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**Abstract:** Climate change, currently affecting the entire planet, is considered by the specialists the result of the increase in anthropogenic GHG concentrations. Sectors such as agriculture, transport, energy, tourism and also food security, population health, water resources, and ecosystems become vulnerable to the changes in climate. The climate change could generate costs and benefits for the Romanian seaside and mountain tourism, the multiple linear regression models proving that the tourism demand (arrivals and overnights) is depending on tourism offer (bed-places' number, tourism capacity in function), but also on climate parameters (air temperature, layer of snow).

**JEL classification:** L83, O13, Q54

**Key words:** climate change, costs, economy, tourism

## 1. Introduction

The specialist in various fields recognizes climate change as a global challenge, which can bring irreversible consequences. As it regards the intervention through appropriate policies to reduce the negative of climate changes at economic and social level, it is necessary openness and understanding of this phenomenon and its consequences. Climate change causes various problems related to environment and at the same time governments and other institutions are looking for solutions to some of the economic problems.

According to International Panel on Climate Change (IPCC, 2007a), climate changes refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Unlike the definition provided by United Nations Framework Convention on Climate Change, for IPCC climate change refers to any change in time of climate due not only as a result of human activity, but also of natural variability.

The IPCC's papers (2007b) indicate that since 1850, the warmest years were those between 1995-2006. The 100-year linear trend (1906-2005) indicates an increase in temperature of 0,74°C. The linear warming trend over the 50 years from 1956-2005 (0,13°C) is nearly twice that for the 100 years from 1906-2005. In between 1961-2003, the global average sea level rose at an average rate of 1,8 mm per year, in a faster rate

than in between 1993-2003 of about 3,1 mm per year.

Continued GHG emissions at or above current rates would cause further warming, the projected global average increase in temperature of IPCC (2007a) being between +0,1 and +1,5 °C until 2029 and between +4,0 – 5,0°C until 2099, taking into consideration the changes in real time of the anthropogenic activities. The warming is expected to be greater in over the land (north parts of North America, Europe, Asia) and most at high latitudes and least over the Southern Ocean (near Antarctica) and northern North Atlantic.

## **2. Climate changes, biodiversity and productivity losses**

In the literature there are various papers referring to the global warming and the climate change impacts on the environment, society, economy and so on. The effects of climate change are reviewed starting with the projections of rainfall, temperatures, sea level and atmospheric carbon dioxide concentrations.

The following paragraphs present some ideas and aspects of climate change effects on ecosystems and biodiversity, agriculture, forestry and fishing, society, industry and human settlements, human health, being investigated also the economic and financial implications at global or regional level of the climate changes.

### **2.1. Losses in biodiversity and ecosystem imbalance**

The scenarios and projections of the climatologists indicate that in the coming decades, the future changes in climate will affect the world ecosystems and biodiversity. Combined effects of climate change associated with other global changes (changes in land use, pollution) are likely to determine exceeding in the resilience of many ecosystems.

Burkett et al. (2005) considers that temperature and moisture regime are key variables having an important influence on the distribution, growth and reproduction of plants and animals, and the changes in hydrology can influence species in a variety of ways, especially the metabolic and reproductive processes. The IPCC (2008) reports indicate that the increasing in drought conditions together with increased summer temperatures and precipitation declined during the growing season in several regions like Europe or parts of Latin America will influence the forest net ecosystem productivity. Also during prolonged and intensified droughts, it is possible for the diseases and pests to appear, reducing the resilience of the organisms. More than that, the specialists estimate that, in some regions, forests are projected to replace other vegetation types, such as tundra and grasslands.

Forests provide the absorption of CO<sub>2</sub> from the air, but their extension is not necessarily good in all the parts of the world, because it might unbalanced the life equilibrium, like those existing in tundra were the local fauna needs specific conditions. The forest can not grow too much in areas with low temperatures like tundra, the tree growth being hindered by low temperatures and short growing seasons, but if the temperature will increase this would facilitate the growing process of the forests. Thus, the natural equilibrium and the wild life of tundra will be threaten.

Increasing temperature will determine the reduction of the water resources especially the basins fed through the glacier and snowmelt, where more than one-sixth of the world's population lives. The researches (IPCC, 2008) show that for each 1°C of temperature increase, the duration of snow cover is expected to be reduced by several weeks, at mid-elevations in the European Alps, drawing major changes in mountain

flora. In Keller et al. (2005) opinion, missing snow cover exposes plants and animals to frost and influences water supply in spring. The animal movements are disrupted by changing snow patterns and thus the mortality will increase due to the mismatch of the wildlife to the new environmental conditions.

Animals movements vary depending on type of animal, the destination etc. If the environmental conditions are changing, it could influence the life of animals and their ability to adapt to new environmental conditions. Temperature is influencing the movement of animals, and its changes combined with other climatic conditions could affect many animal species.

An exceeding increase in average air temperature is likely to have serious effects on flora and fauna. Thus, according to IPCC (2007c), approximately 20-30% of plant and animal species are likely to be at increased risk of extinction if increases in global average temperature exceed 1,5-2,5°C. The increase in temperature exceeding this level and in concomitant with increasing atmospheric carbon dioxide concentrations will affect the ecosystem structure and function, species' ecological interactions and species' geographical ranges, with predominantly negative consequences for biodiversity and ecosystem. An increase in sea surface temperature of about 1-3°C will result in more frequent coral bleaching events and widespread mortality, unless there is thermal adaptation or acclimatization by corals. The progressive acidification of oceans due to increasing atmospheric carbon dioxide is expected to have negative impacts on marine organisms.

Scientists believe that the ocean acidification, through which the pH of the Earth' oceans is reducing, is caused by anthropogenic carbon dioxide from the atmosphere. This phenomenon is harming the marine animals. The ocean acidification and its impacts should be approached by a large majority of countries, being necessary to be taken appropriate measures of intervention.

## **2.2. Climate change, agriculture productivity and food security**

The evolution of temperature, rainfall and water resources is important elements for agriculture, forestry and fisheries on which depends the change in sector productivity. The main issues raised by climate change and water resources on agriculture, forestry and fishery are increasing demand for irrigation, increasing in frequency and intensity of extreme weather events, negative impacts on aquaculture and fisheries, food security, increased forest fires and insect outbreaks, water pollution and reduced fisheries.

The productivity of agriculture, forestry and fisheries depends on the temporal and spatial distribution of rainfall and evaporation and the availability of freshwater resources for irrigation. Irrigated land, representing a mere 18% of global agricultural land, produces about half the world's total supply, due to the fact that irrigated crops productions is 2-3 times higher than their rain-fed crops (FAO, 2003).

It is expected that the future will record an increase in demand for irrigation of agricultural land in most world regions as a result of reducing rainfall and increasing temperatures. An increase in frequency and severity of extreme climate events, such as increased frequency of heat stress, droughts and flooding will have severe consequences such as on forestry (increased risk of forest fires) or agriculture (reducing the areas favorable for agriculture), which will have significant consequences on food and agro-ecosystem production.

All four dimensions of food security namely food availability, access, stability

and utilization are likely to be affected by the foreseen changes in climate and thus food security will depend not only on climate and socio-economic impacts on food production but also on changes to trade flows, stocks, and food aid policy (IPCC, 2008).

An important element that worth stressed here refers to the fact that climate change may influence growth and development of animals, plants, but also land use in agriculture, access to roads, infrastructure in general, and also human health.

According to Bazzaz and Sombroek (1996) the rise in atmospheric concentrations of carbon dioxide can also be a positive factor for tree and crop growth, because it is stimulating the photosynthesis (the so-called CO<sub>2</sub> fertilizer effect) and improve water-use efficiency. Thus, an increase in CO<sub>2</sub> concentration in the atmosphere can bring benefits and even offset the reduction in crop yield due to the heat stress and reducing in water supply.

Global warming is considered to be caused by increasing emission of CO<sub>2</sub> and other greenhouse gases. Still, a small increase in CO<sub>2</sub> seems to be beneficial for plants because it helps the photosynthesis process. Human activities have influences on environment and on the level of greenhouse gases in the atmosphere, being interesting to note whether the total result of these effects are positive or not, if the positive influences are above the negative ones.

In Stern Report (2006) there are presented several scenarios on 2 or 3°C global warming, temperature increase up to 4°C and a higher temperature with 5-6°C and the CO<sub>2</sub> fertilizer effect on yields. Thus, for 2-3°C warming, the yield of several cereals (wheat and rice) will increase, but then start to fall once temperatures reach 3-4°C increase. Maize yield will decrease with increasing temperature, because the physiology is less responsive to direct effects of rising carbon dioxide. When a weak CO<sub>2</sub> fertilizer effect is used for prediction, world cereal production declines by 5% for a 2°C rise in temperature and 10% for a 4°C rise. The scientists appreciate that if the temperature is even higher the agriculture may collapse in many world areas. Studies indicate that if the temperature rises up 2-3°C, up to 30-200 million people may be exposed to a risk of hunger. Once temperatures increase by 3°C, 250-550 million additional people may be at risk.

Reducing agricultural yields have a direct effect on food resources of the population, especially in poor areas of the world already facing food problems, high dependence in agriculture, decreasing in yields, limited purchasing power.

When the contribution of agriculture to the GDP creation is reduced, due to the effects of climate changes, this could lead to a zero or even negative growth. Many of the climate change influences on agriculture will depend on its adaptation capacity, which will be strongly influenced by the income levels, type of agriculture, irrigated lands, etc.

### **3. Climate change and world economy: winners and losers**

Climate change will affect the society through its impact on necessities and comfort of the population (water, energy, transportation, food, natural ecosystems, health). Human settlements have developed in a climate that varies in a given set of conditions, and rapid climate change will represent a real challenge for them.

Urban settlements in different countries of the world become more complex and interconnected with regional and national economies. They are facing various problems (growing population, poverty and inequalities in health and welfare,

degradation, old buildings and infrastructure, increased air pollution, etc.) and climate change adds new uncertainties to the existing ones.

Climate change will affect various segments of the society in different ways, depending on the exposure and their capacity for adaptation. According to US Climate Change Science Program (2009), in general, the most vulnerable groups are very young, the very old, the sick, and the poor people. Extremely high temperatures in certain areas could cause significant migration waves to other areas with a more favorable climate and this could lead to mass movement of the population, and further more to regional conflicts.

Population is exposed to climate change effects directly through weather phenomena (more intense and more frequent extreme events) and indirectly through changes in quantity and quality of water, air, food, infrastructure etc. Extreme weather events or those occurring in a short period of time may have stronger effects on the population than those that occur over longer periods.

Projected climate change are likely to affect the human health, particularly those with low adaptive capacity, through: increases in malnutrition and consequent disorders, increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts, increased burden of diarrhoeal disease, increased frequency of cardio-respiratory diseases, altered spatial distribution of some infectious disease vectors (IPCC, 2007c).

Infrastructure (transport networks and water supply, sewerage, etc.) may suffer from flooding and changes in the rainfall amount, hence resulting in additional costs and the human settlements located in coastal areas may be exposed to risks due to sea level rise and coastal erosion.

Warren et al. (2006) shows in one study that if the temperature will increase by 3 to 4°C the sea level will increase by 20-80 cm, between 7-70 million and 20-300 million people being flooded (low and high population growth assumption respectively) each year. At higher level of sea level rise, caused by a higher warming, the impacts will be much more serious.

According to Nicholls and Klein (2003) sea level rise will affect many densely populated European areas. An area of 140.000 km<sup>2</sup> is currently less than 1m of sea level, Netherlands being by far the most vulnerable European country to sea level rise. Based on today's population and GDP, the 1m increase in sea level will affect over 20 million people and put an estimated 300 million dollars worth of GDP at risk.

In our days, hydropower makes a substantial contribution to meet the increasing world electricity demand. But, according to some researchers, this sector will not remain unaffected by the climate changes, Lehner et al. (2005) showing that by 2070, hydropower potential for Europe will decline by 6%, translated into a 20-50% decrease around the Mediterranean, a 15-30% increase in northern and eastern Europe and a stable hydropower pattern for western and central Europe.

Climate change can bring some benefits, especially to countries located at higher latitudes, if the warning process is moderate. These benefits will come from higher agricultural yields, shift in tourism flows to more closed destinations, etc. Least developed countries could have some losses because their restricted access to capital for investments in adaptation.

#### 4. Economic costs of climate change

Estimates of macroeconomic effects of climate change using different climate scenarios resulted in different estimations regarding the total losses in GDP. Thus, for a

2-3°C warming it resulted that the cost of climate change could reach around 0-3% loss in global GDP and if the warming is more pronounced with a temperature higher with 5-6°C, the reduction in GDP will be 5 to 10% and even higher in poor countries (Stern, 2006).

The experts believe that climate change will affect differently the developed countries and the developing countries. Thus, climate change will have some positive effects in several developed countries if the warming will be moderate (2-3°C), but will cause greater damage if the temperatures will increase significantly. For low-income countries, major natural disasters today can cost an average of 5% of GDP (Stern, 2006). Moreover developing countries have more economic and social problems being more vulnerable to climate changes.

For other researchers, the economic costs of the climatic change remain unclear and according to International Monetary Fund (IMF) there will be large variations across countries and regions. The measures taken by governments, businesses and individuals to mitigate or to adapt to climate change can have immediate economic and financial consequences. IMF underlines that climate change will directly affect tax bases and public spending needs, but also there will be direct negative impact on output and productivity particularly for agriculture, fisheries and tourism, increased risk of wide spread migration and conflict, additional costs for reducing carbon emissions, higher energy prices, disruption in trade flows due to the damage to ports and roads. Also, balance of payments will suffer severe problems generated by the reduced exports of goods and services or increased need for food and other essential imports.

The economic costs of climate change depend on the response of the society, biological systems, etc. to the global warming, and on the adaptive capacity of the countries but also on appropriate measure taken to cope the negative effects.

The specialists like John Reilly (Massachusetts Institute of Technology) underline that although the models are suggesting that the aggregate economic costs of climate change are small, these estimates are just an average, presenting just the central tendency which summarizes a range of scenarios from relatively favorable to catastrophic effects of climate change, hiding significant differences between countries. Small, weak economies depending on resources are likely to be most affected by climate change.

The costs of climate change can be grouped using the same classification as the impacts namely market, referring to the climate-sensitive sectors (agriculture, forestry, fisheries, tourism, food industry, wood processing, textile industry, production of biomass and renewable energy) and non-market referring to the effect on ecosystems, health, human settlements, infrastructure leisure activities.

According to Schwartz and Randall (2004), climate change could induce correlated risks, especially if the increase in temperature is high. Many parts of the economy will suffer severe impacts simultaneously, the shock exceeding the capacity of markets and could even destabilize regions.

In a “business as usual” scenario provided by the research papers (Stern, 2006), the cost of climate change over the next two centuries, including market (evaluation based on prices like in agriculture, energy, forestry, tourism) and non-market (human health, ecosystems, environment, human settlements) impacts and also the disproportionate burden of climate change on poor world region is equivalent to a loss of 20% of global per-capita consumption. Using as scenarios market impacts and the risk of catastrophic changes to the climate system, Stern (2006) proves that the mean

loss in global per-capital GDP is 0,2% in 2060, 0,9% in 2100 rising to 5,3% until 2200. Also he is estimating that the cost of extreme events (storms, floods, heat waves) will increase rapidly, reaching 0,5-1,0% of world GDP by the middle of the century and will keep rising as the temperature increases. Heat waves will be more frequent by the middle of XXI century, more losses being registered in various sectors.

Another sector particularly vulnerable to extreme weather events is insurance. But this sector could help society manage the associated risks of the climatic changes. Various segments being the subject of the insurance policy are vulnerable to climate changes starting with crops, forest products, electricity, but also human health, life, infrastructure, transportation, livestock, supply-chain and so on. According to Salmon and Weston (2006), increasing costs of extreme weather will not only raise insurance premiums, they will also increase the amount of capital that insurance companies have to hold to cover extreme losses. Thus, it will be necessary to develop new financial products to gain more widespread access to international capital markets.

Mills (2005) appreciate that climate change will spread the risk to other financial sectors. Failure to raise sufficient capital could mean restrictions in insurance coverage. In the future, increasing risks related to weather in certain areas make insurance less affordable generating serious disruption in other sector of the economy, affecting especially small and medium enterprises with less financial resources.

In the future, climate change is likely to affect prices and volume of goods traded between countries, and these issues can create various economic consequences (e.g. disequilibrium, conflicts).

### **5. Climate Change and Tourism Industry**

Tourism sector has recorded in the last decades sustainable growth, bringing prosperity in many regions, creating jobs, having important contributions to the GDP creation. World Travel & Tourism Council research reports that travel & tourism economy GDP accounted US\$ 5.800 billion in 2008, or close to 10% of total global GDP, and accounted for over 230 million jobs worldwide. At the beginning of the XXI century, tourism industry worldwide is one of the most dynamic sectors of activity.

Tourism sector represents a recovery instruments for those economies confronting with difficulties, especially if they have important tourist resources exploited in an appropriate manner, taking into account the principles of sustainability.

However, tourism remains a sector vulnerable to certain shocks (economic, natural disasters, etc.), but still it has a great capacity to adapt, and to revive after turbulent times. The desire and need to travel is the main strength of the sector. Tourism industry is particularly sensitive to climate change and especially coastal and ski areas. Coastal areas become vulnerable to climate change due to the increase in sea level, extreme events like storms, heat waves, hurricane, tropical cyclones, floods. Ski regions are particularly vulnerable to the increase in temperature, reduction and persistence in snow cover, especially at low altitudes, under 1.500 m. Climate change could influence the economy of many local communities depending highly on summer or winter tourism, unbalancing the local development.

According to European Environment Agency (2005) and UNWTO-UNEP-WMO (2008), most affected tourist areas by climate change are the mountain and coastal ones. Increased temperatures will cause premature melting of snow and glacier, affecting winter tourism, and sea level rise would threaten coastal tourism of the Baltic Sea, Mediterranean Sea and Black Sea.

Previous researches proved that Europe is vulnerable to climate change and also the tourism sectors of the different European countries. A research of Deutsche Bank (2008) suggests that the climate change will bring “winners” and “losers” in the tourism activity. Negatively affected by the climate changes will be Portugal, Greece and Turkey, and slightly negatively affect will be Austria, Spain, Hungary, Ukraine, Bulgaria, Romania, Bosnia, Croatia. In contrast, the states that could gain include: the Benelux countries, Denmark, Germany, and the Baltic countries. France and Italy will be slightly favored, due to the diversified structure of their tourism offers.

European Alps and other ski areas in Europe are exposed to climate changes effects, some regions will suffer a decline due the decline in snow reliability (layer of snow, duration, persistence). Organization for Economic Co-operation and Development (2009) arguments that the impacts are not uniform and will lead to “winners” and “losers”, both in terms of regions (*e.g.*, Grisons, Valais, and Savoie are considerably less vulnerable compared to Alpes Maritime, Styria, and Friuli/Venezia/Giulia), and in terms of the ski areas themselves (with areas with high altitudinal range being considerably less vulnerable than low-lying ski areas).

The UNWTO research (2008) indicates that hot summer in South Europe will shift the tourist flows to the North Europe where the weather is colder. Also, Central and Eastern Europe are already affected by the climate change (heat waves, floods, storms) influencing the tourism activity in those areas. Romania will not remain unaffected by the climate changes, their effects beginning to be felt in the last years through weather events like canicular days, floods, snow cover in the winter season, droughts.

The climatologists consider that the period from December 2006 through February 2007 was the warmest winter in the Earth’s history. The 3-month of winter had an average temperature +0,72°C above normal beating the previous record set in 2004 by a substantial +0,12°C. This winter was strongly felt in various parts of the world, USA, Europe, Asia. The warmer winters predicted by the climatic scenarios will probably generate a shift in the tourism demand to higher altitudes and latitudes.

In time, tourism proved to have the capacity to recover after powerful shocks and to revive stronger as never. The adaptation capacity to climate change is linked to the sector capacity to respond to various types of shocks and transformations. Unlike other challenges (*e.g.*, diseases), climate change will manifest its effect on long time. In addition, consumer behaviors are hardly to be predicted in new climate conditions. It is likely that tourists will learn from their previous positive and negative experiences and will adapt their vacations to the new climate patterns. Of course, other economic dimensions should be taken into consideration, like personal incomes, travel budgets, security, sanitation aspects and so on. On the other hand, it should be taken into consideration the social and economic impacts induced by a decline in tourism activity, like for example employment and labor demand. Taking into consideration the multiplier effect of the tourism sector and the interconnections existing among various sectors, the climate changes impacts on tourism will generate various other effects on various other sectors such as agriculture, handicraft industries, transportation, small local business, trade. On the other hand, if other economic sectors are affected by the climate change, like agriculture, fisheries, energy, this will generate indirect effects on the tourism industry, like reducing the agricultural products offer satisfying the tourism demand for food and beverage, increasing prices in energy or transportation. Thus, the effects of climate changes on tourism are much more complex, being created a



feedback among sectors difficult to evaluate in quantitatively or in economic terms.

### **6. Estimations regarding the economic impact of climate change on Romanian seaside and mountain tourism**

In Romania, after 1989 tourism sector entered on a downward slope, and the recovery was very slow due to various economic, social and political factors. Although it was declared top priority for the national economy under Order no. 58/1998 on the organization and development of tourist activity in Romania, the transition period for the tourism sector was even slower than the transition process of the economy. A revitalizing of the tourist activity in Romania has felt starting with 2000 year, when the number of tourist arrivals increased, mainly because of the revitalization of the social and economic context. The Romanian tourists became more interested in domestic destinations and thus their number increased starting with 2003 year.

According to World Travel & Tourism Council (2009), in 2009, travel and tourism economy contribution to GDP increased to 5,7% (9.942,6 million dollars) and the contribution to employment was 6,8% of total employment (582. 000 jobs) or 1 in every 14,6 jobs existing at national level.

Climate is one of the main resource for tourism, and especially for seaside tourism and winter sports tourism. Meteorological events are affecting tourist destinations, making them more or less attractive for tourists. Romanian tourism offer is most varied, including attractive resorts in mountain areas, coastal areas, countryside, in cultural cities, combined with an exceptional balneal resource. Mountain and seaside resorts represent 39,7% and respectively 11,1% of the total accommodation capacity (294.210bed-places) existing at national level. In 2008 year, the seaside resorts attracted 832.589 tourists , respectively 11,7%, and the mountain resorts 998.468 tourists, respectively 14% of the total number of tourists.

Climate change brings new challenges for the Romanian tourism, especially for the winter and summer tourism, seaside and mountain resorts becoming vulnerable. Climatic parameters (temperature, sunshine duration in hours, and thick layer of snow) affect tourism demand and therefore the economic results of the tourism enterprises.

According to the multiple linear regression model developed for the period May-September 2002-2007, the number of the overnight spent by the tourists in the resorts located in the south part of the Romanian coast (Olimp, Neptun, Jupiter, Cap Aurora, Venus, Saturn, Mangalia) depends on the accommodation capacity (bed-places number) and monthly medium air temperature (Surugiu and Surugiu, 2009). The regression function can be written as follows:

*No. overnight stays = 0,2552\*Capacity in function + 46691,93\*Temperature - 795288,4, level of confidence  $\alpha = 0,05$ ,  $R^2 = 0,83$ .*

Assuming the accommodation capacity constant, an increase in temperature by 1°C generates an increase in overnights number by 46.692 tourist-days. According to a National Institute for Research and Development in Tourism study - NIRDT (2005), the daily average tourist expenditure was around 50 Euro. In conclusion, in every summer season (May-September), seaside tourism should win 2.335 thousand Euro due to an increase of 1°C in air temperature. Of course, beyond a certain thermal threshold the discomfort occurs, tourists give up traveling, the plus in the demand being cancelled. Climate change generates also losses for the seaside tourism, due to coastal erosion. According to NIRDT's study (2006), coastal erosion might generated in Mamaia resort,

in between 1966-2005, a loss in tourism demand of 12.892 persons. Given the multiplier effect calculated for Mamaia resort of 1,57 (NIRDT, 2006) and an average tourist expenditure of 515 euro (NIRDT, 2005), the loss was 10,424 thousand Euro.

Winter sports tourism is also vulnerable to climate change, especially resorts located at altitude below 1.500 m. Global warming and reducing in thick layer of snow have a direct influence on tourist arrivals in the winter season. Multiple linear regression model developed for Predeal resort for the period November-April 2003-2007 indicates that tourist arrivals are dependent on the bed-places number of thick layer of snow (Surugiu and Surugiu, 2009), thus:

*No. tourists = 10,725\*No. bed-places + 43,458\*Snow - 6424,565 for level of confidence  $\alpha = 0,05$ ,  $R^2 = 0,71$ .*

Thus, when the accommodation capacity remains constant, a reduction in the thickness layer of snow with 10 cm causes a decrease in the number of arrivals in Predeal, during November-April, with 435 persons. Taking into consideration an average tourist expenditure of 440 Euro (NIRDT, 2005) the total loss arises at 191 thousand Euro. The impact of climate change could be much higher, exacerbating the economic and social problems of the tourism developing host communities. In a resort as Predeal, located at a relatively low altitude to practice winter sports where tourism is the main economic activity in the area, a decreasing demand could generate serious effect on the economic and social life.

## **7. Conclusions**

Climate change represents a challenge at macroeconomic level in all world countries particularly in poor or developing ones, being likely that climate changes to influence the production and the productivity of various sectors such as agriculture, fisheries, tourism.

Worldwide, climate change are manifesting through the increase in mean air temperature, sea level rise, increased salinity of water, sea level increase, glacier melting in polar areas, reducing in thick layer of snow, reducing in persistence and duration of snow and ice, increasing in water temperatures of lakes at medium and high latitudes, increasing in extreme events frequency (heat waves, heavy rainfall, floods etc.).

In the future should be taken the appropriate measures following the sustainable development principles with the aim to reduce the vulnerability of regions or economic sectors to climate change by enhancing their adaptability and their resilience to change.

The costs and benefits of climate change on industry, society and settlements may vary from region to region. The impacts are depending on location, level of socio-economic development, allocation of water resources, infrastructure and other characteristics (pollution, ecosystem degradation etc.). Climate change may exacerbate the existing problems in certain world regions like those facing increased population density, lack of drinking water, flood risks etc. The dependence of the regions on one specific industry (agriculture, tourism) confronting already with difficulties could lead to increased vulnerability of those regions facing climate changes.

For the Romanian seaside tourism, climate changes would generate both positive and negative effects. An initial increase in mean air temperature would generate an increase in the tourist arrivals and consequently in tourism receipts. On the other hand, coastal erosion would generate a loss in total arrivals and thus in loss in the

total revenues.

Vulnerable to climate changes is also the winter sports tourism, especially for resorts at lower altitudes below 1.500 m. The reduction in snow persistence and snow cover will affect the attractiveness of winter resorts, decreasing the arrivals and the receipts.

The new reality of the new century should mobilize the social and political community to take the appropriate measures not to exacerbate the effects of the climate changes and not aggravate the current environmental patterns. Tourism, like other economic sectors should be sustained, taking not just direct actions (investments, promotion, training), but also by protecting its raw material, respectively the natural and cultural environment.

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