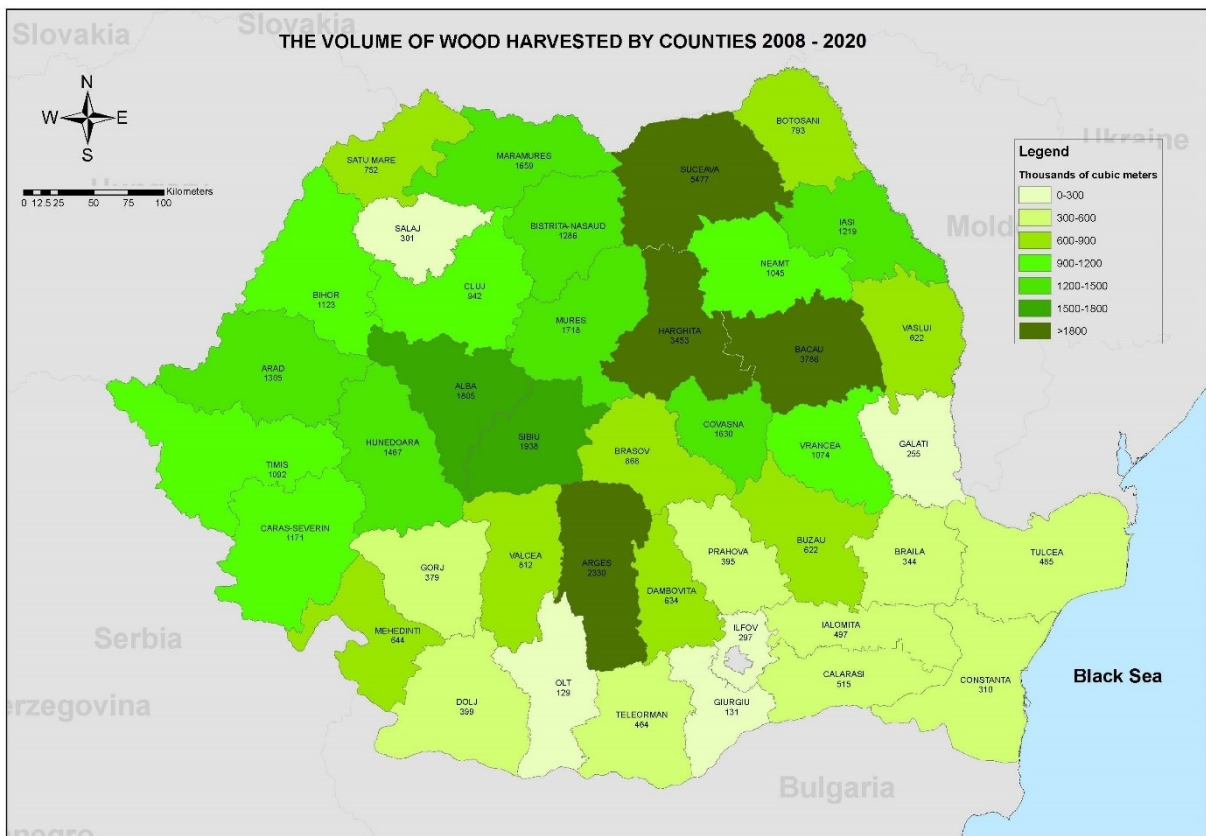
Fig. 1. The volume of harvested wood in Romania between 2008 – 2020, by counties.

The first three counties with the largest quantities of wood collected are: Suceava 5477 thousand of cubic meters, Bacau 3786 thousand of cubic meters and Harghita 3453 thousand of cubic meters. The economic activities in these three counties are based on the furniture industry, related activities of the construction, agricultural and energy sectors. Forest biomass provides heating for households in Romania, but also the prospect of securing jobs, especially in rural areas. The first three counties where there was the smallest volume of wood was extracted are: Olt 129 thousand of cubic meters, Giurgiu 131 thousand of cubic meters and Galati 255 thousand of cubic meters. The average of these quantities in the analyzed period was 1126, which represents approximately 1/10 of the total volume at the national level for the county where the lowest amount was recorded and approximately 5 times higher in the county where the highest was recorded amount of the volume of harvested wood.

As the evolution over time of the volume of wood harvested by counties, there is an upward trend, the amount in 2008 being 16,704 thousand of cubic meters compared to 19,652 thousand of cubic meters in 2020 (Fig. 2).
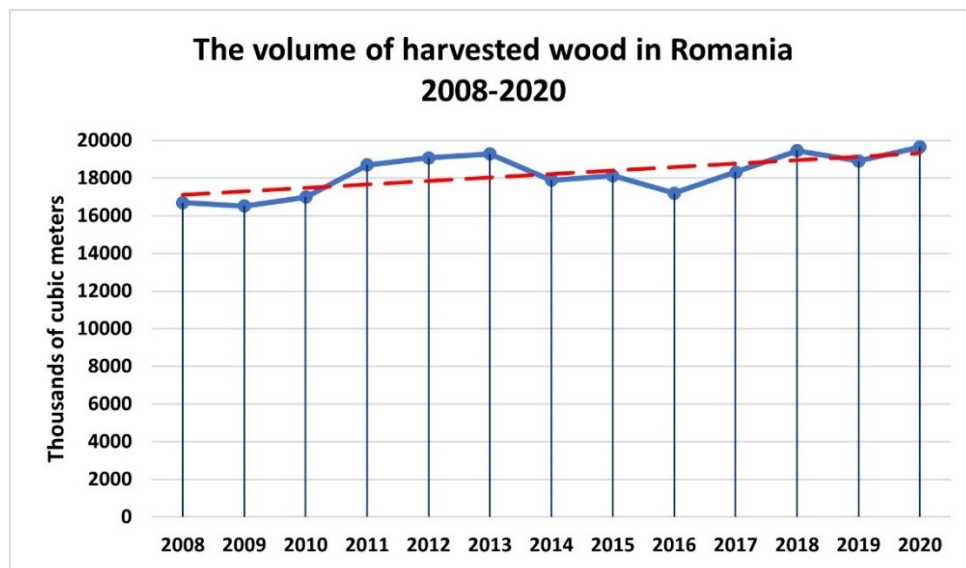

Fig. 2. The evolution of the volume of harvested wood in Romania between 2008 - 2020.

From the graphic analysis of the volume of harvested wood, it is obvious that larger quantities were extracted, over 19,000 thousand of cubic meters in the years 2012, 2013, 2018 and 2020, compared to the period 2008 - 2010 when quantities around 1,600 thousand of cubic meters were extracted.

Not only the amount of wood extracted from the Romanian forests should be considered, but also the economic value of the wood collected. In this sense, in Fig. 3 were represented the volume of harvested wood by species. The highest percentage, 38%, is represented by softwood (pine, fir, spruce) and in second place, 32% beech.
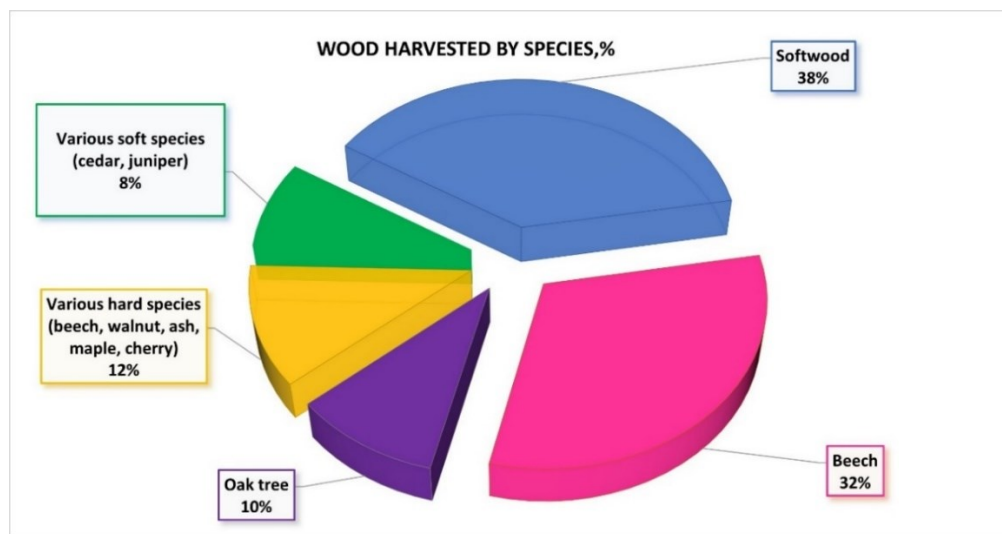

Fig. 3. The percent of harvested wood in Romania between 2008 – 2020, by species.

The small difference is then 12% various hard species (beech, walnut, oak, ash, maple, cherry), 10% oak tree and 8% various soft species (pine, fir, spruce). Globally it is obvious that the cheapest wood comes from soft species (spruce, pine and fir). Spruce, pine and fir grow quickly and are used as commercial timber, pulpwood for paper, including particle board, plywood and fiberboard, so production and harvesting occurs on a larger scale than other types of wood. On the other hand, in Romania it can be observed that the volume of various soft species (cedar, juniper) extracted in the thirteen analyzed years is only 8%, the lowest percentage. Timber from hard species is most frequently used in furniture, floors, wood and veneer, and in Romania the percentage of various hard species (beech, walnut, ash, maple, cherry) is 12%.

Forests have a crucial role in mitigating climate change and its effects; therefore, it is important to have a comparative analysis of the volume of wood extracted and the amount of greenhouse gas emissions. At the national level, the two economic activities for which carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) emissions are collected are: Forestry and logging and Wood processing and manufacturing. Forestry and logging close to nature play an important role in the development of an adequate and environmentally friendly forest infrastructure, it has many beneficial effects and without which the sustainable management of the forest is very difficult.

Fig. 4 indicates the evolution of the volume of harvested wood compared with the emissions of the main greenhouse gases: CO_2, CH_4, N_2O resulting from Forestry and logging, in the analyzed period. The three greenhouse gases are represented in the turquoise color, area graph and the quantities of extracted wood are represented in the green columns (Fig. 4).
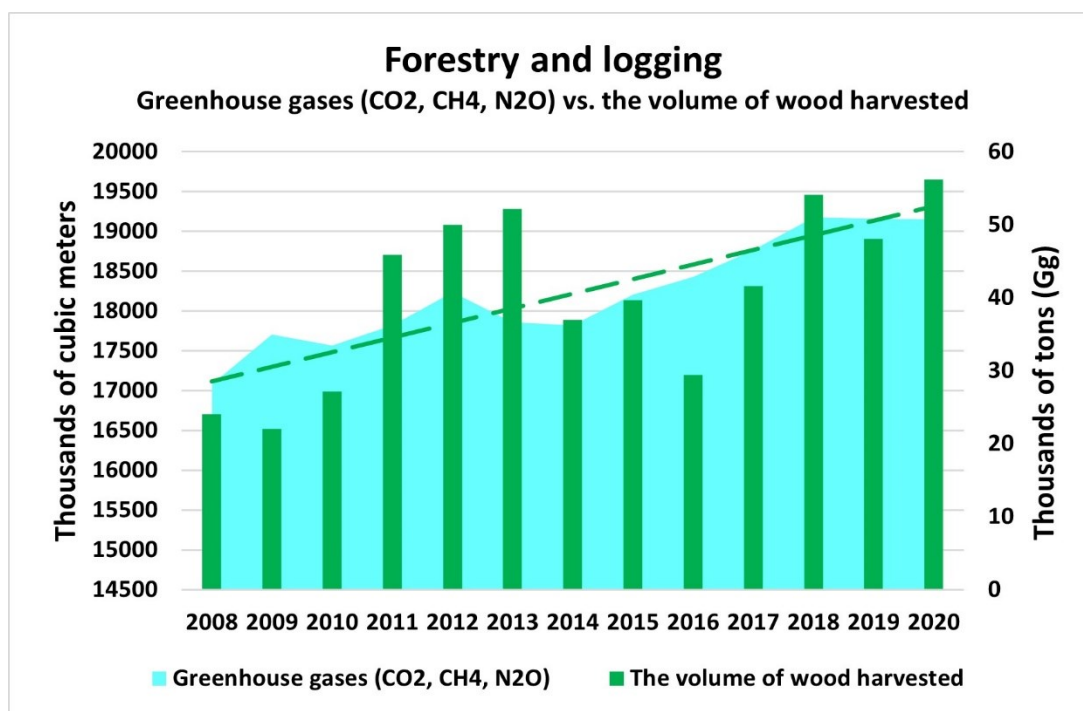

Fig. 4. The evolution of the volume of harvested wood compared with the emissions of greenhouse gases: CO_2, CH_4, N_2O resulting from economic activity: Forestry and logging, in Romania between 2008 - 2020.

The three greenhouse gases were summed for each year of the period 2008 - 2020. Both elements included in the graph have an upward trend with values starting in 2008 from 28.1 thousand of tons (Gg) for CO_2, 0.0123 thousand of tons (Gg) for CH_4 and 0.038 thousand of tons (Gg) for N_2O and which reach 50.75 thousand of tons (Gg) for CO_2, 0.0181 thousand of tons (Gg) for CH_4 and 0.0101 thousand of tons (Gg) for N_2O in 2020. The largest increases are observed for CO_2, almost from single to double in the thirteen years and in the case of N_2O from single to triple. As the total amount of greenhouse gas emissions, there are variations from 28.2 thousand of tons (Gg) in 2008 and 50.78 thousand of tons (Gg) in 2020.

Both the values of greenhouse gas emissions and the volume of wood extracted have increased values in 2012 and 2018 and a decrease observed in both cases in 2014, the evolutions having the same pattern quite well overlapped.

In Fig. 5 were graphically represented the evolution of the volume of harvested wood compared with the emissions of the main greenhouse gases: CO_2, CH_4, N_2O resulting from Wood processing and manufacturing, in the analyzed period. The three greenhouse gases are represented in the purple color, area graph and the quantities of extracted wood are represented in the blue-black columns (Fig. 5).

Unlike the economic activity analyzed previously, in this case the trend of greenhouse gas emissions is a decreasing one, and the trend of the volume of wood extracted is an increasing one.
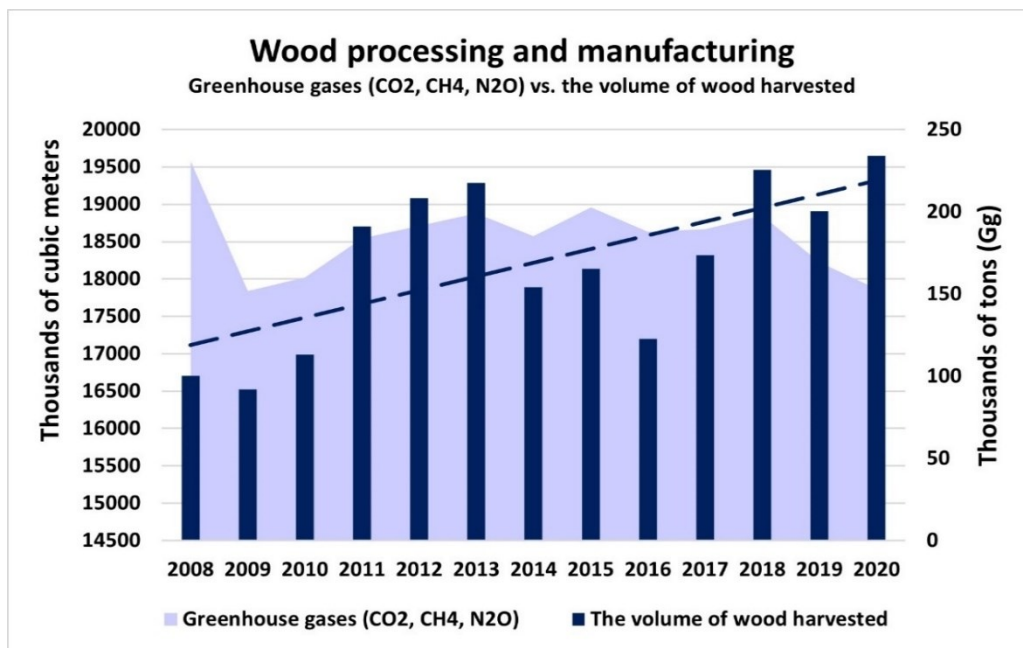

Fig. 5. The evolution of the volume of harvested wood compared with the emissions of greenhouse gases: CO_2, CH_4, N_2O resulting from economic activity: Wood processing and manufacturing, in Romania between 2008 - 2020.

In the case of Wood processing and manufacturing may be observed values starting in 2008 from 230.7 thousand of tons (Gg) for CO_2, 0.0131 thousand of tons (Gg) for CH_4 and 0.0038 thousand of tons (Gg) for N_2O and which reach 153.1 thousand of tons (Gg) for CO_2, 0.0062 thousand of tons (Gg) for CH_4 and 0.0023 thousand of tons (Gg) for N_2O in 2020. The highest amount of greenhouse gas emissions is 230.7 thousand of tons (Gg) the amount from 2008, and the lowest one is 151.61 thousand of tons (Gg) from the year 2009.

The two categories of data analyzed in this graph are quite different from the point of view of evolution in the given period. However, in the period from 2011 to 2013, increases can be seen both in the case of the volume of harvested wood and for Wood processing and manufacturing, and in 2014 a decrease can be observed for the volume of harvested wood and for Wood processing and manufacturing.

Indeed, during the period 2008-2020, Wood processing and manufacturing activity was reduced in Romania and there is a limited final processing industry for furniture, raw materials for construction and housing. This decrease in industrial activity also results in a decrease in pollutant emissions in the atmosphere.

Conclusion

Permanent monitoring and a correct analysis of greenhouse gases and the volume of wood extracted are the primary elements for a sustainable development.

During the period 2008 -2020, Suceava is the county with the highest amount of the volume of harvested wood and Olt is the county with the lowest amount of the volume of harvested wood and if we analyze this information from the point of view of the relief forms, we can conclude that the largest quantities were extracted from the mountain and hill areas and the smallest quantities from the plain areas. The evolution of the volume of harvested wood in Romania between 2008 – 2020 has an ascendent tendency, similar to the emissions of the most important greenhouse gases analyzed: CO_2, CH_4, N_2O resulting from economic activity: Forestry and logging and the opposite to the greenhouse gases: CO_2, CH_4, N_2O resulting from economic activity: Wood processing and manufacturing.

In the analyzed years the highest percentage of harvested wood is 38%, being represented by softwood (pine, fir, spruce) compared with the lowest percentage, only 8%, the volume of various soft species (cedar, juniper).

Henceforth the whole forestry sector should be better link to the national economy and society, contributing to the generally goal of climate neutrality and energy independence and the forestry activities ought to try to find a balance between adapting forest regeneration practices to the needs imposed by climate change.

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