STUDY CONCERNING THE IMPORTANCE OF FOREST CURTAINS IN THE DIMINUTION OF CLIMATE CHANGE RISKS IN ROMANIA

NICOLETA MATEOC-SÎRB, CAMELIA MĂNESCU, T. MATEOC, E.BIANU ARCADIE, ADA-FLAVIA CRISTINA

Banat´s University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Romania

Faculty of Agricultural Management

Abstract: *At the beginning of this century and millennium, specialists in the field admit that economic and social development as main concern of the nations – i.e. economic growth and life quality – depend directly on the available nature resources. They have developed the concept of "sustainable development" which is at the basis of developed or developing economies. Certain irrational models of economic growth practiced at present in the world cause ecologic unbalance, and contribute to the appearance of certain phenomena that cause climate change and to the deterioration of the environment and of human life quality. The authors of this paper present the main phenomena that face the environment as a result of climate change and a few solutions that could diminish their negative effects on environment and humans.*

Keywords: climate change, disastrous effects, meteorological phenomena, forest curtains

INTRODUCTION

Sustainable development ensures a balance between two major goals of humankind: continuation of economic and social development and protection and improvement of the environment. This is the only way to ensure the welfare of both present and future generations. To do so, all the countries in the world need access to and improving in the field of the use of clear technologies with lower consumption of resources.

At present, environmental policies pay increased attention to such global aspects as irrational use of renewable and non-renewable natural resources, biodiversity loss, accumulation of persisting chemicals, and climate change with negative impact on humankind because of their disastrous effects.

Climate change is a reality all over the world and its effects and span are increasingly obvious.

The report on **"Climate change, impacts and vulnerability in Europe 2012"** states that there are higher mean temperatures in Europe, and less rainfall in southern Europe and more rainfall in northern Europe. The ice cap in Greenland, the floating ice in the Arctic and several glaciers in Europe are melting and the snow layer has thinned. On the other hand, extreme meteorological phenomena such as heat waves, floods and drought have caused, these last years, the increase of damage all over Europe and we expect these phenomena to become more intense and frequent. The report mentions that some regions will be less capable of adapting to climate changes than others in part because of the economic differences between the countries of Europe, which could become more serious because of climate change.

Drought and phenomena associated to it – aridisation and desertification – are, after pollution, the second major issue of mankind; it affects all the regions of the globe. At

world level, 3.6 billion ha of the 5.2 billion ha arable land are lands threatened by drought [3].

"Besides the effects on health related to global heating, other effects on human health are also important" says the report. Climate change contributes to the transmission of diseases by ticks, mosquitoes or flies because of the favourable reproduction environment.

It was this reality that made us carry out an analysis of the impact of climate change on Romania given that our country has been facing catastrophic phenomena and calamities these last decades. The increasing number of floods starting with 1970 has produced important damage, including the loss of human lives. They are frequently accompanied by torrents, erosions, and land glides with destructive effects on localities, routes, lands, and crops. At short time intervals and in plain areas, there have been droughty and excessively droughty years when yields represented only 10-30% of the normal yields.

These situations also occur because the share of forests from the country's area (26.7%) is low, because their distribution is uneven and improper, because past deforestation made to increase agricultural area was done in most cases without taking into account the relief, the features of the hydrographical network, the features of the area climate, etc. and because of the excessive lumbering in certain areas.

MATERIAL AND METHOD

Research methodology consisted in the bibliographic study of scientific documents through information on sources, data collection, study and classification of documentary sources, and assessment and study of documents. The main method we used was content analysis.

RESULTS AND DISCUSSION

Natural resources are the natural asset, a main component of Romania's riches. Valorising this resource through exploitation of both renewable and non-renewable raw materials and processing them into products necessary to life determines largely the economic and social level of development of a country, the condition of the environment and the population's living conditions. The mission of sustainable development is to find the ways to increase total wealth together with the careful use of common natural resources so that renewable resources can be maintained and non-renewable resources be sued at a rate that takes into account the needs of the future generations.

Romania's renewable resources are diverse but limited. Some renewable raw materials are vital riches for the economic and social development of the human society. The most important natural resources are water, soil, flora, fauna and forests.

Waters are a natural renewable, vulnerable and limited resource, an element that is indispensable for life and society, the raw material for productive activities, a source of energy and a way of transport, as well as a determining factor in the maintenance of ecological balance. Waters are part of the public heritage. Water resource protection, valorisation, and sustainable development are actions of general interests. Romania's water resource consists in surface waters (inner rivers, natural and artificial lakes, the Danube River) and, in a smaller measure, ground waters (10%).

Romania's population has face **extreme meteorological phenomena** of particular span: severe heat and drought, abundant rainfall and catastrophic floods, tornadoes, abundant snowstorms, snowing up of roads, and change of the main seasons that have

become more severe and frequent after 2000. Romania has also faced a clear trend to intensification and extension of drought and desertification because of bot natural and manmade causes (lack of irrigation). Desertification has affected about 350,000 ha. The most affected areas are southern and south-western Oltenia, south-eastern Banat, southern Moldavia, and Dobruja.

The flood-risk map shows that most of Romania's territory is marked by floods. Areas of high flood risk are in the hydrographical basins of the rivers Mures, Somes, Cris, Olt, Siret, the Danube and the Danube Delta, as well as the small rivers in central Moldavia, which cause floods in the area and economic, social, and environmental damages.

Air pollution is the most serious issue since its effects are short-, medium-, and long-term. Short- and medium-term, pollution has negative effects on human health, and it damages biological and ecological systems and economy as well. Long-term, pollution causes environmental changes.

Law no. 3/2001 ratified the Kyoto Protocol at the United Nations Framework Convention on climate change; Romania was among the first countries to ratify this international document of particular importance for the issue of climate changes.

Soil is, due to its position, nature and role, a component of the biosphere and a product of the interaction between the biotic and abiotic environments; it is a living organism with an intense life and a certain ecologic balance.

Soils determine agricultural production and forest condition; it conditions vegetal cover, water quality (particularly that of the rivers, lakes, and groundwater), regulates liquid and solid seepage in the hydrographical basins, and acts as a geo-membrane in the diminution of air and water pollution through the retention, recycling, and neutralisation of the pollutants such as chemicals used in agriculture, organic wastes and residues, and other chemicals [1].

The main natural limiting factors of soil quality are erosion and land glides. According to some studies on the land fund, there are, in Romania, wide areas of degraded lands most of which in the hill and mountain areas. As shown in the "*Strategia nationala si programul de actiune privind combaterea desertificarii, degradarii terenurilor si secetei"*, the total area of the degraded lands is about 7 million ha. Excessive erosion, associated with collapsing and land gliding, occurs on over 2 million ha, and moderate-strong erosion, on almost 5 million ha. There are large degraded land areas in the Getic Plateau, in the Wallachia sub-Carpathians, in the Somesan Plateau, in the Transylvanian Plateau, in the Moldavian sub-Carpathians, in the Moldavia Plain and Plateau, and in Dobruja. With more intensification of the use of agricultural lands, over 2 million ha of degraded lands will have to be reforested.

The paper mentioned above shows that **practically, the entire agricultural area of Romania is in areas affected by drought**. The studies carried out concerning drought control have pointed out the necessity of a national system of protective forest curtains. These studies show that, to put it into practice, we shall have to reforest about 300,000 ha.

The protection of nature and biological diversity, the protection of the environment from the increasing pressure of human activities have become among the most issues of humankind because they are a prerequisite of sustainable development nationally and internationally.

At present, there are, on Romanian territory, about 3,700 plant species, of which 23 nature monuments, 74 extinct, 39 endangered, 171 vulnerable, and 1,253 rare. As for the animal species, there are 33,792 animal species, of which 233,085 invertebrate and 707 vertebrate.

The impact of climate change on biodiversity overlaps the pressure by habitat destruction and environmental pollution.

The drastic disturbance of the environmental factors has a direct impact on the evolution of the living beings, first on their capacity of adaptation and then on their capacity of surviving; they can be, in extreme cases, factors of elimination of certain species from the food chains with dramatic consequences on the evolution of biodiversity at local level and with an impact at general level. Thus, the slightest climate changes can even cause the extinction of certain species represented by a single population of by very few populations, and that fill some very narrow ecological niches that are particularly vulnerable to climate change.

This has extremely serious consequences not only on the conservation of biological diversity but also on the capacity of surviving of the human civilisation given that the products of biological diversity are the basis of survival. In other words, human civilisation is part of the global ecological systems and the loss of its functional balance affects directly the ongoing development of human civilisation.

Forests are a major component of Romania's Natural Capital and the main factor of ecological stability.

Romania has a wide biodiversity and a high percentage of intact natural ecosystems. It has the largest area covered by natural forests in Europe and numerous migration channels. The high level of diversity of ecosystems and the geographical location reflect in the rich floristic and faunistic diversity.

Romania is relatively poor in forests compared to other European countries with similar climate and relief conditions. The forests and the other lands with significant forest vegetation cover only 26.7% of the country's territory. From this perspective, Romania ranks 13 in Europe, i.e. below European mean (32.8%) and much below the forestation percentage of such countries as Austria, the Czech Republic, etc. The distribution of the forests over the country is uneven. The distribution of the forests over large geomorphologic areas shows that the smallest percentage (10%) is in the plain areas, while the most deforested are the Western Plain 93,2%), the Baragan Plain (3.5%), the Moldova Plain (4.1%), the Oltenia Plain (5,3%), etc.

The low percentages of reforestation in the plain areas are correlated with frequent and prolonged droughts, as well as the deforestation in the hill area and the massive logging in some mountain forests correlate with torrent formation and land degradation. These phenomena are stronger and stronger on the background of social and legislative deficiencies and of the lack of institutional and financial capacities of most forest or land owners who should be reforested. Investments in the field have been diminished or even neglected.

To stop or diminish these negative phenomena, we need to take firm measures for the cessation of the deforestation of any kind and for the increase of the areas covered by forest vegetation. This increase could be done mainly by reforesting some degraded or marginal lands improper for efficient agriculture, as well as by the establishment of protective forest curtains for the protection of agricultural fields, of the watercourses and of the communication means, and of the anti-erosion protection of slope lands, etc.

The main actions to take to conserve and develop forestry resources in order to improve environmental and living conditions are:

- Defending the integrity of the forest fund; prohibition of the change of land use covered by forests and other forest vegetation if they are important to the ensurance of environmental and living conditions;

- Proper alignment of the notion of forest and of its content within the European Union and including among forests, with respect for the ownership right, of the so-called forested grasslands that have not been deforested or degraded yet;
- Extending forest areas and other types of forest vegetation, particularly degraded lands that are improper for profitable crops (about 2,220,000 ha until 2020);
- Initiating, within a special programme, actions within a national system of protection forest curtains aiming at protecting agricultural fields and drought control, at anti-erosion protection, at the protection of communication ways, of watercourses, etc. (about 300,000 ha until 2020);
- Establishing with the assistance of land owners of intensive forest cultures for energy uses, as well as of some agricultural and sylvicultural cultures depending on the requirements of the rural development;
- Supporting actions of increase of areas covered by forest vegetation, including through foreign investments – European funds, funds or subsidies for carbon storage, etc.

Romania's territory affected by **desertification** covers the entire Dobruja and a considerable part of south-eastern Romania which is, in fact, our main agricultural area[2].

The soils in the territory are affected by different processes of degradation. The decrease of the content of humus, the shortage of nutrients, the worsening of the soil structure, compaction, the forming of the crust are processes that, in the conditions of improper agricultural techniques, affect most of the area[4].

Measures for the prevention and control of desertification:

- Rehabilitation and development of irrigation systems;
- Establishment of forest curtains and belts;
- Improvement of hydrologic regime in river dammed areas;
- Terracing slope lands to retain water;
- Promotion of alternative drought-resistant agricultural crops and special agricultural technologies;
- Ecological reconstruction of the forests affected by drought;
- Management of water resources in drought conditions.

Importance of Protection Forest Curtains

Between the Wars, Romania was famous for its forest curtain networks established right after World War I. Unfortunately, these forest curtains were deforested during 1957-1962, with the compaction of lands during the collectivisation.

Romania's Parliament adopted, in 2002, Law no. 290 regarding the achievement of a national system of forest curtains. According to this law, forest curtains were conceived not only for the protection of communication ways against massive snow falls, but also as a shield against land glides, erosion, rainfalls, and other meteorological phenomena.

Eco-protective and Aesthetic-Social Functions of Forest Curtains

▪ ***Protection of crops and increase of agricultural yield***

Forest curtains reduce plant evaporation and transpiration increasing crops with up to 20% though some of the land is covered by forest curtains. The optimum share of an area covered by forest curtains is 4-6% of the agricultural land.

▪ ***Increase of the forest fund***

The network of forest curtains can be an important basis for an extension of the forest fund in arid areas that prove to be less favourable and profitable for agricultural use.

▪ ***Storage of carbon***

Each 100 ha of forest curtains with 40,000 trees can store about 5 t of CO_2 when aged 20, amount that increases with the age.

▪ ***Reduction of air temperature***

In summer, the effect of air cooling in an area with forest vegetation is above 3^0C. The cooling effect is due not only to the diminution of the radiation by the layer of leaves, but also to leaf evaporation, which uses 60-75% of the radiation energy for transpiration.

▪ ***Increase of air moisture***

Reducing temperatures is associated with an increase of air moisture of about 18%, particularly at the end of the diurnal cycle. The increase of the atmospheric moisture is due to the evaporation capacity of the leafage, which is 10 time higher than that of a land with no vegetation. Trees are necessary also to use water excess from rainfall, which is eliminated with difficulty through evaporation and on plane relief (biological drainage).

▪ ***Diminution of direct and indirect light***

Intense, blinding light from the sun or from reflecting surface (natural or manmade) can be reduced. Thick leafage and branches reduce light intensity considerably.

▪ ***Stimulation of air exchange***

On balanced summer days, there occurs an urban breeze around and within localities, a phenomenon explained by the differences in thermal regime between tree plantations and constructions. Built areas warm up more than green ones.

▪ ***Release of oxygen by the trees***

A hectare of forest absorbs during 8 h 8 kg of carbon dioxide, as much as 20 people expire during the same period of time.

▪ ***Filtration of suspension particles and of dust***

Trees, shrubs, and vegetal cover making up the forest curtains filter and purify the air polluted by dust or different setting particles, as well as by noxes from industrial facilities and by transportation means in the area.

▪ ***Diminution of chemical and gaseous pollution***

Toxic gases in the atmosphere (sulphur oxides, nitrogen oxides, fluoride or chlorine compounds, carbon hydrates, etc.) penetrate vegetal tissues, react with the substances metabolised by the plant and accumulate in the woody tissue. Forest vegetation retains noxious gases directly through metabolism and indirectly through climate change, particularly wind speed and air turbulence.

▪ ***Diminution of noise***

Trees and shrubs can reduce noise level lowering sound oscillations while passing through the branches or leafage because their acoustic resistance is higher than that of the air. Tree and shrub canopies reflect and disperse almost 75% of the sound energy, while the remaining 25% are absorbed.

▪ ***Improvement of human health***

Woody vegetation influences directly or indirectly human health, determining also humans' psychical state.

▪ ***Increase of biodiversity***

Forest curtains increase the degree of biodiversity of agricultural habitats ensuring shelter for numerous plant and animal species. Curtaining agricultural fields also makes possible the development of biota specific to game and the development of conditions favourable to game number (hares, partridges, pheasants, and deer).

▪ ***Exertion of economic and social effects***

Forest curtain ensure thermal comfort necessary during the hot summer days for both agriculturists and cattle. Woody vegetation influences directly or indirectly human health, determining also humans' psychical state. Forest curtains supply small yet non-negligible amounts of firewood and building material particularly if their life cycle is short (20 years, as in acacia). The role of forest curtains in the improvement of environmental

conditions is obvious 3-6 years after establishment, with maximum effects after the age of 10-12 years[5].

Opportunities for forest curtains

For the fall of 2014, Romsilva intends to start the planting of forest curtains along the auto-route A2 on its over 23 ha in its administration (the planting will be done by specialised firms).

"Within a coherent plan of 10 years we will establish these forest curtains, claimed the General Manager of Romsilva in a conference on February 4, 2014, underlining the idea is not new but, for the first time since 2002, when the Law no. 289 regarding forest curtains was passed, we also have the necessary budget of 30 million RON for 2014 and 60 million RON for 2015."

The national programme for forest curtains for the protection of auto-routes and national routes was adopted through Emergency Ordinance on December 23, 2013.

The programme is to be implemented by county councils with financing from the state budget within the limits for the year from the Ministry of the Environment and Climate Change – the Department for Waters, Forests and Fisheries and from funds allotted annually from local budgets of county councils according to legislation.

According to the Manager of Romsilva 92014), the necessary of forest curtains would be 19,000 ha of which they have already established 740 ha on the lands administered by Romsilva and 1,300 ha on other properties.

CONCLUSIONS

The main effects of forest curtains consist in the following:

- Improving microclimate conditions (decreasing the span of air temperature – both diurnal and nocturnal, reducing wind speed, retaining snow, reducing evapo-transpiration, increasing air moisture);
- Diminishing diurnal span of air temperature with 1-4^{0}C and annual span with 1-2^{0}C, reducing wind speed, reducing non-productive evapo-transpiration with up to 30%, increasing air moisture at soil surface with 3-5%;
- Improving crop growth and development conditions;
- Increasing soil fertility and conservation conditions, reducing erosion and water leakage on the slopes, reducing and eventually stopping deflation, increasing soil moisture, enriching humus content and other nutrients in the soil, changing the soil pH due to the surplus of organic substance from the leaves and roots;
- Increasing woody mass and accessory products;
- Increasing the areas covered by forest vegetation;
- Protecting economic and social objectives and communication ways;
- Developing the conditions for local fauna;
- Increasing area biodiversity;
- Improving the stock of fixed carbon and diminishing atmospheric one;
- Reconstructing and improving the landscape, etc.

BIBLIOGRAPHY

1. **GAVRILESCU, CAMELIA** - Managementul resurselor de sol, Editura Academiei Române, Bucureşti, 2008, pp..51-53.
2. **GAVRILESCU, CAMELIA, GAVRILESCU D.** – Agricultura României după un an de zile de la aderarea la UE*,* Vol. Lucrări ştiinţifice, seria I, vol. X, USAMVB, Timişoara, 2008,pp 45-52.
3. **M. STANCIU, D. CHIRIAC, C. HUMA**, Impactul schimbărilor climatice recente asupra calităţii vieţii, CALITATEA VIEŢII, XXI, nr. 3-4, 2010, pp. 238-250.
4. ***Strategia nationala si programul de actiune privind combaterea desertificarii, degradarii terenurilor si secetei.
5. ***Hotărârea Guvernului nr. 1343 din 31.10.2007 pentru aprobarea înfiinţării perdelelor forestiere de protecţie a câmpului în judeţele Constanţa, Ilfov şi Tulcea, publicată în Monitorul Oficial, Partea I, nr. 778 din 16.11.2007.