

Cost-benefit analysis of adaptation measures on Climate Change in Bosnia and Herzegovina

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Abstract

The cost-benefit analysis of proposed adaptation measures on climate change in Bosnia and Herzegovina (B&H) was conducted during the development of the Third National Communication of B&H under the United Nations Framework Convention on Climate Change (UNFCCC). The main goal of analysis was to quantify and present financial consequences of flood and drought for those sectors most affected by climate change. The analysis placed emphasis on the cost and benefits of adaptation measures in relation to agriculture, forestry and tourism.

The cost-benefit analysis addressed structural measures that included certain technical and technological solutions. These adaptation measures included implementation of infrastructure and other works to reduce the respective problems within agriculture, forestry and tourism as well as other sectors. For the purposes of this analysis, the Profitability Index was used in respect to the current value of all anticipated benefits, the costs and the value of investment in the proposed measures.

The range of the Profitability Index for acceptable structural adaptation measures in all sectors was between 1.06 and 14.15, which translates into achieving the present value of between 1.06 and 14.15 euros benefit per each euro invested.

Following the implemented cost-benefit analysis, all the proposed structural adaptation measures on climate change, except for one measure in the forestry sector that had a Profitability Index below one, were acceptable. The good results of the analysed measures on climate change represent an acceptable option and offer a positive signal to state and private investors to develop the investment potential of such measures.

Keywords: cost-benefit analysis, adaptation, measures, Bosnia and Herzegovina.

INTRODUCTION AND METHODOLOGY

The cost-benefit analysis of the proposed adaptation measures on climate change in Bosnia and Herzegovina was implemented during the development of the Third National Communication of Bosnia and Herzegovina in accordance with the UNFCCC. The main goal of the analysis was to quantify and present the financial consequences of flood and drought for those sectors in Bosnia and Herzegovina most affected by climate change. The analysis focused in particular on the cost and benefits of adaptation measures on climate change in the sectors of agriculture, forestry and tourism.

The first part of the analysis offers a financial presentation of the damage and losses incurred as well as the consequences of flood and drought in Bosnia and Herzegovina for the period 2000 to 2015. This overview was used in the second part of the analysis as the basis for the assessment of the benefits of the adaptation measures on climate change to be proposed in the Third National Communication of Bosnia and Herzegovina in accordance with the UNFCCC. The main benefit of the proposed adaptation measures would be to avoid damage and losses in different sectors, while the financial value defined by the analysis is the amount saved by avoiding such damage and losses. In this way, the defined financial benefit was compared with the cost of preparing and implementing the adaptation measures. This in turn allowed them to be ranked and priority measures determined.

The main challenge for this analysis was to collect sufficient valid data pertaining to the quantification and financial presentation of the positive effects of the adaptation measures on climate change and to achieve a realistic overview of the initial and operating costs for these measures. The reports of the authors providing technical support to the process of developing the Third National Communication were used as the main source of information, because they described the status and proposed the adaptation measures for the sectors of agriculture, biodiversity, tourism, forestry, water resources and health. [1]

Other reports from the regional, entity and state level and reports by international stakeholders such as the United Nations Development Programme, European Union, World Bank and others [2] that addressed the relevant issues were utilised. Other reports by agencies [3], ministries [4], institutes [5], civil defence units and others were also considered.

After collecting data from the technical reports of the authors per sector within the Third National Communication of Bosnia and Herzegovina in accordance with the UNFCCC [6], the measures were then analysed and grouped into the following categories: institutional-organisational measures, structural measures and educational-informative measures. Institutional-organisational and educational-informative measures are understood within the context of climate change adaptation as preconditions for more specific climate change problem solving as well as the basis for more effective and efficient adjustment to climate change. The proposed structural measures included the use of certain technical and technological solutions for which a cost-benefit analysis was conducted, and the effects of climate change adaptation analysed.

1. ADAPTATION MEASURES ON CLIMATE CHANGE

Climate change adaptation comprises measures that respond to both current and future climate change and vulnerability within the context of current and anticipated social changes. Adaptation not only means protection from the future negative impact and a reduction in the potential damage and the related costs but also the utilisation of all possible benefits and new opportunities that might arise through new climatic conditions.

The consequences of climate change are already visible in Bosnia and Herzegovina, Europe and the world. The forecasts are that these effects will intensify in the decades to come. The key consequences of climate change are increased average global air temperature, increased sea level worldwide, increased intensity and frequency of extreme climatic phenomena such as extreme temperature, flood and drought, increased occurrence of heatwaves, thunderstorms, cumulonimbus clouds and others. These changes are a serious threat to human lives, economic development and the natural world on which human welfare depends.

As stipulated in the Second National Communication of Bosnia and Herzegovina under UNFCCC [7], the presented changes in the annual distribution of precipitation and increases in temperature are the factors to which all of the activities should be adapted, particularly in the sectors of agriculture, biodiversity, tourism, forestry, water resources and health.

The text below shows the adaptation measures on climate change grouped in three categories: institutional-organisational measures, structural measures and educational-informative measures.

3.1. Institutional-organisational measures

Institutional-organisational measures should improve the quality and availability of data aimed at climate monitoring, data collection, modelling, analysis and climate related data forecasts, including the development of the administrative and technical capacities of public institutions addressing climate change. These measures include preparing and developing legislation that on the one side complies with the actual needs in terms of climate change adaptation and on the other responds to the obligations of Bosnia and Herzegovina (B&H) in relation to the European Union accession process and other sectorial organisations in the world. These measures include the integration of adaptation measures into all strategic and development documents, particularly for those sectors most sensitive to climate change.

The table below presents the institutional-organisational measures and shows the sectors to which they belong and their initial value. These measures, because of their character, are not analysed from a cost and benefit perspective because the context of the analysis did not consider the quantification or financial presentation of the effects but rather the benefits of the institutional-organisational measures (e.g. financial benefits due to the fact that the monitoring system for the impact of climate change on biodiversity has been established and similar). Institutional-organisational measures are understood within the context of climate change adaptation as preconditions for more specific resolving of climate change related issues and as the basis for more effective and more efficient climate change adaptation, particularly through structural adaptation measures.

Table 1. Structure of institutional-organisational adaptation measures on climate change

No.	Sector	Measure	Initial value of the measure (€)
1	Biodiversity	Audit Red lists through field assessments.	460,162
2	Biodiversity	Develop a monitoring system for climate change impact on biodiversity.	409,033
3	Biodiversity	Increase the protected area.	255,645
4	Biodiversity	Active protection measures, reintroduction and repopulation.	255,645
5	Tourism	Develop the model for the institutional linkage of different users of tourist products on the one side and service providers on the other.	30,677
6	Tourism	Establish a legal framework in the tourism and hotel management sectors.	30,677
7	Forestry	Install two towers with all measurement instruments and the permanent monitoring of all forest ecosystem parameters.	An initial 2,556,459 with 25,564 per year for maintenance (data collection and processing).
8	Forestry	Change the management system, through small-scale cutting. The second part of the measure pertains to the accumulation of growth or change in the share ratio of certain types.	This would not incur particular costs, except for the changes to and adjustment of the wood processing capacity.
9	Forestry	Organise a fire protection department and establish bio indication points.	An initial 1,533,875 with 51,129 for annual maintenance.
10	Forestry	Increase the protected surface area.	An initial 51,129 with 25,564 for annual activities to preserve the protected area.
11	Water resources	Build the capacities of the institutions responsible for water management in B&H and provide an adequate level of coordination with other institutions in the country and relevant international bodies.	2,556,459
12	Water resources	Water management.	101,235,792
13	Water resources	Assess drought vulnerability in B&H, including identification of the risks related to a higher frequency of drought periods in terms of water supply to citizens and industry and a deterioration in water quality.	511,292
14	Water resources	Provide conditions for the sustainable use of underground water (establish monitoring and assess the available quantities for sustainable use).	An initial 5,112,919 with 511,292 for annual maintenance.
15	Water resources	Establish a hydrology forecast system in B&H.	An initial 10,721,791 with 1,072,179 for annual maintenance.
16	Health	Implement a complex assessment of the impact that climate change could have on certain diseases and its importance to modern medicine (e.g. consciousness disorders, myocardial infarction, chronic obstructive pulmonary disease) and develop a corresponding action plan.	153,387
17	Health	Adopt legislation that defines the sector in terms of working hours and obligations during periods of climate extreme.	51,129
18	Health	Build the capacities of the emergency services.	511,292

Total	126,437,363 initially with a further 1,685,728 per year for maintenance of measures
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Source: Technical reports per sector by authors involved in the preparation of the Third National Communication of Bosnia and Herzegovina in accordance with the UNFCCC.

Around 126 million euro with 1.68 million for annual operating and maintenance is foreseen for all institutional-organisational adaptation measures. Annual maintenance means the cost of takeover and processing of data from the system for monitoring environment parameters, the costs related to the preservation of the protected areas as well as the cost of maintaining the hydrology forecast system in Bosnia and Herzegovina.

The water resources sector takes the biggest share per value of the foreseen adaptation measures, which is understandable considering the fact that it is the basis for climate change adaptation. Measures that can be described as a precondition for the successful work of institutions dominate this sector, particularly in relation to the harmonisation of legislation in the water sector of Bosnia and Herzegovina with the relevant EU legislation and implementation of water protection measures, especially in areas at high risk of flooding. The total planned amount for institutional-organisational adaptation measures allocates 95 per cent to the water resource sector and 3 per cent, 1 per cent and 0.05 per cent to the forestry, health and the biodiversity and tourism sectors respectively.

3.2. Structural measures

Structural measures are those that include the use of certain technical and technological solutions as a means of enhancing climate change adaptation. These adaptation measures include the implementation of infrastructure and other works aimed at reducing the problems in agriculture and increasing the yield, increasing the yield in forestry, increasing resistance to flood and drought and increasing tourism and other capacities [6].

3.2.1. Overview of the structural adaptation measures on climate change

The structural measures are those presented in the table below, which includes an overview of the sectors to which they belong, the value of the measure, annual operating and maintenance costs and the effects or benefits of the measures within the context of climate change adaptation. Because of their character, these measures were analysed from the aspect of cost and benefit. It was possible to quantify or present the financial effects and the benefits of these measures. For example, an increase in the surface area allocated for intensive forestry could be presented in terms of the market price of wood mass and similar. In addition to institutional-organisational measures, structural measures are key measures in the process of climate change adaptation. This is because they provide specific benefits and results presented in monetary values.

Table 2. Overview of the structural adaptation measures on climate change

Sector	Measure	Initial value of the measure (€)	Annual operating and maintenance costs (€/year)	Effect or benefits of the measure	Financial value of the benefit (€ per year or period)	Lifetime of the measure (years)
Agriculture	Use of agro technical measures for holding and conserving humidity: - changes to the operational time in the field and the sowing thickness; - biological methods of protection; - change of land processing terms; - careful use of fertilizers (taking into account the changed efficiency of the fertilizer resulting from changed climatic circumstances).	10,225,838	N/A	This measure reduces the stress on plants and contributes to an increase in yield of up to 30%, except in extreme years. ¹	13,372,474 (This amount is defined on the basis of the damage avoided for around 5,000 farmers on land covering 5,000 ha.)	5
Agriculture	Reconstruction and building of the irrigation system in agriculturally developed areas.	8,947,608	843,632	Ensure safe agricultural production with a minimum increase in yield of 50%. ²	1,533,876 (This amount is defined on the basis of safe agricultural production on 5000 ha with a minimum increase in yield of 50% and is based on the average income of a farmer per hectare.)	30

¹ This also improves water infiltration, thus slowing down the surface drain and reducing the risk of flood. This measure is proposed for the area of low Herzegovina (including the upper stream of the River Neretva and karst fields) and the high karst area with karst fields. The average surface area covered by this measure would be around 5,000 ha (which according to all scenarios and the current status are most exposed to climate change and potentially include all types of herb production). The goal of this measure covers 5,000 farmers.

² This measure is proposed for areas with more intensive agricultural production (valleys of the Neretva, Trebižat and Trebišnjica rivers as well as the Posavina and Semberija regions). The goal of this measure covers 5,000 ha and 5,000 farmers.

Agriculture	Reconstruct and build the irrigation system in floodplains and on difficult land.	15,338,756	766,938	Ensure safe agricultural production, optimise sowing and harvest, increase the land surface area under winter crops and mitigate flood risk and erosion. Goal: 20,000 ha and 6,000 farmers.	1,840,651 (This amount is defined on the basis of safe agricultural production on 20,000 ha with a minimum increase in yield of 50% and is based on the average income of a farmer per hectare.)	30
Agriculture	Build the micro accumulations.	409,033	20,452	Micro accumulations used as reservoirs for irrigation and cattle watering points. They can also be used for water supply to citizens and the irrigation of gardens. Goal: 100 ha	46,016 (This amount is defined on the basis of an increase in yield of 50% and is based on the average income of a farmer per hectare.)	30
Tourism	Develop alternative programmes of touristic supply (develop new touristic potential) aimed at improving the overall tourism product and extending the tourist seasons in affirmed winter tourism centres in B&H.	153,388	N/A	Conditions created for the development of tourism and the extension of the tourist seasons (winter and summer).	254,470 (This amount is defined on the basis of a 20% increase in the use of the mountain tourist centre capacity in B&H.)	10
Tourism	Provide all technical conditions for laying artificial snow on ski tracks. Priorities areas: Jahorina, Bjelašnica, Vlačić, Kupres and Kozara.	6,135,503	184,065	Conditions created for extending the tourist season.	530,146 (This amount is defined on the basis of an increase in the use of the mountain tourist centre capacity in B&H.)	30
Forestry	Increase the surface area under forest through afforestation of the significant surface area evaluated as favourable for afforestation.	3,834,689	127,823	A direct increase in the surface area under forest. Increase in annual growth of 3m ³ /ha based on 2,500 ha. Higher absorption and storage of CO ₂ .	383,469 (This amount is defined on the basis of an increase in annual growth and the average market price of wood mass.)	100
Forestry	Establish intensive plots (energy plots and plantations). Establish intensive plots under	255,646	25,565	It is possible to produce biomass of 20 to 40m ³ /ha on favourable land surfaces	102,258	100

	poplar tree in the basins of large rivers.			with carefully selected clones. Higher adoption and storage of CO ₂ .	(This amount is defined on the basis of an increase in annual growth and the average market price of wood mass.)	
Forestry	Establish forests on steep and shallow land and on the non-permeable layer, vulnerable to erosion processes.	511,292	25,565	On favourable land surfaces, it is possible to produce biomass of 5 m ³ /ha based on 100 ha ³ .	33,745 (This amount is defined on the basis of an increase in annual growth and the average market price of wood mass.)	100
Water resources	Rehabilitate and reconstruct flood protection facilities ⁴	380,733,499	5,711,002	Decrease in flood damage of 35%. ⁵	713,083,192 (at least once in 50 years) and 23,263,781 (at least three times in 50 years) ⁶	50
Water resources	Construct multipurpose accumulations and redistribute big and small water: flood protection and irrigation. Hydro energy established as a renewable energy source of electricity companies.	3,579,043,168	53,685,648	Decrease flood damage by 35%. In terms of irrigation, an average increase in yield of around 50%. Use of additional energy. potential of around 2.07 TWh. ⁷	713,083,192 (A decrease in flood damage of 35%) 56,242,107 (In terms of irrigation, an average increase in yield of around 50%) 93,150,000 (Additional energy potential)	60

Source: Designed by the author.

³ Decreased damage in agriculture by rinsing fertile land as well as direct damage caused by slides.

⁴ Including a) rehabilitation of the damage caused by flood, erosion and torrents in 2014 (The reconstruction and elevation of dams, reconstruction and cleaning of the channel network, the rehabilitation and reconstruction of construction buildings, pump stations and related hydro-mechanical and electrical equipment and the clearing of debris and the rehabilitation and arrangement of parts of the banks) and b) reconstruction (after rehabilitation) of the existing flood protection facilities to the necessary level of protection, taking into consideration the criteria of climate change impact, the construction of protective facilities in the affected areas, as per the priorities, and ensuring the functionality of the system.

⁵ Flood protection in the basins of the Sava, Una, Vrbas, Bosna and Drina rivers. Rehabilitation of the damage caused to dams and other water protection facilities in the Sava river basin during the floods in 2014, this emergency activity is a precondition for the reconstruction of the flood protection facilities.

⁶ This amount is based on the fact that this measure would ensure a decrease in flood damage of 35 per cent, based on a situation similar to that of 2014.

⁷ Practically, accumulations are the most important measure for the adaptation of the natural water regime to the needs of humans. Their role in transforming the available hydrology regime to the desired one is irreplaceable and follows a trend of increased importance in terms of the conditions for climate change adaptation.

The largest share per value of the foreseen adaptation measures is in the water resources sector, which is understandable given the fact that it is the basis for climate change adaptation. This sector is dominated by accumulation building measures for multipurpose use, such as the redistribution of large and small waters aimed at flood protection, irrigation for agricultural purposes and hydro-energy as a renewable energy source within power supply companies and similar. Accumulations are an important measure for the active adaptation of the natural water regime to meet the needs of humans. Their role in transforming the available hydrology regime to the desired one is irreplaceable and follows a trend of increased importance in terms of the conditions for climate change adaptation.

In the amount of around 4 billion euro planned for structural adaptation measures the water resources sector accounts for more than 99 per cent through its dominant share of accumulation building measures, followed by the agriculture and the tourism and forestry sectors that account for less than 1 per cent.

3.2.2. Cost-benefit analysis of structural adaptation measures on climate change

A cost-benefit analysis was conducted for the foreseen structural measures. For the purposes of this analysis, the Profitability Index was used. The index respected the present value of all cash inflows (benefits) and outflows (operating and maintenance costs) described in table above and the initial value of the investment in the structural adaptation measures. The ratio is presented with the Profitability Index (PI). The discount rate used in this analysis was 3 per cent.

The Profitability Index (PI) is presented through the following formula:

$$PI = \frac{\sum_{n=0}^N \frac{(b_n - c_n)}{(1 + \frac{p}{100})^n}}{I_0};$$

- PI- Profitability Index;*
- N-project / measure life;*
- b_n- benefit (inflows) at the end of period n, b_n ≥0;*
- c_n- cost (outflows) at the end of period n, c_n ≥0;*
- p-discount rate;*
- I₀-initial value of investment.*

This coefficient defines the acceptability of a measure in such a way that the result of the PI is above one. The bigger the PI the better quality results and effects of the structural adaptation measure. If the PI is below one then the measure is rejected, because it generates more cost than benefit. Therefore, this coefficient is used to rank the measures presented in the following table from the most to the least profitable measure.

Table 3. Ranking structural adaptation measures according to the PI

Rank	Sector	Measure	Profitability Index
1	Tourism	Develop alternative programmes of touristic supply (develop new tourism potential) aimed at improving the overall tourism product	14.15

		and extending the tourist season in affirmed winter tourism centres in B&H.	
2	Forestry	Establish intensive plots (energy plots and plantations). Establish intensive plots under poplar tree in the basins of the large rivers.	9.48
3	Forestry	Increase the surface area under forest through afforestation of the significant surface area evaluated as favourable for afforestation.	2.11
4	Agriculture	Reconstruct and build the irrigation system in agriculturally developed areas.	1.51
5	Agriculture	Reconstruct and build the irrigation system in floodplains and difficult land.	1.37
6	Agriculture	Build the micro accumulations.	1.23
7	Agriculture	Use of agro technical measures for holding and conserving humidity: - change in operational time in the field and the sowing thickness; - biological methods of protection; - change in land processing terms; - careful use of fertilizers, taking into consideration the changed efficiency of fertilizers caused by changed climatic circumstances.	1.13
8	Tourism	Provide all technical conditions for laying artificial snow on ski tracks. Priority areas: Jahorina, Bjelašnica, Vlačić, Kupres and Kozara.	1.11
9	Water resources	Rehabilitate and reconstruct flood protection facilities.	1.09
10	Water resources	Construct multipurpose accumulations and redistribute big and small water: flood protection and irrigation. Hydro-energy established as a renewable energy source within electricity companies.	1.06
11	Forestry	Establish forests on steep and shallow land and on the non-permeable layer, vulnerable to erosion processes.	0.51

Source: Designed by the author.

Except for the case of one measure in the forestry sector, ‘Establishing forests on steep and shallow land and on the non-permeable layer, vulnerable to erosion processes’, with a Profitability Index (PI) below one (0.51), all of the measures were acceptable for funding because they enable a greater amount of benefit than cost. Yet there were measures in the same sector with a high PI that exceeded 2, in fact 9.48 and 2.11 (which means a present value of 9.48 and 2.11 euro benefit achieved per each euro invested), which indicates the exceptional potential of these measures for climate change adaptation.

Structural adaptation measures in the tourism sector showed very good results with PI of 14.15 and 1.11. The PI for the first structural measures in the tourism sector was 14.15, which means that the present value is 14.15 euros benefit achieved per each euro invested.

All of the proposed structural adaptation measures in the agriculture sector showed good PI results ranging from 1.13 to 1.51, which means that the present value is 1.13 to 1.51 euros benefit achieved per each euro invested.

A similar situation exists with the structural adaptation measures in the water resources sector where the results were slightly under those achieved for measures in the two previous sectors, but still acceptable and with potential for implementation. These somewhat poorer results can be attributed mainly to the fact that these measures have an exceptionally high amount of initial investment, particularly the accumulation building measures. The PI of 1.06 and 1.09 mean that the present value is 1.06 and 1.09 euros benefit achieved per each euro of expenditure.

After the implemented the cost-benefit analysis, all of the proposed structural adaptation measures on climate change, with the exception of one measure with a PI below one in the forestry sector, were acceptable. The acceptable structural measures on climate change adaptation represent a good result and provide a positive signal for state and private investors to develop the investment potential of these measures.

3.3. Educational-informative measures

In addition to institutional-organisational measures, educational-informative measures are understood within the context of climate change adaptation as preconditions for more specific climate change problem solving and as the basis for more effective and more efficient climate change adaptation. These measures focus primarily on increasing awareness on the consequences of climate change and ways of living under extreme climatic conditions. They are aimed at the public, local authorities, agencies, institutions and other organisations. The educational-informative measures are shown in the table below together with an overview of the sectors to which they belong, the value of the measures and the effects or benefits of the measures within the context of climate change adaptation. Because of their character, these measures are not analysed from a cost-benefit perspective. This is because it was not possible to quantify or present the financial effects and the benefits of these measures.

Table 4. Overview of the educational-informative adaptation measures on climate change

Sector	Measure	Initial value of the measure (€)	Effect or benefits of the measure
Water resources	Adjust the flood protection system in B&H in line with EU Directive 2007/60/EC on assessment and management of flood risks (Make the hazard map and risk map, make and adopt the flood risk management plan, including the related national and regional coordination, integrating the impact of climate change).	5,624,211	Raise the awareness of the public, local authorities and other organisations about the probability of floods. People living and working in areas susceptible to flooding are encouraged to take adequate measures in order to learn more about flood risks. Information helps public institutions to allocate and better target funds to resolve related problems.
Health	Raise awareness and knowledge about the prevention of possible health problems caused by climate change (extreme temperature, quality of drinking water, flood and drought) and define measures and recommendations on behaviour in extreme weather/climate situations.	766,938	Additional education made available to citizens in order to better prepare them on how to survive and behave during extreme situations.
TOTAL		6,391,149	

Source: Technical reports per sector by authors involved in the preparation of the Third National Communication of Bosnia and Herzegovina in accordance with the UNFCCC.

Educational-informative measures are presented through two adaptation measures from two sectors, the water resources and the health sectors, with the total value of measures amounting to 6.4 million euro.

CONCLUSION

This analysis should be used as an overview and assessment of the cost-benefit relationship of adaptation measures on climate change as stipulated by the Third National Communication of Bosnia and Herzegovina in accordance with the UNFCCC.

Climate change adaptation comprises measures intended to respond to both present and future changes in climate and vulnerabilities within the context of current and anticipated social changes. Adaptation does not only mean protection from the negative impact and a decrease in possible damage in the future and the associated costs but also the use of all benefits and new opportunities that might occur as a result of new climatic conditions.

This document shows climate change adaptation measures grouped in three categories: institutional-organisational measures, structural measures and educational-informative measures.

Institutional-organisational and educational-informative measures are understood within the context of climate change adaptation as preconditions for more specific problem solving of issues related to climate change as well as the basis for more effective and more efficient climate change adaptation. In total, 18 institutional-organisational adaptation measures are proposed for the sectors of biodiversity, tourism, forestry, water resources and health amounting to around 126 million euro with 1.68 million to cover annual operating and maintenance of these measures. Within the planned amount of about 126 million euro for institutional-organisational adaptation measures, the water resources sector takes 95 per cent followed by the sectors of forestry, health, biodiversity and tourism with 3, 1 and 0.05 per cent respectively.

The proposed structural measures include the use of certain technical and technological solutions to help the relevant sectors adapt to climate change. The structural measures foresee measures that include the implementation of infrastructure and other works in order to reduce problems in agriculture and to increase the yield in forestry and in agriculture, increase resistance to flood and drought and to increase touristic and other capacities. A total of 11 structural measures are foreseen in the sectors of forestry, agriculture, water resources and tourism amounting to a total value of around 4 billion euro. In this amount, the water resources sector takes more than 99 per cent through its dominant share of the accumulation building measure, followed by the agriculture, forestry and tourism sectors.

The cost-benefit analysis shows that all of the proposed structural adaptation measures on climate change, except for one measure in the forestry sector with a PI below one, are acceptable from an economic perspective. Acceptable structural measures on climate change adaptation represent a good result and provide a positive signal to state and private investors to develop the investment potential of these measures.

The Profitability Index for acceptable structural adaptation measures in all sectors ranged between 1.06 and 14.15, which means that the present value is between 1.06 and 14.15 euros benefit achieved per each euro invested in structural measures.

In addition to the institutional-organisational measures, the educational-informative measures are understood within the context of climate change adaptation as preconditions for more specific climate change problem solving and as the basis for more effective and more efficient climate change adaptation. These measures focus primarily on increasing awareness on the consequences of climate change and ways to live in situations of extreme climatic conditions. The educational-informative measures are presented through two adaptation measures from two sectors, water resources and the health sector, with the total value of the measures amounting to 6.4 million euro.

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