

# Risk Assessment of the Impact of Natural Disasters in Rural Areas and Application of the Cost–Benefit Analysis

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## Summary

In the last decade, the issue of implementing adequate approach for managing the risk of natural disasters has become a serious concern. The financial resources needed for the renewal the damages of the weather and climate change events are limited. However, the evaluation methodology applied for assessment of the different types of risk is general not specified for agriculture sector. The agriculture sector is very sensitive to increase of the average temperature and rainfalls, also. The climate change impacts on the productivity, yield and on income of agricultural holdings.

The main purpose of the report is to identify the key issues concern to the quantitative assessments of the disasters risk. The Public authorities following the EU conception for climate change adaptation and there are official documents and guidelines for risk management of the floods and other disasters. The guidelines consist of different measures sure for prevention of the negative climate change consequences. The selection of the package of measures implied at local level is defined by the needs of population, business structures and probability of risk events. The analysis cost–benefit could be used for assessment of the options for mitigation of the risks. The funding is not enough to assess the social and economic impact at different levels. This paper reviews key, commonly accepted, approaches to systematizing risk management measures included in national guidelines and catalogues, and comments on the difficulties that arise when applying the Cost–benefit Analysis for their assessment. The different approaches for systematizing the measures for risk assessment, which are included in national documents, are reviewed. Additionally the good practice in risk assessment of climate change negative impacts is outlined.

**Key words:** risk management, vulnerable sectors, cost-benefit analysis, rural areas

## Оценка на риска при ефекта от природните бедствия в селските райони и приложение на анализа разходи–ползи

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## Резюме

През последното десетилетие проблемът за прилагането на адекватен подход за управление на риска от природни бедствия е сериозен поради климатичните промени. Необходимите финансови средства за покриване на щетите от метеорологичните събития и промените в климата са ограничени. Няма установена практика за оценка на различните видове рискове, които засягат селското стопанство. Земеделският сектор е много чувствителен към увеличаване на средната температура и интензивността на валежите. Последниците от изменението на климата като наводнения, суши и градушки оказват влияние върху производителността, доходността от земеделските култури и доходите на земеделските стопанства,

Основната цел на доклада е да се идентифицират ключовите въпроси, свързани с количествените оценки на риска от бедствия. В България, съгласно концепцията на ЕС за адаптиране към изме-

нението на климата, съществуват насоки за управление на риска от наводнения и други бедствия. Документите и ръководствата се състоят от различни мерки за предотвратяване на отрицателните последици от изменението на климата. Изборът на пакета от мерки, включени на местно ниво, се определя от нуждите на населението и вероятността от рискови събития. Анализът за ползите и разходите може да се използва за оценка на възможностите за смекчаване на рисковете. Анализът прави преглед на ключови, общоприети подходи за систематизиране на мерките за управление на риска, включени в националните насоки и каталози, и коментира трудностите, които възникват при прилагането на Анализа за разходи и ползи. Разглеждат се различните подходи за систематизиране на мерките за оценка на риска, които са включени в националните документи. Освен това са описани добрите практики за оценка на риска в случаи на отрицателни въздействия върху изменението на климата.

**Ключови думи:** управление на риска, уязвими сектори, анализ на разходите и ползите, селски райони

## Introduction

The development of the rural areas plays a key role in achieving economic development and decreasing the depopulation. The population in rural areas of Bulgaria is very vulnerable to natural disasters and risks. In addition natural resources management has to deal with soil degradation and desertification, floods, and poorly equipped and poorly coordinated disaster preparedness procedures, insufficient or inaccurate risk analyses and a lack of strategies and instruments for a sustainable rural development. There are different sorts of losses from natural hazards: human, economic, social cultural, etc. However, this study concentrates on the risk measures aimed at prevention from losses in rural areas.

The European Commission recommends member counties to use standardized approaches for the evaluation of projects which are aimed for prevention from natural disasters. It should be noted that for any certain significant risk of a natural disaster can applied tools for assessment and mitigation relevant options. The measures for risk prevention foresee to be applied in corresponding with the specific characteristic of each territory. The choice of which measures for risk management will be undertake is made through a cost-benefit analysis. However a major issue is a lack of a unified approach related to the typology of the different interventions and applicable

indicators<sup>1</sup> as well as cost effectiveness of implementing various<sup>2</sup> foreseen measures.

<sup>1</sup> This was found by several researchers in the period before the introduction of the 2008 European Commission Guide. For example, refer to: Mechler, R., 2004, Natural Disaster Risk Management and Financing Disaster, Losses in Developing Countries, Verlag für Versicherungswirtschaft, Karlsruhe; Developing the Cost-Benefit Framework for the Appraisal of Flood and Coastal Erosion Risk Management Projects, Produced: December 2004, Author: Professor Robert Sugden /Joint Defera (Department of environment flood and rural affairs) and EA(Environment agency)/; Evaluation of the impact of floods and associated protection policies (Contract N 07.0501/2004/389669) – Final Report, April 2005; Integrating Cost-Benefit Analysis and Multi-Criteria Analysis of Flood and Coastal Erosion Risk Management Projects, Produced: April 2005, Author: Professor Robert Sugden /Joint Defera (Department of environment flood and rural affairs) and EA(Environment agency)/; Cost-benefit analysis of Natural Disaster Risk Management in Developing countries – Manual, august 2005, Reinhard Mechler etc.

<sup>2</sup> For example: A Floods Working Group (CIS) Resource document Flood Risk Management, Economics and Decision Making Support – October 2012; Flood risk and Water management in the Netherlands, Update 2012, Ministry of Infrastructure and Environment, The Netherlands; Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century, 2012, Jha, Abhas K.; Bloch, Robin; Lamond, Jessica. 2012. Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century, World Bank. © World Bank; Ranking sources of uncertainty in flood damage modelling: a case study on the cost-benefit analysis of a flood mitigation project in the Orb Delta, France December 2012, Nathalie Saint-Geours, Frederic Grelot, Jean-Stephane Bailly, Christian Lavergne, <https://hal.archives-ouvertes.fr/hal-00762009>; Water Appraisal Guidance; Assessing Costs and Benefits for River Basin Management Planning, Final Draft, May 2013; A Common Framework

The EC Guide<sup>3</sup> excludes examples for risk assessments of natural disaster project. In the guide there is recommendation to use the methodology for cost-benefit analysis and taking into account developed national guidelines. Unfortunately in Bulgaria there is national guideline only in terms of flood risk management.

In methodological terms, it is essential to consider not only the review and analysis of existing practices, but also consider a comprehensive overview of national and European legislation governing relations and processes in the area of intervention. This is where diversification of measures (individual intervention components) applies, regarding the multi-aspect nature of these measures and determining relevant typological features as divided and reviewed in the following aspects: according to risk management elements – prevention, protection, preparedness, recovery, disaster response, etc. This aspect of typing is essential to cover the full range of intervention measures expected to be included in project investment decisions assessed through the CBA methodology:

- **Risk management elements** – prevention, protection, preparedness, recovery, disaster response and etc. This approach of division is essential for cover the full range of intervention measures, which expected to be included in project investment decisions and respectively assessed by the CBA methodology.

- **Type of the intervention** – structural<sup>4</sup> and non-structural<sup>5</sup>.

- **Scope of interventions** – the interventions for risk management are implemented at nation-

Of Flood Risk Management Cost Benefit Analysis Features, Support Tool N1: Cost benefit analysis Guidelines - Middlesex University Flood Hazard Research Centre, 28/02/2014; Making Communities More Flood Resilient: The Role of Cost Benefit Analysis and Other Decision-Support Tools in Disaster Risk Reduction, Zurich Flood Resilience Alliance, September 9, 2014 and others.

<sup>3</sup> Under Delegated Regulation (EU) № 480/2014 of the Commission, dated March 3, 2014, the Guidelines of the European Commission in December for cost-benefit analysis of investment projects, published on [http://ec.europa.eu/regional\\_policy/sources/docgener/studies/pdf/cba\\_guide.pdf](http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf).

<sup>4</sup> Structural type of interventions concerns to build up infrastructure facilities for prevention from floods

<sup>5</sup> Non-structural type of interventions refers to soft measures such as training, develop strategies, plans and etc.

al, regional and local level. The prevention of floods are the hot spots in the River Basin Management Plans and Plans for management the risk of floods. The plans indicate the flood risk zones and measures for protections., comprises measures which plan to be execute at national level and regional level.

*Impacts on risk evaluation – assessment of the vulnerabilities to the floods and risk exposition.* The risk evaluation is a complex, the economic benefit and cost of prevention of the risk could be evaluated by the Cost-benefit analysis<sup>6</sup>.

Since the implementation of various instruments (methods) for analysis and evaluation is inhomogeneous to the typology of the different measures included in a potential project, it is appropriate to identify specific requirements and characteristics. These should be taken into account when developing management analysis of costs and benefits, along with the methodological tools to be included in regard to spending public funds in the Member States.

Diversification of the risk depends on the information, the threat, and the vulnerability level. The information is crucial for the risk evaluation. The River Basin Management Plants consists of information for the past and present floods, measures for prevention of the floods are part of the Plans for floods management. There are different approaches and guidelines for appraisal the effect of the implementation of various risk measures, as follows<sup>7</sup>:

<sup>6</sup> These classifications are used in the National Catalog of Flood Risk Management Measures.

<sup>7</sup> Guideline for economic effects and evaluation in EIA, PlanningNSW, November 2002; Use of Benefit/Cost Analysis for FEMA Programs, Association of State Flood Plain Managers, 06 July 2007; Guide to economic appraisal: Carrying out a cost benefit analysis, Central Expenditure Evaluation Unit, September 2013 (<http://publicspendingcode.per.gov.ie>); Economic Aspects of Integrated Flood Management, World Meteorological Organization, June 2007; Flood and Coastal Defence Project Appraisal Guidance: Economic Appraisal, Ministry of Agriculture, Fisheries and Food, Flood and Coastal Defence with Emergencies Division, December 1999; A methodological approach to land use-based flood damage assessment in urban areas: Prague case study, Elisabetta Genovese, 2006; Defra Flood and Coastal Defence Appraisal Guidance, Social Appraisal Supplementary Note to Operating Authorities Assessing and Valuing the Risk to Life from Flooding for Use in Appraisal of Risk Management Measures, May 2008 etc.

## **Assessment of the different types of measures by the impact on the risks**

Diversification of the risks finds a necessity of specific application with some of the tools for analysis, related to the need to generate sufficient and adequate information base for the implementation of evaluation methods. These characteristics are useful when assessing the effect of the implementation of various measures, falling in each of the types of typological distribution as follows<sup>8</sup>:

- **Prevention** – Prevention – measures falling within this group are characterized by the need to form a detailed and comprehensive database. Special attention is required for the application of the methodology for quantifying benefits. Measures of this group are characterized by totally avoiding the risk of certain natural disasters happening (in cases where this is possible) in the area. This requires an alternative “cost” in case of occurrence of risk events, or estimating alternative costs regarding the consequences of such occurrence. In the metrological documents and good practices examined, it is recommended that this is done either via the method of historical direct costs and losses formed (for the damage, disability cases among affected population, and others) or by applying the method of avoided payment of insurance premiums. In the first case, the total amount of the losses prompts for the adequate transformation of these losses into present value for the reporting period, on the one

<sup>8</sup> Some of the sources used as references to the problem are: Guideline for economic effects and evaluation in EIA, PlanningNSW, November 2002; Use of Benefit/Cost Analysis for FEMA Programs, Association of State FloodPlain Managers, 06 July 2007; Guide to economic appraisal: Carrying out a cost benefit analysis, Central Expenditure Evaluation Unit, September 2013 (<http://publicspendingcode.per.gov.ie>); Economic Aspects of Integrated Flood Management, World Meteorological Organization, June 2007]; Flood and Coastal Defence Project Appraisal Guidance: Economic Appraisal, Ministry of Agriculture, Fisheries and Food, Flood and Coastal Defence with Emergencies Division, December 1999; A methodological approach to land use-based flood damage assessment in urban areas: Prague case study, Elisabetta Genovese, 2006; Defra Flood and Coastal Defence Appraisal Guidance, Social Appraisal Supplementary Note to Operating Authorities Assessing and Valuing the Risk to Life from Flooding for Use in Appraisal of Risk Management Measures, May 2008 etc.

hand, and raises the question for their full reporting within the period when the event occurred. It is necessary to consider whether such event has occurred in past years. Application of a single value rate nationwide, based on the level of risk determined when relevant assessment was made for respective zones is also questionable, since it does not take into account local specifics. As a result, specific alternative losses can be substantially under- or overvalued. In case of applying the approach of insurance premiums, it is necessary to request information from the insuring companies operating on the territory of the intervention divided by type, size and specific insurance, as well as information about the insurance premiums that are paid in prior periods. Given the poor practice of insurance of property (as in the countries applying this method) it questions the general applicability of this methodological tool. This is a serious issue in rural areas, where as a result of a number of factors, the historical information and especially the detailed statistics at local level is extremely fragmented. By applying the tools of the multi-criteria analysis, one questions the detailing of sensitivity (whether or not calculated by correlation or another dependence) of the studied factors. This means the method should focus primarily on the endogenous factors, thus undermining the most serious advantage of applying this method.

- **Protection** – the measures falling within this group should include historical information regarding the degree of impact of relevant events. With some of the measures in this group the risk is avoided, while with others it is significantly reduced. In the first case, the tools relevant to “protection” measures actually have the same typological features as the “prevention” measures. In the second case, it is necessary to determine a factor reducing the likelihood of risk event occurrence and/or reduction factor for economic costs. In addition, with each of the measures in this group one should assess whether, and to what extent, it falls within the first or second of these two hypotheses. Such information must be gathered and compiled by the relevant competent authority, separately for each country. It is appropriate to diversify it according to the specificity



of the region – for rural areas and urban environment. The specificity in this case is that the choice of database cannot consider the – ”Measure for measure” method, as the analysis of costs and benefits should be based on an uniform information database, regardless of which particular measure or set of measures are evaluated. The method can be applied to sets of measures and types of anti-risk interventions that have similar characteristics, and not only to the type of natural phenomenon, but also in regard to the authenticity of the risk of their occurrence. In this respect, it is relatively highly reliable to predict the risk, for example, of floods on agricultural land alongside rivers, when the rivers are prone to extensive spills, whereas we have opposite value to risk prevention, for example, in cases of earthquakes.

• **Preparedness.** Measures falling within this group, typified based on the elements of the risk management of natural disasters. In this case, one needs to define a factor reducing the likelihood of risk event occurrence and/or a reduction factor of economic costs. It is more likely that the need for a degree of reduction of the cost of a possible occurrence has higher econometric value, since this group includes measures suggesting further reaction, such as for example a warning of a high risk of flooding or further expansion of existing fires to a particular settlement or in proximity to cultivated areas.

• **Recovery.** Measures falling within this group are characterized by the typical accounting of alternative costs. In this case, it is necessary to apply a combined approach to account for both the paid public insurance premiums and the unreported damage<sup>9</sup>.

<sup>9</sup> Basic recommended methodology as according to: Flood Risk Management in Europe: European flood regulation, Star-Floodq Marloes Bakker, Colin Green, Peter Driessen, Dries Hegger, Bram Delvaux, Marleen van Rijswijk, Cathy Suykens, Jean-Christophe Beyers, Kurt Deketelaere, Willemijn van Doorn-Hoekveld, Carel Dieperinkq 03 June 2013; Cost&Benefits of Irrigation in the Zambezi River Basin; Benefit-Cost Analysis in the Chehalis Basin, A West Coast saga exemplifies how these analyses can create more controversy than they resolve, By Ryan Scott, Richard O. Zerbe Jr., and Tyler Scott, 2013; FLOOD-CBA Project: Stocktaking on Flood Risk Management and Cost-Benefit Analysis, Seminar, Lisboa, 21 January 2014 etc.

As noted, in the absence of a common practice for reporting on insurance premiums, the first component has a controversial nature. The public compensations are the only credible source of information, while unreported damage can be determined only on a comparative basis or based on general estimates that generally vary significantly. This problem can be solved with the adoption of a detailed methodology to quantify the overall damage from the occurrence of the event and from its prevention, which, however, is both a complex enough task and falls out of pure assessment methods.

• **Reaction in case of natural disaster.** Measures falling within this group, specified on the basis of the elements of risk management, are characterized by the presence of the second hypothesis from the “protection” group measures. In this case, one needs to define a factor reducing the likelihood of risk event occurrence and/or a reduction factor of economic costs. It is more likely that the need for a degree of reduction of the cost of a possible occurrence has higher econometric value, since this group includes measures suggesting further reaction, such as for example a warning of increased risk of natural disasters in a particular location or target territory.

Assessing the economic benefits and losses avoided is a different matter. For individual measures within the described group of measures, it is necessary to build an information database or develop a mechanism for the formation of such database – for example: by requesting from the Commission for Financial Supervision summaries of insurances made and insurance premiums paid. This should be done considering the territorial scope of the insured objects situated in the areas of intervention.

With such information existing and available, the application of tools and methods for risk assessment are not characterized by additional typological features for individual groups of measures in this classification. This refers to evaluation of sensitivity, multi-criteria analysis etc., identified and reported within the scope of the present study.

## **Assessment of the effect of the implementation of the various measures for risk management**

Diversification based on the type of measures finds a specific application with some of the tools of analysis relating to the need to generate sufficient and adequate database for implementation of valuation methods. These characteristics are applicable when evaluating the effect of the implementation of the various measures falling in each of the types of typological distribution as follows:

- **Structural.** Measures falling within this group are characterized by the existence of an infrastructure, hence the specifics of the accounting for the cost of relevant construction works. It concerns the question of the cash flow of investment costs and operating costs related to maintenance and renewal of short-term and long-term elements, in the case of a reference period longer than the period of economic depreciation of assets.

The special treatment of these costs is associated with the period of their full economic depreciation and the need for renewal. In the studied literature, there is virtually no methodology for determining the economic period for amortization of this asset. The best option is the economic period for amortization to be determined by the engineers when drafting the technical assignment and the blueprints, considering the applied technology and materials.

The use of standards for permissible accounting amortization is not relevant, because their logic is adapted for tax purposes and does not reflect the specifics of the facilities in subject. With the methodological approaches to assessing the residual value described in the 2014 European Commission Guide<sup>10</sup>, this problem is generally solved.

- **Non-structural.** Measures falling within this group are characterized by determining the duration and magnitude of their impact, since they are a separate factor associated with

the prevention of floods, hence these are more or less complementary to the structural measures.

At the same time, effects or outcomes from the implementation of non-structural measures have a particular impact on the risk of natural disasters, as their expected occurrence is associated more with decreasing the magnitude of the risk of occurrence of the event, moreover – with a certain intensity, which can be changed within the time period. Reforestation of certain areas can be an example of this, where the risk of occurrence of a natural disaster can change over time according to the condition of the forested territory (floods and fires) and can display different values in the period of analysis.

It is advisable that non-structural measures are implemented mainly in combination with structural ones, because including only non-structural measures in the infrastructure project could lead to a negative evaluation of the effects or benefits of the measures. However, this cannot be set as a requirement, especially in situations where the availability of financial resources (from the source of EU funding) is limited and structural measures cannot be implemented.

The measures for risk management can be implemented at national, regional and local level. In designing the measures is necessary to take into account the specifics of the information at national and regional level. The measures applied at regional level needs to show the territorial scope, economic and social development, and requires specific information. The indicators for assessment the impact of the measures on prevention of risks at regional level differ significantly from national level ones. The difference in the implementation of methods of risk analysis is associated primarily with assessing the benefits and risk sensitivity. In cases of absence enough financial information is appropriate to apply the multi-criteria analysis.

The risk prevention measures applied at local level are connected with local economic and social development. In this case, it is possible that values of individual indicators at local level differ

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<sup>10</sup> Guide to Cost-Benefit Analysis of Investment Projects. Economic appraisal tool for Cohesion Policy 2014-2020, European Commission.

significantly from national level ones, or from the average value for the territory.

The measures concerns to tackle to the impact on the disaster risk requires past information, the results of simulation models and other valuation models. These measures components, allows for a specific application of some of the tools of analysis, relating to the need to generate sufficient and adequate information database when using valuation methods. Information on hazards is generated using catalogues of historic events and scientific models that describe the spatial and temporal dynamics of such hazards. In recent years, researchers and experts developed methods to conduct the assessment of hazards, vulnerability. Vulnerability describes a set of conditions of people that derive from the historical and prevailing cultural, social, environmental, political, and economic contexts. In this sense, vulnerable groups are not only at risk because they are exposed to a hazard but as a result of marginality of everyday patterns of social interaction and organization, and access to resources (Watts and Bohle, 1993; Morrow, 1999; Bankoff, 2004<sup>11</sup>). Vulnerability is related to impact on likelihood. Information on vulnerability is more difficult to compile given its social and economic nature. In some cases detailed assessments of vulnerability are conducted using specific surveys at the level of rural and non-urban communities. Such approaches provide more precise information on the different dimensions or components of vulnerability and are better tailored to capture information on the vulnerability of various sectors of development. In other cases, the vulnerability is assess on using demographic, economic and social data such as the Gross Domestic Product (GDP), household income, employment rate and etc.

Mapping can be important tools to show information about hazards, vulnerabilities and risks in a particular area and thereby support the

risk assessment process and overall risk management strategy. They can help set priorities for risk mitigation and management. Maps have important role to ensure that all actors in risk assessment have the same information about hazards and in the dissemination of the risk assessment results to stakeholders and could also be useful in the strategic planning. Vulnerability assessment criteria may include capabilities to anticipate events such as scenario planning, real options, capabilities to prevent events such as risk responses in place, capabilities to respond and adapt quickly as events unfold, and capabilities to withstand the event such as capital buffer and financial strength. The multi-criteria analysis is used for assessment the vulnerabilities, the difficulties are associated with forming the correct sensitivity coefficients of separate factors examined. Although the method can always be used based on endogenous factors, its basic logic is to study the complex elasticity of the project results, compared to the impact of the exogenous variables.

### Stages in Risk Assessment

Risk assessment can be divided into four major stages: hazard identification, adverse effect, exposure assessment, and risk characterization. The hazard identification is the most easily recognized in the actions of regulatory agencies. It is defined here as the process of determining whether exposure to farmers and rural community can cause an increase damages of crop and agricultural facilities.

Adverse effect assessment is the process of characterizing the relation between the administrative capacity and the incidence of an adverse effect in exposed farmers and estimating the incidence of the effect as a function of agricultural holdings exposure to the risk. It takes account of intensity of exposure and variables such as farmers, crop productivity, income and other factors. The adverse effect assessment should describe and justify the methods of extrapolation used to predict incidence and should characterize the statistical and weather uncertainties.

<sup>11</sup> Watts, M.J. and H.G. Bohle, 1993: The space of vulnerability: the causal structure of hunger and famine. *Progress in Human Geography*, 17(1), 43-67. Morrow, B.H., 1999: Identifying and mapping community vulnerability. *Disasters*, 23(1), 1-18. Bankoff, G., 2004: *The Historical Geography of Disaster: 'Vulnerability' and 'Local Knowledge' in Western Discourse*. Earthscan, London, UK

Exposure assessment is the process of measuring or estimating the intensity, frequency, and duration of exposures to farmers currently present in the environment or of estimating hypothetical exposures that might arise from the climate change. In its most complete form, it describes the magnitude, duration, schedule, and route of exposure; the size, nature, and of the agricultural assets exposed; and the uncertainties in all estimates. Exposure assessment is often used to identify feasible prospective control options and to predict the effects of available control technologies on exposure.

Risk characterization is the process of estimating the incidence of the climate change disasters. The summary effects of the uncertainties in the preceding steps are described in this stage.

## Conclusions

The decision on what risk management measures are optimal for the particular location and which projects to be funded should be implemented through a cost-benefit analysis. Some conclusions for the financial and economic evaluation of disaster risk projects and respectively the management:

- The implementation of a unified methodology for evaluation is very difficult because of highly specific characteristic resulting from the typology of intervention;
- The difference is in the application of evaluation methods for all varieties of measures to manage the risk of natural disasters. The cost-benefit analysis is used to evaluate the damages cost of the nature disasters (floods, droughts) and benefits of climate change adaptation measures. Features associated with the magnitude of the damage to assets in different areas are not reported. In case of equal competitive basis for projects (i.e. limited financial resources, financing only the most effective projects, according to the methodology), the interventions in rural areas and in areas with a high concentration of agricultural production would practically drop out.
- The overall evaluation of the specifics of the application of different assessment methods, in-

tended to become part of the Guide to Cost–Benefit analysis, is that the measures in the groups of this typology require a specific approach to the compilation of the output database in applying the tools of economic analysis. This applies in particular when forming and transforming an economic cash flow and when implementing the multi-criteria analysis. The above-prescribed methods to build a single quantitative information database should be used as measures to address the said specifics.

All of these findings raise the question for developing a detailed national guidance on the application of the Cost–benefit analysis for assessing measures (and projects) for managing the risk of natural disasters. These guidelines should take into account the specificities of the various economic sectors affected by the climate change and nature disaster, especially in rural areas. The synergistic effect of the policy to manage the risk of natural disasters in rural areas and agriculture sector could be achieved by developing specific guideline, which combines the Cost–Benefit analysis and methods included in National Guideline related to floods and disaster risk assessment and management.

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