MEGA

The Codru Quest:

Final Report

Study on the economic valuation of ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest in Moldova.

Dear Friend,

We are researchers from the Moldovan Environmental Governance Academy (MEGA; www.megageneration.com), an organization in Moldova that specializes on environmental research and education by using the approaches of gamification, open-source eco-innovations, and citizen science. We are interested in nature conservation and its relation to people's well-being in Moldova.

In November 2016 – August 2017, we conducted the research project entitled "The Codru Quest". This was a study on the economic valuation of ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest in Moldova. The main goal of the project was to estimate and present the indirect use and non-use economic values of ecosystem services and biodiversity conservation in this protected area. There was a need to understand people's attitudes to these environmental goods and valuation of benefits coming from the Codru Nature Reserve in order to better manage and expand it through reforestation and biodiversity conservation activities.

In this Final Report, we present you the ultimate results of the Codru Quest project along with brief description of the choice modelling technique used for collecting and analyzing data, outline of the process of capturing and estimating willingness to pay for changes in ecosystems services and biodiversity conservation, validity testing of the results, and our discussion and recommendations. The Report includes references to the methodological guidebook written by us while conducting the Codru Quest study, design of the main choice modelling survey, datasets with organized respondents' answers and preferences from it, and other materials that can be useful for further economic valuation research on the topic of the Codru Quest project.

We hope you will find the Report valuable for your own environmental study, cost-benefit analysis, environmental policy proposal, or any other uses, and wish you MEGA great success in your work.

Yours Truly,

The MEGA Team

Moldovan Environmental Governance Academy (MEGA)

Moldovan Environmental Governance Academy (MEGA) is the social entrepreneurial organization focused on delivering services of gamification, game development, gamified trainings, and e-learning with environmental and social value.

MEGA represents an innovative solution for addressing the modern world's most pressing social and environmental issues, including inefficient natural resource management, environmental pollution, loss of biodiversity, climate change, etc. The organization tackles these issues through community participation and collaborative environmental governance.

The vision of MEGA is a sustainable world, where every person lives an eco-friendly life, has open access to practical learning opportunities, constructs own open-source eco-innovations, and thus contributes to sustainable development and creation of positive social and environmental impact in a collaborative, enjoyable, and fun way anywhere in the world.

The purpose of MEGA is to create this sustainable world on the basis of such positive and motivating feelings as fun, enjoyment, and optimism about the future. To achieve this the organization combines psychology + technology + ecology in an innovative way and uses their combined advantages. More specifically, MEGA applies gamification, open-source eco-innovations, and citizen science for granting communities the "power" to create the clean, green, and environmentally prosperous world they dream of with their own hands and minds.

The core product of MEGA is MEGA Game: The Game with Impact. It is the unique gamification system, where creating positive impact becomes a habit. MEGA Game represents a web platform with elements of gamification that connects individuals with Green Tech companies and environmental organizations and educates them on different aspects of nature conservation and sustainable development through practical real-world tasks and e-learning trainings linked to each task.

More information is available at www.megageneration.com.

Contents

Abbreviations

CAPI	Computer-assisted Personal Interviews
CBA	Cost-benefit Analysis
CE	Choice Experiments
CM	Choice Modelling
ES	Ecosystem Services
IIA	Independence of Irrelevant Alternatives
MDL	Moldovan Lei
MEGA	Moldovan Environmental Governance Academy
NGO	Non-governmental Organization
PA	Protected Area
PES	Payments for Ecosystem Services
SP	Stated Preference
TEV	Total Economic Value
WTA	Willingness-to-Accept compensation
WTP	Willingness-to-Pay

Executive Summary

Economic valuation of ecosystem services and biodiversity represents a useful scientific tool for assessing and demonstrating how important and valuable these environmental goods can be, especially when no actual market for them exists. It is mainly for this reason that the economic valuation methodology was selected to be applied in the Codru Quest project for addressing the problem of degradation of the Codru forest and other forest ecosystems and the loss of biodiversity in Moldova. It was assumed that one of the reasons behind such problem is lack of awareness about indirect use and non-use values of these ecosystems for society and their undervaluation in cost-benefit analysis (CBA), land use planning, and environmental policy making.

The main goal of the Codru Quest project was thus to estimate and present the economic indirect use and non-use values of ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest in Moldova. The Codru Nature Reserve is the oldest protected area in the country, located in one of the last remnants of the Codru forest.

To achieve this goal, the researchers in the Codru Quest project conducted choice modelling survey with 201 respondents, who represented 100 residents of the capital city Chisinau and 101 residents of 9 villages situated around the Codru forest. On the basis of survey results the researchers estimated negative willingness to pay for expansion of the Codru Nature Reserve territory at -13 798 MDL (650.16 EUR) per year and for protection of more plant species at -40 775 MDL (1921.31 EUR) per year. These negative values are caused mostly by specific socio-economic factors and influences of corruption in Moldova. At the same time there is strong positive willingness to pay for conservation of more insect species at 57 050 MDL (2688.19 EUR) per year and for protection of endangered symbolic species, such as small-flowered black hawthorn and stag beetle, at 64 260 MDL (3027.92 EUR) per year. To a great extent these monetary metrics represent existence and bequest values that Moldovan citizens attach to ecosystem services and biodiversity in the Codru forest.

The Codru Quest conveys the message that indirect use and non-use benefits of ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest are important and valuable for Moldovan citizens. Therefore, they should be considered in CBA, decision-making, land-use planning, and policy-making related to this environmental good.

Introduction

"The Codru Quest: Final Report" represents the summary of results, discussion, and conclusions of the research project "The Codru Quest" (www.megaimpact.md/the-codru-quest) realized by the organization Moldovan Environmental Governance Academy (MEGA; www.megageneration.com) in November 2016 – August 2017. The Report is prepared for local communities in Moldova, administration of protected areas, environmental organizations, Ministry of Environment, policy makers, environmental researchers, and generally for people, who are interested in using the Codru Quest results and recommendations for their own environmental studies, educational and conservation initiatives, CBA, land use planning, environmental policy making, and other purposes.

The Codru Quest was a scientific research initiative on the economic valuation of ecosystem services and biodiversity in the protected area the Codru Nature Reserve and the Codru forest in the Republic of Moldova. The main goal of the Codru Quest project was to estimate and present the indirect use and non-use economic values of ecosystem services and biodiversity conservation in this protected area. By doing so, the researchers wanted to understand how Moldovan citizens perceive these environmental non-market goods and how much they value environmental benefits coming from the Codru Nature Reserve in order to help manage and expand it through reforestation and biodiversity conservation activities. The expected result of the Codru Quest project was thus the value of indirect use and non-use benefits of ecosystem services and biodiversity conservation for raising awareness and educating people about the need to protect such ecosystems, conducting CBA that accounts for such values of forest ecosystems, land use planning, and environmental policy making. A side "product" that came out of the project is the methodological guidebook "The Codru Quest: Methodology", which describes how to conduct a similar economic valuation study for researchers who wish to learn about it and use it in their own scientific projects.

The Codru Quest represents the first economic valuation study on ecosystem services and biodiversity conservation done in the Republic of Moldova with the use of the choice modelling technique. Choice modelling is an economic valuation technique that applies specially designed surveys and hypothetical markets to elicit respondents' preferences for certain changes in provisioning of an environmental good or service. In this way, the

technique allows for the estimation of such non-use values as ecosystem services and biodiversity that do not have market price and are usually undervalued in decision making. Previous studies on related subjects in Moldova have used literature review and market-based valuation techniques, which can only estimate use values of forests for society. There are also economic valuation studies conducted with choice modelling technique that estimated both use and non-use values of ecosystem services in other developing countries, yet so far not in Moldova. The Codru Quest complements all these studies with economic estimation of indirect use and non-use values of ecosystem services and biodiversity conservation in such a complex socio-economic and political situation as the one existing in Moldova at the time of writing the Report.

The Final Report on the Codru Quest project is structured as follows:

- Chapter I describes the target environmental good that had been valued, which is ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest, and the problem that the researchers had addressed and intended to solve with the Codru Quest study.
- Chapter II explains the underlying assumptions related to the roots of the problem addressed and its influence on the long-term quality and provision of the target environmental good, as well as possible solutions to mitigating or resolving the problem that the researchers had before commencing the Codru Quest study.
- Chapter III states the main goal and objectives of the Codru Quest study and discusses whether they had been achieved.
- Chapter IV presents and briefly explains the economic valuation technique and methods used in the Codru Quest study. Specifically, it covers the reasons of choosing the choice modelling technique, the way population sampling was done and attributes of the target environmental good were chosen, the arguments for the choice of willingness to pay as a measure of wellbeing and visitor price as a payment vehicle, and other methodological aspects of the study.
- Chapter V lists the main steps of the surveying process, including how the choice modelling survey was designed and tested, how the sample of respondents was determined, what methods of approaching respondents were used, and what were the reasons for choosing specifically those methods.

- Chapter VI explains how the data from the choice modelling survey were processed, how non-valid answers were identified, how many were removed from the sample, and what econometric models were used to estimate mean and median willingness-to-pay values and confidence intervals.
- Chapter VII presents how the results obtained from the data analysis were tested for validity and what were the outputs of these tests.
- Chapter VIII describes what were the challenges and limitations faced by the researchers while conducting the Codru Quest study and what efforts were made to deal with them.
- Chapter IX shows the actual results of the Codru Quest study, specifically the profile of the respondents, their relation to the target environmental good and attitude towards it, mean and median willingness-to-pay values from the target sample surveyed and their estimates aggregated to the full target population, as well as influence of socio-demographic and economic characteristics on these estimates.
- Chapter X contains the researchers' reflection on the final results obtained from the Codru Quest study, explanation of reasoning behind them, implications they might have on the target environmental good, and finally recommendations for different stakeholders, who might use the study, its data, and final results.

The Report concludes with acknowledgements to the sponsors, partners, advisors, and team members of the Codru Quest project, references to the literary sources used, explanation of the key terms used throughout the Report, indexes, and annex. The Annex includes links to the main choice modelling survey, datasets with organized respondents' answers and preferences from it, and publications released during the project, as well as photos representing ecosystem services and biodiversity in the Codru Nature Reserve and the Codru forest taken during several expeditions within the Codru Quest project.

I. Problem Addressed

The problem addressed by the project is the degradation of the Codru forest and other forest ecosystems in the Republic of Moldova and their biodiversity, caused by lack of awareness about indirect use and non-use values of these ecosystems for society and their undervaluation in CBA, land use planning, and environmental policy making.

Forests are the historically representative and symbolic ecosystems of modern Moldova. However, the share of forest cover in Moldova has declined, from approximately 60% of total land cover of the country to about 11-15% (Figure 1; Moldsilva, 2011).

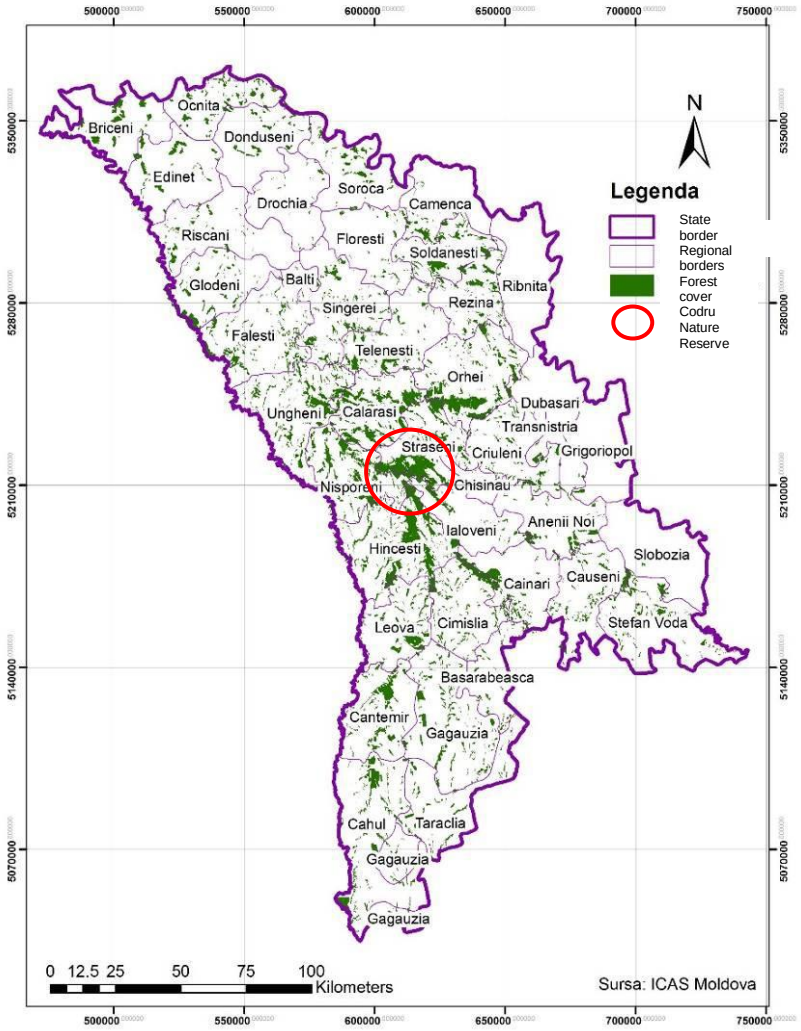

Figure 1. Map of the Republic of Moldova with the remaining national forest cover. Source: Adapted from Transilvania University of Brasov, 2015.

In spite of a certain level of legal protection of forests and a number of reforestation initiatives organized by state agencies and environmental non-governmental organizations (NGOs), the natural forest cover and its biodiversity continue to disappear due to prioritization of forests as mainly sources of direct use values, such as consumption of timber for construction and heating. The problem is even more alarming, as the timber consumption is done unsustainably with numerous cases of uncontrolled and illegal logging happening even in protected areas, such as the Codru Nature Reserve.

In terms of protected areas (PAs), their scarcity reflects the scarcity of forest ecosystems in the country. In fact, Moldova has the lowest coverage of PAs on its territory compared to other European countries. Certain sources (National Institute of Ecology, 2004; Parks.it, 2000) state that the PAs cover only 1.96% of the country's territory. However, more recent sources (Protected Planet, 2014 – 2015; Rodríguez, 2009) claim that the PAs cover approximately 4 – 4.7% of Moldova's total area, amounting to 161 173 ha, or 1 298 km^2.

1.1. Study Area

The Codru Nature Reserve is the oldest PA in Moldova. It was established in 1971, when Moldova was part of the former Soviet Union (Moldsilva, 2017). This nationally protected territory covers approximately 5 175.8 ha of the Codru forest located in the central part of Moldova, specifically on the intersection of the Straseni, Hincesti, and Ialoveni regions, at a distance of 49 km from the capital city Chisinau (Figure 2).

Figure 2. Present territory of the Codru Nature Reserve. Source: Adapted from MEGA, 2017b.

The Codru Nature Reserve is administered by the state agency Moldsilva under the supervision of the Ministry of Environment of Moldova. The PA consists of 720 ha of strictly protected zone that can be accessed only for official research and nature conservation activities and 4 455.8 ha of buffer zone, where visitors are allowed under the permission of the Codru Nature Reserve's administration (Moldsilva, 2017). These zones are surrounded by approximately 123 000 ha of transition zone, where all anthropogenic activities are allowed with the condition that they do not create negative effects on the Codru forest ecosystem. Access to the transition and buffer zone of the PA and excursions in the Codru forest are free. Only visits to the Museum of Nature situated in the administration building near the forest have a visitor price of 20 Moldovan lei (MDL) (1 EUR) for adults, 10 MDL (0.5 EUR) for students, and 100 MDL (5 EUR) for a guided walk. Generally, there are about 3500 tourists visiting the Codru Nature Reserve annually.

The Codru forest is a dominantly oak forest, with oak trees occupying about 49% of its territory. The other tree species present in the ecosystem are ash, hornbeam, beech, maple, and poplar (Photo 1).

Photo 1. The Codru forest in the Codru Nature Reserve. Source: Alexandr Iscenco, 2016.

Overall, the Codru forest has more than 1 000 species of protected plants, representing half of Moldova's flora; 43 species of mammals; 145 species of birds; 7 species of reptiles; 10 species of fish; and more than 8 000 species of insects. It is also the habitat for the 2 species, one of a plant and another of an insect, which are symbolic for the country but which are included in the Red Book of Moldova as endangered for the country (Ministry of Environment of Moldova, 2015) (Photo 2). They are:

- Plant: small-flowered black hawthorn (*Crataegus pentagyna*). There were only 2 – 8 representatives found and registered on the territory of the Codru PA in 2015.
- Insect: stag beetle (*Lucanus cervus*). Its population in the Codru PA is unknown, but the beetle's populations all over Europe are in decline and even extinct in some EU states.

Photo 2. Small-flowered black hawthorn (*Crataegus pentagyna*) to the left and stag beetle (*Lucanus cervus*) to the right. Source: MEGA, 2017b.

1.2. Description of the Problem

The Codru Nature Reserve and the Codru forest are suffering from numerous cases of legal and illegal logging which have their roots in extensive state-level corruption, including in the PA administering agency Moldsilva. This is not surprising, as Moldova in general bears the overall bribery risk score of 70 points on the TRACE Matrix indicator of bribery risk, meaning that there is a high risk of corruption in the country (TRACE International, 2016).

The most recent publicly known cases of corruption related specifically to Moldsilva and management of forest ecosystems in Moldova include arresting its former general director

for allocating a forested area and using the resources of the agency to plan, design, and construct a residential complex in 2015 and accusation of the agency for extensive budget expenditures and signing service contracts with economic agents under its own subordination in 2016 (Anticoruptie, 2016).

Certainly such level of corruption certainly has its consequences. According to Ecology.md (2015), in 2007 (the latest year for which their data are available) there were 810 cases of illegal logging and poaching in the Codru forest and the PA registered by rangers and the police. Another source, CrimeMoldova, 2016, states that in 2014 Moldsilva allowed illegal cutting of trees and sales of timber in the volume of 2487 m^3, while in 2015 the volume of illegally cut timber in the forests managed by Moldsilva rose to 4579 m^3. However, the information on how many cases of illegal logging remained unprosecuted, as well as the amount of damage done to the Codru forest ecosystem is either not known or not communicated publicly. As a result, such situation allows corruption to prosper further and loggers and poachers to continue their ecosystem damaging activities.

In addition to that, during expeditions to the Codru Nature Reserve and the Lozova village nearby within the Codru Quest project, as well as from the discussions with both the PA administration and the Lozova residents, it was observed that there is a significant reduction in the cooperation level between them, which was more or less present in the Soviet Union times. There is actually an area of the Codru forest of about 500 ha that is shared between the PA and the Lozova community. Also, many Lozova residents work as foresters and rangers for the Codru Nature Reserve. However, the relations between these two direct stakeholders of the Codru forest ecosystem are less cooperative and even rather tense nowadays. Moreover, due to very difficult socio-economic situation in Moldovan villages and extensive poverty in rural areas, the villagers working as foresters in the Codru forest are often forced to overuse timber resources and contribute to the rate of deforestation.

All in all, extensive corruption, prioritization of direct use resources of the forest ecosystems, challenging socio-economic situation around Moldovan forests, lack of cooperation with nearby residents, and other factors lead to significant rate of logging in the Codru forest, overconsumption of its direct use natural resources, degradation of ecosystem services, and loss of biodiversity and habitats in the forest. Similar situations with these underlying factors and consequences are mirrored in other forest ecosystems in Moldova, which results in the loss of forest cover and resources on the national level and at an alarming rate.

1.3. Addressing the Problem

The Codru Quest project addresses the problem described through the scientific perspective. It targets specifically people's lack of understanding and awareness of overall value of forests for society, not just direct use one, and the undervaluation of benefits coming from forest ecosystem services and biodiversity in CBA, land use planning, and environmental policy making. As concrete example and as target study area the project uses the Codru Nature Reserve and the Codru forest. This is because they are the most well-known PA and forest ecosystem in Moldova.

Additionally, the Codru Quest approaches the problem of investing significant effort and costs required from a researcher to conduct economic valuation studies on ecosystem services and biodiversity conservation and obtaining the necessary participation and response rates from the targeted population sample. The burden of this problem is the greatest for researchers, who are at the beginning of their economic valuation experience, but need to start an economic valuation study from somewhere. The literature review is helpful, but still not sufficient, especially in the case of conducting the study by using the choice experiments (CE) method as its application in environmental research is still fairly limited. The researchers in the Codru Quest project had experienced this problem themselves, and decided to use the project also to enrich literature sources on this subject.

II. Key Assumptions

The Codru Quest project and its research process relied on a number of assumptions about the roots and different aspects of the problem addressed, its long-term consequences and threats to forest ecosystem services, and possible solutions to mitigate or resolve the problem (Figure 3). These assumptions formed the basis of decision making in terms of what should be researched in the project, what economic valuation technique and method should be used, how the necessary data should be gathered, and what should be the results expected from the project.

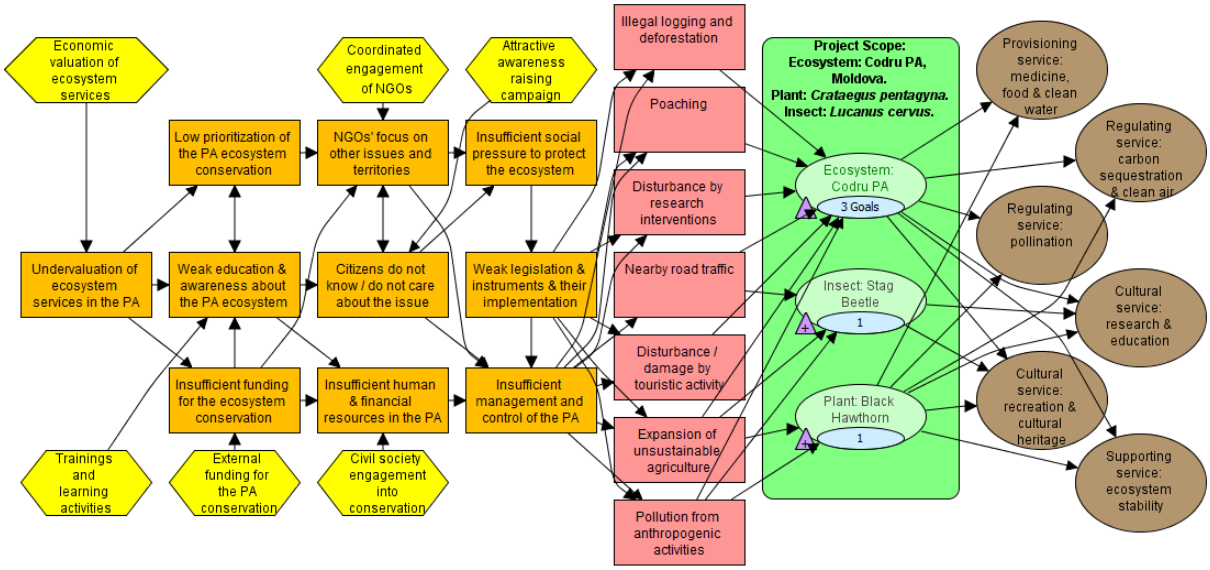

Figure 3. Miradi conceptual model demonstrating the assumptions of the Codru Quest project in terms of the roots and different aspects of the problem addressed (**orange**), their consequences and threats (**pink**) to the Codru forest ecosystem services (**brown**), and possible solutions to mitigate or resolve the problem (**yellow**). Source: Iscenco, 2017.

2.1. Problem-related Assumptions

The key assumptions related to the problem and its long-term consequences and threats were the following:

- One of the main underlying reasons behind the existence and development of the problem is the undervaluation of forest ecosystem services, especially the ones related to indirect use and non-use values, such as soil formation, erosion prevention, water

purification, climate change mitigation, habitat balance, biodiversity support, cultural, bequest, and existence values, etc. This causes prioritization of the forest ecosystem mainly as a source of timber by state officials, local communities, foresters, and other stakeholders and therefore active logging and increasing deforestation.

- Insufficient knowledge about the total economic value (TEV) of forests among the Moldovan citizens and state agencies, the undervaluation of the importance of ecosystem services and biodiversity for the environment and society, and lack of information about the current state of these important aspects of forest ecosystems and threats to them – all these influence decision makers' and local communities' preferences and priorities in relation to the use of Moldovan forests. As a result, people do not know and/or are not concerned about the state of the forest ecosystems, such as the Codru forest, and what they might lose in terms of wellbeing and welfare if the negative trend of their degradation continues. In turn, this leads to the lack of social pressure on the decision makers to improve the protection of forests, which allows even more deforestation, logging, poaching, etc. to happen.
- One stakeholder, who might be concerned about the values of forests besides consumption of timber, is tourists visiting Moldova forests, including the Codru forest, for sightseeing and recreational purposes. Theoretically, they should have strong opinion against logging and deforestation, as this action and trend decreases their enjoyment of forest environment and wellbeing obtained from visiting a forest. However, the number of such eco-tourists in Moldova is insignificant for them to have any voice in terms of management of forest resources and ecosystem services.
- PAs, such as the oldest one the Codru Nature Reserve, and forest ecosystems, such as the unique Codru forest, should have additional non-use values related to their historical, cultural, and environmental significance attached to them. Moldovan citizens, even those who do not use country's forests in any way, may still care about them and may be willing to support their conservation. In other words, they may have existence, bequest, and altruistic values attached to forest ecosystems and biodiversity in them, which adds to their sense of personal wellbeing. However, no one has ever considered them and definitely not quantified them to be used in decision and policy making. So, even if these values exist, and the degradation of forest ecosystems decrease the sense of wellbeing of people having them, no one can refer to them in awareness-raising, education, and conservation initiatives aimed to protect Moldovan forests.

- In relation to administration and management of PAs in Moldova, their staff can change little in the existing situation. For instance, the Codru Nature Reserve administration does a lot of important and hard work in conserving ecosystem services and biodiversity in their PA, managing forest stand, regulating logging activities, planting new trees, and so on. Its contribution to environmental education of its visitors is also worth to be noted and appreciated. Unfortunately, with extensive corruption on the state level, weak implementation of environmental legislation, difficult socio-economic situation in the rural areas nearby, and insufficient human and financial resources, the PA administration alone is not able to offer the necessary level of conservation of the Codru forest. It needs more support from the local communities, state agencies, and other citizens to monitor and deal with all the negative anthropogenic pressures on the forest ecosystem it is designed to protect. However, this support is very challenging to obtain, if people do not know and do not appreciate the overall importance and total economic value of the Moldovan forests.

2.2. Solution-related Assumptions

The key assumptions related to the solution to mitigate or resolve the problem addressed included the following:

- Even though Moldovan citizens, especially the ones living near the forests and depending on them, do not know and do not prioritize indirect use and non-use values of forest ecosystems and biodiversity in them, they may still attach these values. In fact, when shown and explained in an easily understandable way how valuable forests are for their wellbeing and welfare, people may increase their perceived value and prioritization of their conservation and sustainable use. They may even demand proper forest conservation policies and activities from the state and directly engage in these activities. Therefore, it should be a meaningful and very valuable initiative to estimate indirect use and non-use values of non-market environmental goods of Moldovan forests and then integrate the resulting estimates into raising awareness campaigns, educational initiatives, CBA, and proposals for land use plans and environmental policies.
- The universal “language” that all types of stakeholders understand is money. It is important but difficult to communicate consequences of deforestation and forest system degradation on people’s wellbeing, especially in case of regulating and supporting forest ecosystem services, through real but complex biophysical and biochemical relations.

Similarly it is difficult to talk with people about benefits of healthy forest ecosystems to them by using the same processes and scientific language. However, when such things are “translated” into the “language” of money, people understand what they are losing in the first case and gaining in the second one. On the basis of this understanding they become concerned, fearing to lose part of their welfare and willing to maximize the benefits “translated” into money. People may actually be willing to pay for the improvements in the quality and provisioning of ecosystem services, if they see and understand the gains from them. People may also want to secure such improvements in the future, and this is what they may be willing to pay for. This is what is known in environmental economic theory as willingness to pay (WTP) for ecosystem services. In addition, having the indirect use and non-use values of the non-market forest ecosystem services “monetized” allows them to be considered and used in CBA, land use plans, and policies, where they will give additional (and in many cases significant) weight to the option of protection and sustainable management of forests versus the option of unsustainable and uncontrolled logging and deforestation.

- Appreciation of indirect use and non-use values of forest ecosystem services and biodiversity conservation and clear understanding of their effects on social wellbeing and welfare bring possibilities for better management of forests and PAs. They can even give rise to the establishment of collaborative governance of forest ecosystems together with local communities. Furthermore, by promoting the importance and value of forest ecosystems and biodiversity in them to people, PAs can set up visitor prices that people are committed to pay, attract additional visitors, and in such way obtain financial resources for better monitoring, management, and conservation activities. At the same time, local communities can contribute to the development of rural and eco-tourism, securing additional source of income to support themselves and improve their wellbeing. The estimates of the value of forest ecosystem services and biodiversity can be used to analyze different strategies to forest management and choose the ones that offer long-term benefits to local communities, PA administration, the state, tourists, and the natural environment with minimal costs need to implement them.
- Certainly, estimating, demonstrating, and promoting economic values of forest ecosystems and biodiversity will not remove the “grip” of corruption on them. However, such actions are likely to give concerned citizens and environmental organizations an additional tool to be used in fighting against it and its harmful effects. This input can also help them bring additional supporters and resources to their side and increase their

chances of achieving the vision of protected and collaboratively and sustainably managed forests in the country.

- Having economic values of ecosystem services and biodiversity for one PA and/or forest, such as the Codru Nature Reserve and the Codru forest, will allow the estimation of approximate values of these non-market environmental goods in other forests in Moldova. This can be an important input for improving conservation and management practices in other PAs and forests, as well as for designing and implementing better environmental policies on the national level.

These assumptions related to the problem of the degradation of the Codru forest and other forest ecosystems in Moldova and biodiversity in them, as well as possible solution to it, were considered and reviewed during all phases of the Codru Quest project to see how the information and inputs obtained at each phase confirm or reject them. They were also useful as a “compass” to stay on track in achieving the main goal and objectives of the project.

In terms of the additional problem of significant effort and costs required from a beginner researcher to conduct economic valuation studies on ecosystem services and biodiversity conservation, the assumption here was that by carefully documenting the experience of conducting the Codru Quest study and then presenting it as a step-by-step guidebook will help other researchers in their own studies. They will be able to follow the steps and immediately see how each step was reflected in the Codru Quest study, thus using both methodological description of the process and the Codru Quest examples to prepare a valid and reliable economic valuation study that brings even more value to the domain of nature research and conservation than the Codru Quest project did.

III. Main Goal and Objectives

Based on the problem addressed and assumptions about its causes and possible solutions, the main goal of the Codru Quest project and its specific objectives were formulated. These were then aligned with the timeframe, budget, and other available resources of the implementing organization and project partners.

3.1. Main Goal

The main goal of the Codru Quest project was to estimate and present the indirect use and non-use economic values of ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest in the Republic of Moldova. It was envisioned that achievement of the goal would help to understand how Moldovan citizens perceive these non-market environmental goods and how much they value environmental benefits coming from the PA and the forest when they are better managed and expanded through reforestation and biodiversity conservation activities (Figure 4).

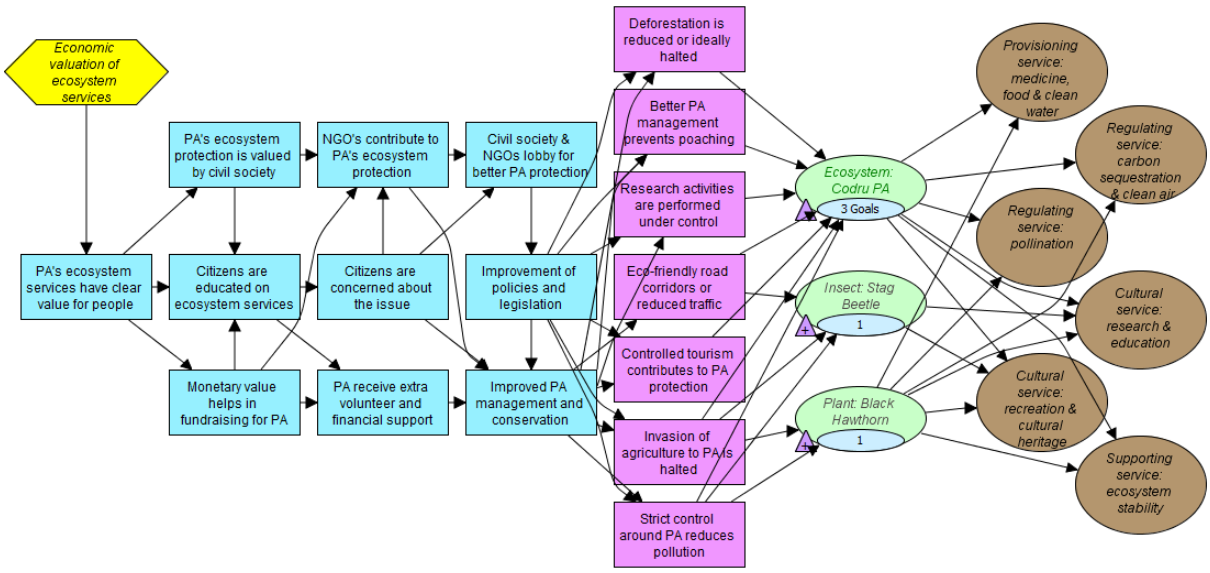

Figure 4. Miradi results chain showing the assumed influence (**yellow**) of the Codru Quest project on the short-term outputs (**light blue**) and long-term positive impact (**purple**) on the Codru forest ecosystem services (**brown**). Source: Iscenco, 2017.

In turn, this understanding would help project stakeholders concerned about the problem organize raising awareness and educational campaigns on the importance of forest

ecosystem services and biodiversity in them. This should raise concern of other Moldovan citizens and engaging them in nature conservation and lobbying for sustainable forest use.

Moreover, having information on and understanding of people's attitudes to forest ecosystem services and biodiversity conservation expressed in estimates of economic values of these environmental goods should support the development of PAs, specifically the Codru Nature Reserve, with better management plans and attracting of additional resources. Last but not least, such output should influence the improvement of relevant environmental policies and stimulate the implementation of collaborative reforestation and biodiversity conservation activities in other Moldovan forests and PAs.

3.2. Key Objectives

To measure the progress towards the main goal of the project and ensure its achievement, the following objectives were set:

1. By 01.01.2017 200 Moldovan citizens have completed the Codru Quest survey, received knowledge on the importance and value of the Codru Nature Reserve and the Codru forest with its 2 targeted endangered species, small-flowered black hawthorn (*Crataegus pentagyna*) and stag beetle (*Lucanus cervus*), and provided their economic valuation data for ecosystem services and biodiversity conservation in the PA and forest.
2. By 01.05.2017 the Codru Quest study report with the respondents' economic valuation data, estimated results, conclusions, and suggestions for stakeholders is openly available on-line for other environmental organizations, individual researchers, research institutions, PA administration, local communities, and policy makers to use for environmental research, CBA, and nature conservation purposes in the Codru Nature Reserve and the Codru forest.
3. By 01.09.2017 the knowledge, economic valuation results, conclusions, and suggestions from the Codru Quest project are presented to the local communities, the Codru Nature Reserve administration, Ministry of Environment, environmental organizations, and other relevant stakeholders to be used by them in organizing raising awareness and educational campaigns around the topic of the Codru Quest project, improving management of the Codru forest ecosystem, and implementing collaborative reforestation and biodiversity conservation activities.

3.3. Achievement of the Goal and Objectives

In terms of the achievement of the main goal and objectives of the Codru Quest project, these were fully accomplished resulting in the present Report. The deadlines of the objectives do not entirely coincide with the dates they were achieved, as there were certain constraints and challenges that impeded achievement of the objectives on time. The short-term effects and long-term impacts from achieving the project goal and objectives are yet to be seen, measured, and evaluated.

An additional goal of the Codru Quest project was to elaborate and publish a methodological guidebook that describes the step-by-step process of conducting an economic valuation study with choice modelling technique, where each step is illustrated by examples from the Codru Quest study. It was envisioned that the guidebook would help other researchers, who begin to use economic valuation methodology in their environmental studies, to prepare and conduct these studies in an easier and time-and-cost-efficient way while achieving higher validity of their results.

This additional goal was also achieved. It resulted in a side “product” of the Codru Quest project entitled “The Codru Quest: Methodology” that includes the context and features mentioned above. The Methodology also serves as a supplement to the present Report, where the methodology used in the Codru Quest project is described in more details.

IV. Methodology

The Codru Quest project used the stated preference (SP) methodology for economic valuation of ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest. SP methodology is based on interviews and surveys asking respondents for their willingness to pay (WTP) or willingness to accept compensation (WTA) in relation to an environmental good or offering them to choose different scenarios of provisioning the good, where the respondents' choices help to infer their WTP or WTA. In the project, the focus of economic valuation was on the indirect use and non-use values of ecosystem services and biodiversity conservation. This was the reason for choosing specifically SP methodology, as it is the only economic valuation approach able to elicit non-use values and benefits of environmental goods (Pearce et al., 2006).

4.1. Choice Modelling Technique

Within the diversity of techniques in SP methodology, the choice modelling (CM) technique was applied to the surveying and data analysis process in the Codru Quest. CM technique represents a family of survey-based methods for modelling people's preferences for environmental goods that are described in terms of their attributes (specific characteristics) and of the levels (changes in these characteristics) that these take. Survey respondents are presented with alternative scenarios of provisioning the target environmental good, differentiated by their attributes and levels, and then are asked to rank alternative scenarios, rate them, or choose their most preferred ones. By including price or cost as one of the attributes, WTP or WTA can be elicited from the respondents' choices (Pearce, 2006). In the Codru Quest, it was important to understand how Moldovan citizens value the benefits of the Codru Nature Reserve and the Codru forest as a whole, as well as what is their attitude to and valuation of specific attributes of this environmental good, such as expansion of the territory, conservation of plants and insects, and presence / abundance of the two symbolic endangered species: small-flowered black hawthorn (*Crataegus pentagyna*) and stag beetle (*Lucanus cervus*). CM technique was considered as the best fit for this kind of study.

Within the family of CM methods, the choice experiments (CE) method was chosen for eliciting WTP values for ecosystem services and biodiversity conservation in the Codru Quest project. In a CE study, respondents are requested to choose their most preferred alternative scenarios from a series of choice sets, where these scenarios differ in terms of

attributes and their levels. A baseline scenario, corresponding to the status quo or "do-nothing" situation, is also included in each choice set for the CE results to be consistent with utility maximization and economic demand theory (Pearce, 2006). In the Codru Quest the choice of the CE method was justified not only for its clear consistency with the economic theory, but also because it is most suitable for estimating the values of non-market attributes, such as biodiversity of flora and fauna in the Codru Nature Reserve and the Codru forest and conservation of the targeted endangered species, *Crataegus pentagyna* and *Lucanus cervus*. Detailed explanation of the choice of the CE method in the Codru Quest project is described in the publication "The Codru Quest: Methodology".

4.2. Research Process

The Codru Quest research process was organized into 3 key phases designed on the basis of literature review and previous knowledge on conducting economic valuation studies. These phases were:

I. Pilot survey and preliminary data analysis.

II. Full-scale survey and complete data analysis.

III. Preparation of results and their presentation to stakeholders.

Phase I was about calculating the target population sample to approach with the Codru Quest survey, deciding on the exact surveying methods to be used on getting information from the calculated sample of respondents, deciding and testing the CE survey, analyzing first respondents' feedback and preliminary data, and drawing preliminary conclusions and inputs for next steps. Phase II included such activities, as improving the CE survey on the basis of feedback received and lessons learnt from preliminary data analysis, determining the full population sample, releasing the improved CE survey, collecting and analyzing data from it, and coming up with immediate conclusions regarding WTP estimates. Finally, Phase III contributed to the Codru Quest research process with testing the final results on validity, aggregating them to the target population of the project, elaborating final conclusions on the entire research work and its results, and preparing the present Report. In the Report, only the outputs and conclusions of Phases II and III are presented, as the purpose of Phase I was only designing and testing the CE survey on a very small sample size, which is not representative of the target population, making its preliminary results non-valid and irrelevant to be reported.

4.3. Target Population Sampling

With regard to the target population chosen in the Codru Quest, it consisted of direct users of the Codru Nature Reserve and the Codru forest. They included Moldovan citizens aged 18+ from urban and rural areas living close to the Codru Nature Reserve and the Codru forest and/or having easy access to it. The sample of respondents for surveying was narrowed down to the residents of the capital city Chisinau and 9 villages located in close proximity to the Codru Nature Reserve and the Codru forest: Lozova, Stejareni, Capriana, Micleuseni, Huzun (Straseni region); Horodca, Bursuc, Dragusenii Noi (Hincesti region), and Condrita (Municipality of Chisinau region) (Figure 5). In the first phase of the study only residents of Chisinau were surveyed to save the costs and efforts. However, in the second phase all the targeted locations were included in the surveying process.

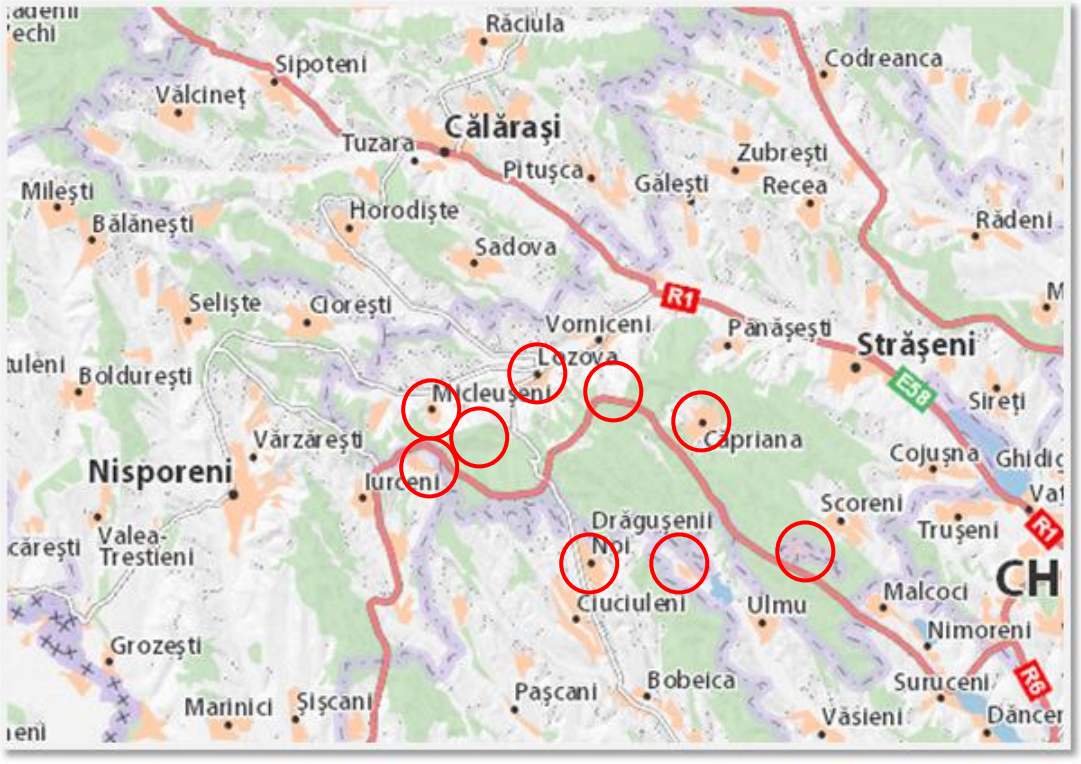

Figure 5. Locations of 9 villages around the Codru Nature Reserve targeted in the Codru Quest project. Source: Adapted from ViaMichelin, 2017.

The target population sample size was calculated by simple random sampling, which resulted in 384 respondents. However, only 100 respondents were surveyed in Phase I and 201 in Phase II. This relatively small sample size approached was affected by the time and budget constraints of the Codru Quest project. It was compensated to a certain extent by

eliciting additional relevant information about their WTP and attitudes towards the target environmental good from each respondent.

The final sample size of 201 respondents was split into two groups: 100 residents of the city Chisinau and 101 residents from 9 villages near the Codru forest listed above. The selection of the respondents from the city was straightforward, as only 100 people (0.02% of the total population of 492 894 residents) could be surveyed within the time and budget constraints. The selection of the respondents from the target rural area was done through proportional calculations. Firstly, the information on the population in each of the 9 target villages was obtained from the National Bureau of Statistics of Moldova (2017). The population of each village was then compared to the total population of all 9 villages. The percentage share of the population of that village in the total population of the target rural area represented the number of respondents surveyed in that village (Magenta Consulting, 2017) (Table 1).

Table 1. Sampling of target population from 9 target villages in the Codru Quest study.

Village	Region	Number of population, pers.	Percentage share of population, %	Number of target respondents, pers.
Lozova	Strășeni	5 934	38	38
Căpriana	Strășeni	2 362	15	15
Micleușeni	Strășeni	2 038	13	13
Drăgușenii Noi	Hîncești	1 913	12	12
Bursuc	Nisporeni	1 306	8	8
Condrița	Mun. Chișinău	658	4	4
Stejăreni	Strășeni	647	4	4
Horodca	Hîncești	346	2	2
Huzun	Strășeni	296	2	2
TOTAL		**15 500**	**100**	**100**

Source: Adapted from Magenta Consulting, 2017.

4.4. Valuation Scenario and Choice Sets

In relation to the valuation scenario and choice sets offered to the respondents from the target population sample through the CE survey, these were created on the basis of the current situation in the Codru Nature Reserve and the Codru forest and the problem addressed by the project. In the valuation scenario the respondents read about the status

quo / baseline scenario with the present area of the PA, some statistical information about the biodiversity of flora and fauna in it, and presence of endangered species on the example of small-flowered black hawthorn and stag beetle. Then the hypothetical scenarios were presented to the respondents. These described possible improvements in ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest due to the implementation of a hypothetical development plan to be prepared and implemented by the Ministry of Environment of Moldova, Moldsilva, and the Codru Nature Reserve administration on the basis of the respondents' choices. It was then stated that the hypothetical plan envisions enlargement of the PA territory through possible annexing of additional forest areas near the Capriana village, as well as through reforestation and other nature conservation activities.

The target environmental good, which is the ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest, was represented in the valuation scenario and choice sets through 5 attributes. These were:

1. Total territory of the Codru Nature Reserve;
2. Number of species of plants conserved;
3. Number of species of insects conserved;
4. Presence of symbolic species: small-flowered black hawthorn and stag beetle;
5. Price to visit the Codru Nature Reserve and the Codru forest.

The first 4 attributes had 3 levels of possible changes to their provision and quality, while the last one, the payment vehicle, had 5 levels (Table 2).

Table 2. Attributes and their levels of the target environmental good in the Codru Quest project.

#	Attribute	Number of Levels	Values of Levels
1	Total territory of the Codru Nature Reserve, ha	3	5175; 5300; 5425
2	Number of species of plants conserved	3	1000; 1050; 1100
3	Number of species of insects conserved	3	8000; 8500; 9000
4	Presence of symbolic species: small-flowered black hawthorn and stag beetle (representatives observed during a visit)	3	2; 4; 6
5	Price to visit the Codru Nature Reserve and the Codru forest, MDL	5	0; 30; 60; 90; 120

The attributes and their levels were determined through different activities, which included:

- Several expeditions to the Codru Nature Reserve and the Codru forest;
- Research at the Museum of Nature located in the Codru Nature Reserve;
- Workshops and discussions with the first respondents during and after the expeditions to the Codru forest;
- Consultations with the professional guide working in the PA.

One of the attributes, the last one, was the representation of the economic measure of wellbeing. For this measure WTP was preferred over WTA. This choice was made based on a number of reasons related to:

- Property rights: The respondents were assumed to feel the right to the status quo of the target environmental good, but not to its improvements. So, WTP was selected as a measure for them to secure gain in quality and provisioning of the good. WTA would have been more appropriate if the economic valuation was about decreasing the quality and provisioning of ecosystem services and biodiversity conservation; and in such case it would have been very high.
- Income effect: With WTP it could be seen how the respondents' preferences were related to their income constraints, thus producing more realistic economic values. If WTA would have been chosen, then it would not have been constrained by income and would have been unrealistically larger than WTP.
- Substitution effect: It was assumed that the Codru Nature Reserve and the Codru forest are perceived by Moldovan citizens as culturally and historically symbolic, unique, and practically irreplaceable as a forest ecosystem with its biodiversity. So, if the valuation scenario had been about decrease in their quality, and WTA would have been chosen, it is likely that the respondents would have demanded extremely high levels of compensation to tolerate such possible negative outcome. Therefore improvements in ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest and WTP to secure them were selected as more appropriate to such environmental good.

The representation WTP in the CE survey was the payment vehicle, which was selected to be the hypothetical price that is charged for visiting the Codru Nature Reserve and the Codru forest. The respondents were informed in the survey that the funds collected through it would finance the proposed plan, leading to improvements in the quality and provisioning of the

target environmental good. Visitor price was chosen over the income tax increase and voluntary payments as being the most credible and realistic choice of payment vehicle and representation of the wellbeing measure of them all.

The attributes, their levels, and the payment vehicle represented by visitor price were combined into 6 choice sets with 3 alternative scenarios each (the first one was always status quo) by using fractional factorial design and statistical software (Table 3).

The choice sets were represented in the CE survey through graphical illustrations that reflected the differences between levels of attributes in alternative scenarios (Figure 6). This allowed the respondents to visualize these differences, compare gains that each alternative scenario hypothetically brings in each attribute, and possibly express their preferences better and closer to their "true" WTP for changes in the quality and provisioning of the target environmental good.

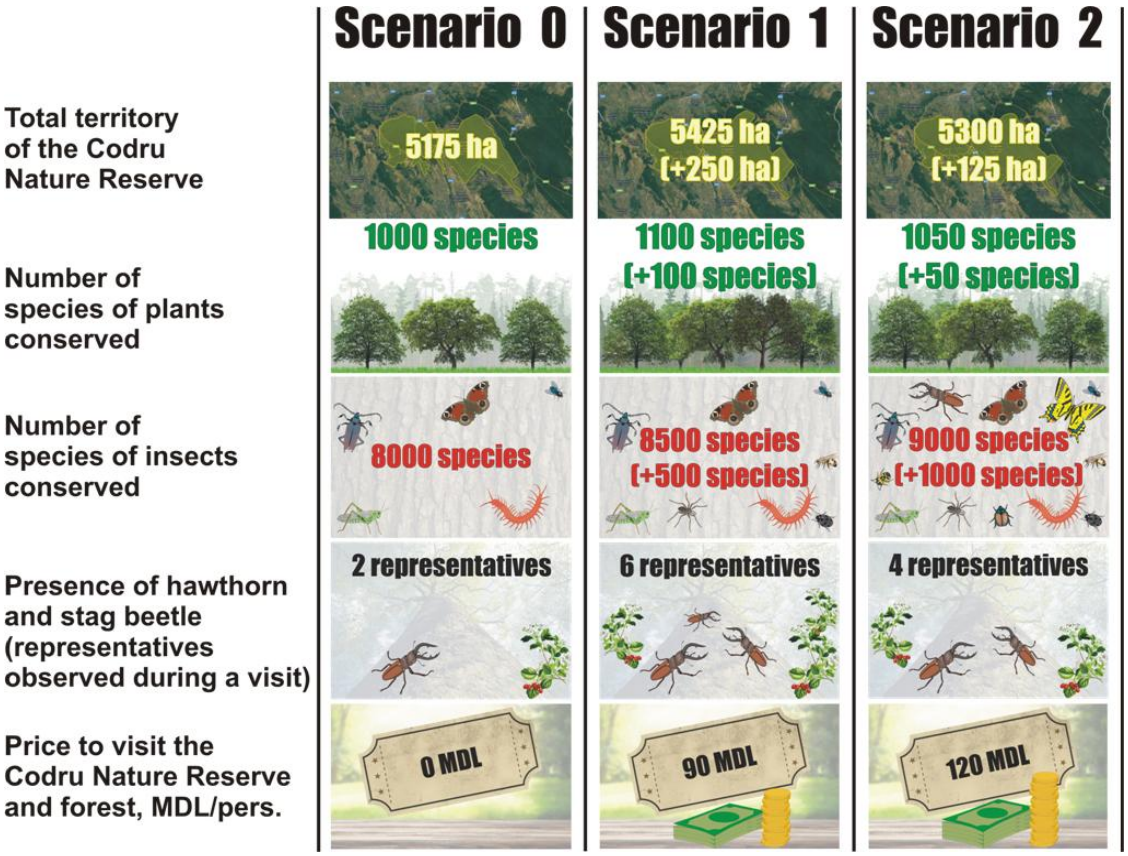

Figure 6. Example of a choice set from the CE survey of the Codru Quest with status quo and two alternative scenarios, each with changing attribute levels. Source: MEGA, 2017c.

Table 3. Choice sets selected for the CE survey in the Codru Quest project.

#	Attributes	Scenario 0	Scenario 1	Scenario 2
1	Total territory of the Codru Nature Reserve, ha	5175	5425	5300
	Number of species of plants conserved	1000	1100	1050
	Number of species of insects conserved	8000	8500	9000
	Presence of symbolic species	2	6	4
	Visitor price, MDL	0	90	120
2	Total territory of the Codru Nature Reserve, ha	5175	5425	5425
	Number of species of plants conserved	1000	1050	1100
	Number of species of insects conserved	8000	8500	9000
	Presence of symbolic species	2	6	6
	Visitor price, MDL	0	30	90
3	Total territory of the Codru Nature Reserve, ha	5175	5300	5425
	Number of species of plants conserved	1000	1100	1100
	Number of species of insects conserved	8000	8500	8500
	Presence of symbolic species	2	6	6
	Visitor price, MDL	0	90	120
4	Total territory of the Codru Nature Reserve, ha	5175	5300	5300
	Number of species of plants conserved	1000	1100	1100
	Number of species of insects conserved	8000	9000	8500
	Presence of symbolic species	2	4	6
	Visitor price, MDL	0	30	60
5	Total territory of the Codru Nature Reserve, ha	5175	5425	5300
	Number of species of plants conserved	1000	1100	1100
	Number of species of insects conserved	8000	8500	9000
	Presence of symbolic species	2	4	6
	Visitor price, MDL	0	90	60
6	Total territory of the Codru Nature Reserve, ha	5175	5425	5300
	Number of species of plants conserved	1000	1050	1100
	Number of species of insects conserved	8000	9000	8500
	Presence of symbolic species	2	4	4
	Visitor price, MDL	0	60	120

Besides the valuation scenario and choice sets, other data were collected from the respondents through additional questions in the survey design. These included socio-demographical, attitudinal, follow-up, economic questions, questions about the use of the target good, and request to share contact information. The latter was optional for the

respondents, but still played an important role for applying the concept and techniques of gamification into the Codru Quest surveying process, which is described in the next chapter.

The complete description of methodology of the Codru Quest project is presented in a separate publication “The Codru Quest: Methodology”. The detailed process of preparing the economic valuation study, calculating the target population sample, designing the CE survey with its valuation scenario and choice sets, and other methodological aspects of the project can be found there.

V. Surveying Process

The surveying process of the Codru Quest project included the "traditional" method of designing and implementing the CE survey and an additional innovative approach of using gamification in increasing participation, response, and completion rate of the survey. The "traditional" surveying was done by following the guidelines from literature review (Pearce et al., 2002, and Pearce et al., 2006) and adjusting them to the specifics of the Codru Quest.

5.1. Survey Testing

Before releasing the CE survey to the target population, its design was tested in 3 ways: with focus groups, in consultations with a specialist, and with a sample of 100 respondents.

Focus groups were used to discuss the valuation scenario of the Codru Quest, attributes and levels of the target environmental good, people's attitudes towards the concept of economic value of ecosystem services and payments for their conservation, and key questions included in the first design of the CE survey. Focus groups were done only with a very small number of potential respondents from the capital city Chisinau (Photo 3).

Photo 3. One of the focus group discussions within the Codru Quest project.

Source: Alexandr Iscenco, 2016.

Consultations had the purpose to review and improve the valuation scenario and its description in the CE survey on the basis of information on the current state of the Codru Nature Reserve and the Codru forest, as well as the PA administration's plans regarding their development and management. Consultations were done with Dragos Voda, the professional guide from the Codru Nature Reserve (Photo 4).

Photo 4. Expedition to the Codru forest and consultation with Dragos Voda, the guide from the Codru Nature Reserve. Source: Alexandr Iscenco, 2016.

After the focus groups and several consultations with Dragos, the pilot survey was prepared and released. It was sent to a small sample of 100 respondents with the aim to test the survey design in action and gather important feedback on its performance and inputs on how to improve it. The respondents were approached mainly with the on-line version of the survey through direct e-mail messages and Facebook chat. Only several one-to-one interviews were done. The testing of the pilot survey had lasted for approximately 1.5 months, after which the preliminary data were analyzed, feedback was evaluated, and improvements to the survey design were made. The preliminary results from the testing phase were summarized in the publication "The Codru Quest: Phase I Results. Second edition" (MEGA, 2017b). These results are not included in the present Report, as they were

collected from a small non-representative sample of respondents and served only for assessing performance of the pilot survey.

5.2. Surveying Methods

The main CE survey was released after incorporating the first respondents' feedback and inputs from the pilot survey into the design. For the main surveying process, two methods were used in order to balance quality of data from the respondents with the budget and time constraints. These methods were on-line / e-mail survey for the sample of 100 Chisinau residents and computer-assisted personal interviews (CAPI) for the sample of 101 respondents from the 9 target villages near the Codru forest.

The reason for on-line surveys with the city residents was based on the assumption that they are more tech savvy, have access to internet, and are used to on-line surveys. Therefore, they would manage answering the Codru Quest survey on their own via internet. The respondents from the city were found through the network of contacts from the pilot phase of the surveying process and partner organizations.

The choice of CAPI for the village residents was justified by the assumption that the dominant majority of them do not have access to internet, or even to a computer, so on-line surveys would not work in their situation. Telephone interviews were also not considered, as the Codru Quest survey had important visual support in valuation scenario and choice sets. Post mail service in Moldova was not reliable enough to be selected for distributing the survey through it. So, the best surveying option for this group of the population sample remained to be CAPI, as it combines face-to-face interaction and dialogue with the possibility to show visual support to the respondents and record their data into an on-line database immediately. To administer CAPI with village residents before the established deadline, a marketing research company was involved. This company did all the interviews in the target villages by using their interviewers and access to the CE survey via tablet computers connected to internet. The number of respondents approached in every village and the method of choosing them was calculated from the population of each village (Table 1).

While doing CAPI in the villages, the interviewers used the "last birthday" criterion to select the respondent from each household they had visited. This criterion meant that the actual respondent from a household was the person, who had been the last one to celebrate his/her birthday. If that person was not present at that moment, the interviewers tried to reach him/her by coming back to the household some other time or on another day. This approach ensured that there was no dominance of the category of respondents, who stay in

a household longer than other members of it, such as unemployed, retired people, mothers with children, etc. (Magenta Consulting, 2017).

The main surveying process had lasted for about 2.5 weeks. It was much shorter than the pilot phase, as the final CE survey design was already agreed upon and did not require additional testing, review, and improvement. The final data and results obtained through the main survey are presented in the Report.

More comprehensive description of the surveying process of the Codru Quest project can be found in “The Codru Quest: Methodology”. Besides the key points mentioned above, the publication includes detailed explanation of how testing of the pilot survey design was done, list of improvements introduced into the main CE survey after it, and additional explanations of how the surveying methods were chosen and the respondents were approached.

5.3. Gamification

Besides “traditional” surveying methods the Codru Quest project experimented with additional “unconventional” approach to increase the participation, response, and completion rate of the CE survey and obtain as much valuable data from each respondent as possible. This approach was gamification.

Gamification is defined as a concept of applying game design and mechanics to a non-game context. This is a psychology- and motivation-based approach to increase the motivation, engagement, and contribution of the target audience to a certain project or cause, as well as achievement of the necessary results through their active involvement (Iscenco and Li, 2014). In the Codru Quest project gamification was implemented in 2 ways: as an incentive lottery and as an on-line game-like quest.

The lottery gamification was designed for the respondents, both from the city and villages, who do not have access to internet, do not use it much, or do not play on-line games. It was very simple and limited to only an incentive reward and a random selection of two lucky winners among all the respondents, who completed the CE survey and shared their contact information. The reward for one of the winners was 300 MDL (approximately 15 EUR) and for another one 300 experience points that could be exchanged to tangible reward(-s) in the virtual shop of the organization MEGA (MEGA, 2016). The rewards in the virtual shop were obtained from partner non-profit organizations and private companies that supported the Codru Quest project. Such lottery gamification was quite successful in achieving the desired response and completion rate of the CE survey in a cost-efficient way.

The on-line quest gamification was aimed at the respondents, who are tech savvy, have access to internet, and actively use it for different purposes, including playing on-line games. These were mostly young people from the city, but in this group were also some adults. Such use of the gamification concept was more costly and complex to be organized, but more engaging and interactive for the respondents to participate in. It consisted of splitting the CE survey into separate sections and transforming them into 8 concrete tasks (missions) that were logically connected together into a single flow process (quest). By completing a mission, the respondent received immediate feedback in the form of gamification rewards, such as experience points and skill badges, and unlocked the next mission to take on and accomplish (Table 4).

Table 4. Gamified missions of the CE survey in the Codru Quest project.

#	Mission Title	Tasks	Rewards
1	Introduction	Fill in the section "Your Introduction". In the report write your feedback on the section.	40 XP points; 1 Research & Analysis badge
2	Attitude	Fill in the section "Your Attitude". In the report write your feedback on the section.	50 XP points; 1 Research & Analysis badge
3	Experience	Fill in the section "Your Experience". In the report write your feedback on the section.	50 XP points; 1 Research & Analysis badge
4	Challenge	Fill in the section "Your Choice". In the report write your feedback on the section.	60 XP points; 2 Research & Analysis badges
5	Reasoning	Fill in the section "Your Reasoning". In the report write your feedback on the section.	60 XP points; 2 Research & Analysis badges
6	Background	Fill in the section "Your Background". In the report write your feedback on the section.	70 XP points; 2 Research & Analysis badges
7	Feedback	Fill in the entire Codru Quest survey in one go with tracking the time. In the report write the time it took for you to complete the survey and feedback on its structure and your experience with it.	80 XP points; 3 Research & Analysis badges
8	Challenge	Find 10 people that you can interview for the Codru Quest research. Conduct interviews with these people by using the final version of the survey. In the report write the names of people you have interviewed.	90 XP points; 5 Research & Analysis badges

The last mission was done in the form of a final challenge. The task was for the respondent, who completed all missions of the CE survey, to share the survey with 10 more people and get them complete it. In such way the respondent had also tried the role of an interviewer, helping to attract additional respondents to the project and increase the survey response rate. In the end, after accomplishing all missions and collecting sufficient number of experience points, the respondents could exchange them to tangible reward(-s) in the virtual shop, just like in the case of lottery. Only now all “players”, who completed the gamified Codru Quest, were eligible for the rewards.

The on-line gamification was implemented with the use of the web-based gamification platform MEGA Game: The Game with Impact, created and administered by the organization MEGA. MEGA Game connects individuals interested in nature conservation and environmental organizations for them to collaborate in realizing environmental research and educational initiatives. The platform had all the necessary elements of gamification for the Codru Quest, so it was convenient to use it for gamifying the surveying process according to the structure described above. After uploading the CE survey missions and challenges into MEGA Game, the respondents were invited to register and take on the quest (Figure 7).

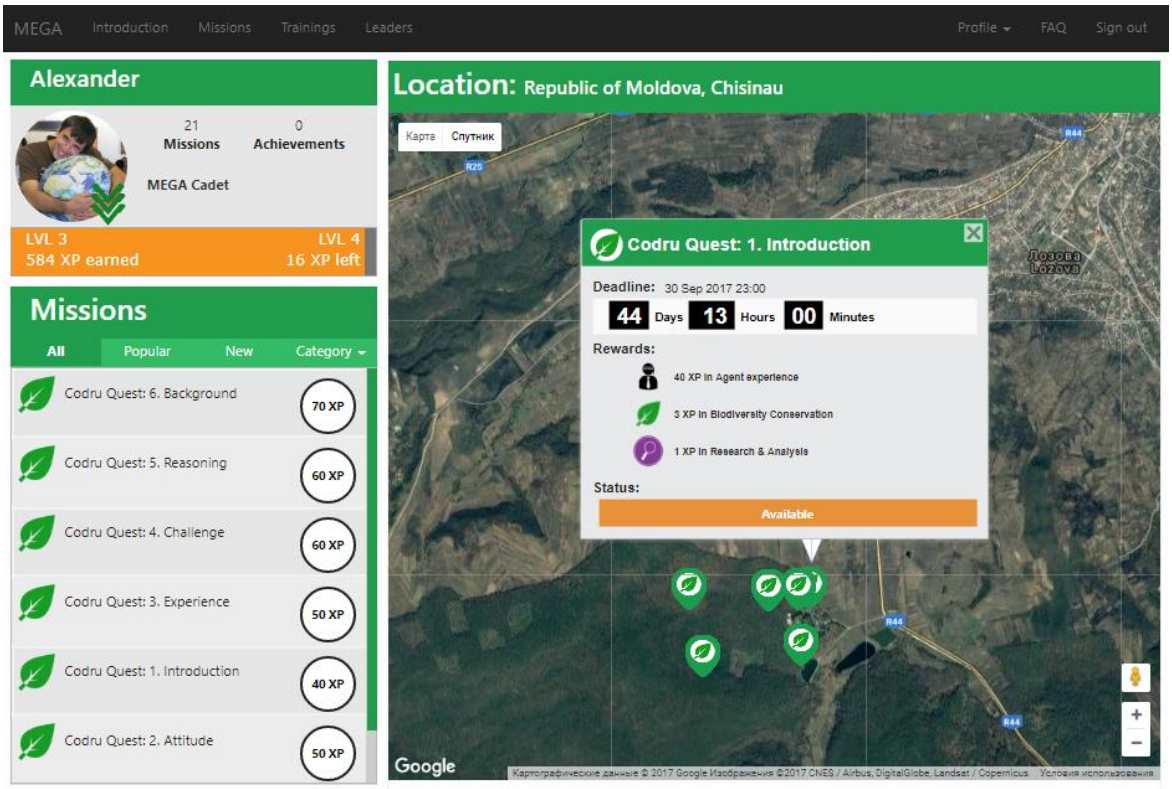

Figure 7. Screenshot from MEGA Game: The Game with Impact showing the Codru Quest missions. Source: MEGA, 2017a.

The on-line gamification had very limited success mostly due to the MEGA Game platform still being in development stage during the Codru Quest surveying process. Only 11 respondents registered in MEGA Game and accepted the quest, and only 8 of them successfully completed all the missions and challenges. Still, the experiment of using on-line gamification for conducting CE study brought the necessary economic valuation data and important feedback from this limited number of respondents, while also suggesting what elements and features should be introduced in the gamification process in general and MEGA Game in particular to improve their performance in future economic valuation studies.

VI. Data Analysis

In the Codru Quest project, the economic valuation data were analyzed twice: firstly, from the pilot CE survey in Phase I, and then from the main one in Phase II. Only the methods and results of the final analysis are described in the Report, as being the most important and valid ones.

The economic valuation data from the main CE survey of the Codru Quest came in the form of two datasets, one from 100 city residents surveyed by the researchers themselves and another one from 101 residents of the 9 target villages interviewed by the marketing research company. Initially the separation of the datasets was maintained for the data analysis, as there was large heterogeneity observed between these two groups of respondents. Nevertheless, an attempt to combine the answers of the two groups into a single third dataset was made. This allowed conducting the analysis and presenting its results in three ways: only for city residents, only for rural area residents, and for the average of the full population sample.

6.1. Selection of Valid and Non-valid Answers

In the total sample of 201 respondents surveyed, the responses of 24 (12%) of them were considered non-valid. Among them the majority were from village residents, 14 out of 101, while among the city residents there were 10 non-valid responses out of 100. The reasons were mainly observed free-riding (the respondent believed that he/she will not be paying for the good) or protesting (the respondent believed that someone else should pay for the good) behaviour. Signs of such behaviour were identified by the respondents' answers to attitudinal and follow-up questions of the CE survey. After removing all non-valid answers the sample size in datasets were reduced to 177 respondents and their answers in total, among which 87 were from the target villages and 90 from the city.

However, later in the data analysis more respondents' answers were labelled as non-valid and had to be removed, thus reducing the sample size even more. The cause for such action was obvious inconsistencies identified in the datasets, especially the one with urban residents. Investigation of these inconsistencies was done by connecting socio-economic information of the respondents to their preferences. This showed a severe issue with consequentiality of the payment vehicle and resulting strategic behaviour of the respondents.

The issue was that the city residents, who are not using the Codru Nature Reserve and the Codru forest, displayed strong strategic behaviour by having positive responses to an increase in visitor price. These responses were clearly conflicting with the underlying economic theory. In contrast, the respondents from the rural area, who were users of the target environmental good, showed behaviour far more in line with the economic theory. Thus, in order to preserve the validity of the Codru Quest research results, only the respondents, who had truly used the Codru Nature Reserve and the Codru forest in the last two years and who expressed preferences consistent with economic theory, were left in the final datasets. The removal of other respondents, non-users of the target environmental good, drastically reduced the population sample size to only 107 respondents.

Reduction of the population sample to such a small size (only 53% from the entire number of respondents surveyed were left in the datasets) was believed to be an inconvenient, but necessary thing to do, because the final datasets now contained only valid data that is consistent with the economic theory. Also, there was a gain in the share of city to village residents, 62% to 38% respectively. It permitted avoiding the use of weights in the data analysis, as such distribution was close to the one in the national population of urban / rural residents in Moldova: 57.47% to 42.7% respectively (National Bureau of Statistics of the Republic of Moldova, 2017). The final valid sample size also offered the possibility to carry out the analysis and estimate the sample average WTP on the basis of the dataset with consolidated data from both city and village residents.

6.2. Econometric Model

For the estimation of WTP values from the final dataset with 107 respondents and their answers the mixed logit model was selected. It is a fully general statistical model for examining discrete choices. During the preliminary data analysis, the conditional logit model had also been experimented with. Nevertheless, the ultimate decision was to go forward with the mixed logit model mainly due to the fact that the attribute levels present in the status quo scenario had not been incorporated into any of the alternative scenarios, making it impossible to include more than one level for each attribute in the regression. In turn, this did not permit to do the testing on the hypothesis of independence of irrelevant alternatives (IIA), which is crucial for the conditional logit estimates to be valid. The mixed logit model, unlike the conditional logit, does not strictly depend on the IIA hypothesis.

Estimation of WTP values by using the mixed logit model relied on the assumption that the random parameters associated with the attributes of the target environmental good are normally distributed, and that the visitor price attribute follows a censored (truncated) normal distribution to account for the fact that it should only take negative values. As it has been mentioned earlier, there were certain inconsistencies with the mixed logit estimates observed, so the WTP estimates were connected to the socio-economic characteristics of the respondents in order to see how the latter affect the respondents' preferences and valuations. This is when significant differences in preferences between the residents of urban and rural areas were identified, and large heterogeneity between the two groups came out. This heterogeneity was dealt with by applying the method used by Kragt and Bennet, 2011, in a CE study in Tasmania, where the authors had to deal with individual preference heterogeneity. This method was basically about including interaction terms on the choice variables and the censored normal distribution on visitor price to capture systematic heterogeneity between city and village residents. After doing this, it was observed that the significance levels of the interaction terms had changed. Specifically, the interaction terms of all attributes except visitor price became significant and positive, which translated into consistently lower WTP estimates for village residents compared to city residents. The attributes for the territory of the Codru Nature Reserve and the number of species of plants conserved had negative average WTP for the respondents from the rural area, whereas the respondents from the urban area expressed only slightly negative but insignificant WTP for the plant species attribute. In terms of the insignificance of the visitor price interaction term, it was assumed to be caused by the model already capturing this difference.

6.3. Estimation and Aggregation

The mean and median WTP estimates, 95% confidence intervals on them, and statistical significance of estimated parameters were obtained by using R, a language and environment for statistical computing and graphics (The R Foundation, 2017). It combines powerful estimation performance with being free open-source software, which suited the needs of data analysis in the Codru Quest project. The output of data processing and estimations by R is shown in chapter "Final Results" of the present Report.

The estimated mean and median WTP values were aggregated only to the target population of direct users of the Codru Nature Reserve and the Codru forest. These were assumed to be Moldovan citizens, who actually visited the PA and the forest at least once in the last two years. The approximate number of these users was obtained from the background research on the yearly number of visitors to the Codru Nature Reserve, which is about 3500 people.

VII. Validity Testing

Both content validity and construct validity tests were applied to the results obtained from data analysis within the Codru Quest project. However, the testing was done in a limited way and mostly based on the researchers' own understanding and judgment.

7.1. Content Validity Testing

Content validity testing is used to verify whether the respondents were asked the right questions in a clear, understandable, and appropriate manner. In the project, such testing was done on the basis of the researchers' subjective judgment on such components of the study, as design of the valuation scenario, choice of visitor price as the payment vehicle, choice of econometric model and measure of wellbeing (WTP or WTA), sampling of the target population, and the administration of the entire research process. Additional consultation on this subject with an experienced environmental economist was also done.

Most of the study components were considered as passing the content validity testing. There had been several issues identified, such as strategic behaviour of city residents, but these were dealt with during the final data analysis.

In relation to village residents, a particular issue with the choice of visitor price as a payment vehicle was discovered. Those respondents showed significant lack of trust in the institutions responsible for the provision of the target environmental good, namely the Ministry of Environment, the Codru Nature Reserve administration, and the Moldovan Government. This issue was observed in a relatively high share of their comments to the CE survey. In these comments the respondents from the rural area explained their mistrust as related to the issue of high level of corruption present in the country and specifically in state agencies. People did not believe that their payments would truly go to support the chosen alternative scenarios in relation to the quality and provision of the target environmental good and not to state officials' pockets. An input to future CM research in such a country as Moldova might be to experiment with other institutions, such as non-government organizations (NGOs), as providers of the good described in the valuation scenario. However, until the issue of high level corruption is present in the country, there is likely to be a problem with the respondents trusting any institution at all.

7.2. Construct Validity Testing

Construct validity testing is necessary to be done in order to check whether the results obtained from the data analysis follow the logical patterns one can expect and are consistent with economic theory, prior studies, past experience, and pure logic. This testing is realized by comparing the results of a CM study with the ones obtained through other economic valuation methods, different CM studies, and/or actual or surrogate (proxy) markets.

In the Codru Quest project it was not possible to do proper construct validity testing because of the time and budget constraints, as well as because of the fact that such economic valuation research was done for the first time on such a non-market environmental good as ecosystem services in the Codru Nature Reserve and the Codru forest and in such developing country as Moldova. Therefore the assessment on whether the Codru Quest study and its results are aligned with prior expectations, past experience, and pure logic was once again done mainly on the basis of the researchers' own judgment. They discussed and evaluated such aspects of the study, as:

- Attitude towards the valuation scenario: whether the valuation scenario was perceived trustful, fair, and ethical by the respondents;
- Attitude towards the good: how the respondents perceived the target good and payment for it;
- Use of the good: whether the relationship between the use of the target good and stated WTP values was positive, as expected;
- Distance to the good: whether the relationship between the distance to the target good and stated WTP values was negative, as expected;
- Quantity of the good: whether the stated WTP values were related to the quantity of the target good provided;
- Perception of the payment vehicle: whether the respondents perceived the payment vehicle chosen as binding, familiar, credible, and realistic;
- Price of the good: whether the respondents indicated reduction in the desire to consume the target good with the increase of its price, as expected;
- Respondents' income: whether the respondents' WTP values increased with the higher personal / household income, as expected;

- Survey method: whether there were certain effects of the survey mode on the values obtained, which should not be substantial, as expected;
- Rationality of the choices: whether the respondents made “rational” choices by seeing if alternative scenarios which are clearly inferior (e.g. have the lowest attribute levels) are chosen over superior ones;
- Consistency of the choices: whether the respondents were consistent in comparing their choices over different choice sets throughout the survey;
- Information effects: whether the respondents’ answers and values were affected or unaffected by the information known by them.

The conclusions of the construct validity testing were compared with the comments and feedback expressed by the respondents in the CE survey, which generally confirmed them. Overall, practically all aspects and components of the Codru Quest study were considered satisfactory in terms of aligning with prior expectations, economic theory, and logic. As in the content validity testing, there was an issue with the perception of the payment vehicle among residents of the rural area, but after careful consideration, the choice of visitor price was still seen as the most appropriate option for the situation of high corruption in Moldova.

The choice of the wellbeing measure (WTP or WTA) was not tested for validity. The reasons were mainly the property rights, income, and substitution effects associated with the target environmental good, which were described in the chapter “Methodology”. Considering them, the choice of WTA would likely give unrealistically high values that could have been useless as outputs of the study. Moreover, the dominant public opinion in Moldova that the corrupt state takes much from citizens’ wellbeing, which is supported by numerous cases, would also likely have strong influence on extremely high results, if WTA had been chosen as the measure of wellbeing.

VIII. Challenges and Constraints

The Codru Quest project was largely an experiment with economic valuation research addressed towards the understanding of the attitudes and values of ecosystem services and biodiversity conservation in such a challenging socio-economic setting as it is in a developing country as Moldova. The project is the first attempt to conduct a CM study on non-market environmental goods in a PA and forest ecosystem in Moldova. Also, it was done by researchers in environmental economics, who are at the beginning of their economic valuation experience and who had been using the project to experiment with the CM method and additional innovative approaches. Therefore, the Codru Quest project experienced a number of challenges that had not been resolved and some constraints that could not be addressed. These should be considered when looking at the results and conclusions of the project. In addition, they should be helpful in identifying the existing gaps in the research and its outputs and planning a much better CM study that will close these gaps in knowledge, understanding, validity, and reliability.

Overall, the challenges and constraints can be grouped into 3 groups, namely challenges in surveying, issues in data analysis, constraints in time, and budget limitations.

8.1. Surveying Challenges

As it has been mentioned earlier, the minimum required target population sample size was estimated to be 384 respondents. However, only 100 respondents were surveyed in Phase I of the study and 201 in Phase II. Moreover, only the economic valuation results from Phase II were considered as valid final ones and were included in the present Report. This resulted in a challenge of having a very small sample of population, which cannot be considered as representative for the national population of Moldova. Whether it is representative for the users of the target environmental good or not is not known, as it is difficult to differentiate direct users from other people who might have existence, bequest, and altruistic values attached to the good.

In terms of survey design and testing, it would have been useful to run several more tests with focus groups and small numbers of respondents. One pilot survey test done in the project brought important information that helped improve the structure and performance of the main survey. However, several challenges with the formulation of the valuation scenario, trust towards change-enabling institutions, and perception of the payment vehicle remained unsolved. Additional focus group discussions and pilot tests could have shed more light on

these survey components and help the researchers design and release much more reliable and better performing survey.

In relation to the surveying methods used, there was a challenge in experimenting with the "unconventional" approach of on-line gamification done via the on-line gamification platform MEGA Game. This experiment elicited valuable information, but was able to bring and engage only a little number of respondents. The main reason was that the means through which survey gamification was done, MEGA Game, was still in the development stage during the project with complex registration process and a number of its features not working properly. This is why it is not possible to properly evaluate the application of gamification in a CM study, such as the Codru Quest. More research already with the fully functional MEGA Game platform and smartphone application is necessary.

8.2. Data Analysis Issues

Most of the challenges in data analysis, such as large heterogeneity between the two groups of respondents, inconsistencies in responses to visitor price increase, and strategic behaviour were identified and dealt with. Unfortunately, this drastically reduced the sample size by 47%, yet making it valid and suitable for analysis and reporting of the WTP estimates.

There were several challenges related to the aggregation of the estimated WTP values to the target population. Firstly, it was difficult to determine the exact target population for the results to be aggregated to. It was decided to do this only to direct users of the Codru Nature Reserve and the Codru forest, therefore excluding non-users, who might still have existence, bequest, and altruistic values attached to them. Then, the information on the exact number of visitors to the Codru Nature Reserve was not available at the time of conducting the Codru Quest study. The PA administration started monitoring and registering the number of its visitors only in 2016, and the data were not available in the first half of 2017 to be used in the study. Therefore, the approximate number of 3500 people from the background research was used for aggregation.

The other important issue was about estimating the benefit transfer equation, which is a recommended practice for all economic valuation studies. It allows the results of the primary study, such as the Codru Quest, to be used in other similar CM studies without the burden of significant time and costs related to conducting the entire study from the start. Unfortunately, in the Codru Quest project it was decided not to estimate the benefit transfer equation for a number of reasons. They included a very small population sample size, small variation of

income in this sample, and unconditional distribution at the sample level. Before making that decision, two approaches to resolve the issue had been tried.

One approach was about estimating conditional, or individual-specific, parameters. The limitation with this approach was that their reliability is positively correlated with the number of alternative choices offered to respondents. Considering that the Codru Quest survey had only three choices available per respondent, conditional estimates would have been unreliable.

The other approach represented an attempt to introduce socio-demographic and economic variables in the choice likelihood function and then interact these variables with the visitor price parameter. The idea behind this attempt was to transfer the estimated choice function to predict how people would make their choices at the Codru Nature Reserve and the Codru forest and subsequently calculate the associated welfare measures of the change considered in the quality and provision of the target environmental good. Unfortunately, the interaction terms produced either non-significant or unreliable outputs. For these reasons the final decision was not to proceed with estimating the benefit transfer equation, since its results would not have been reliable or even valid.

The final issue faced in the Codru Quest project refers to testing its outputs on reliability. It basically means that the study results can be relied upon to give the same WTP or WTA estimates in repeated experiments under controlled conditions. It was not possible to do reliability testing in the Codru Quest project, as this requires repeating the same research at different points in time and therefore additional time and budget resources.

8.3. Time Constraints

A typical economic valuation study needs a couple of years to be done properly and give valid and reliable results from a full representative population sample. The Codru Quest project was realized in the period of only 10 months (November 2016 – August 2017) with the final deadline for reporting on its outputs being the 1st of September 2017. Such a short timeline was established due to the experimental nature of the project and budget limitations. Certainly, there was a lot of work done and valuable results obtained during the ten-month timeline. However, such a short realization period did not allow additional background research, extra focus group discussions, more survey tests, and more comprehensive data analysis to be done. It also did not permit the whole target population sample to be surveyed and additional respondents to be interviewed to cover the gap that appeared after removing non-valid answers from datasets. Finally, time constraints created the above-mentioned

issues with aggregation of the project's results to the full target population and their testing on reliability.

8.4. Budget Limitations

The time constraints described above were largely influenced by budget limitations of the Codru Quest project. A thorough and reliable economic valuation study usually has the budget ranging from 20 000 to 30 000 EUR (Pearce et al., 2002). The Codru Quest project was realized with the total budget of approximately 8 000 EUR that included both grants and financial sponsorships and in-kind contributions. This is only about 30 – 40% from the recommended budget for such a study.

Certainly, such a limited budget was sufficient for the experimental CM study with 201 respondents interviewed (with the costs of about 10 EUR per CAPI with one respondent), which was conducted in the developing country of Moldova, where prices and costs are lower than in a developed one. Nevertheless, the sum of 8 000 EUR for the entire Codru Quest project was a very tight budget that imposed certain limitations and constraints on the target population sample size addressed, number of focus group discussions and pilot tests organized, surveying methods used, and generally the research work process, which ultimately affected its results.

All in all, due to the challenges and constraints of the Codru Quest project, its final results and conclusions should be treated and used with care. Still, they can be considered as valuable learning points and inputs for designing further CM studies researching the problem of the Codru Quest, as well as other studies on economic valuation of ecosystem services and biodiversity conservation, in a much better way from the preparation till the reporting phase.

IX. Final Results

The final results of the Codru Quest study include a series of important interconnected outputs. Firstly, it is necessary to present the general profile of the respondents and their level of use of the target environmental good. This information is then connected to the respondents' mean and median WTP estimates and reasons behind their valuations. Afterwards, the WTP estimates aggregated to the full target population sample are shown. Finally, this chapter describes how the socio-demographic and economic variables of the respondents influenced their choices of alternative scenarios and values of WTP.

9.1. Profile of Respondents

The average age of all the respondents surveyed in the Codru Quest project was 20 – 30 years. Quite expectedly, most of the city residents were young, while the majority of rural residents were older than the average age.

Among the respondents the majority were women: 60% share of women against 40% share of men. Such distribution maintained when looking at the datasets of city and village residents separately.

In terms of marital status, the distribution of unmarried and married respondents was practically equal (41% versus 43% respectively, with additional 14% living in a relationship and 2% divorced or widowed). However, while there were more unmarried respondents among the city residents (64%), the ones living in the rural area were mostly married (75%).

In relation to education, most (58%) of the respondents had either secondary school or Bachelor degree as the highest education level. Among the village residents there were also many (32%) with only primary school and professional school education as being the last one achieved. This fact reflects the limited access to schools and especially higher education in the rural areas of Moldova.

Regarding main occupation of the respondents, its distribution was quite diverse, ranging from not working for various reasons (23%) and still studying (32%) to being employed full-time (31%), freelancing (7%), and working at a farm (7%). Looking at the differences between city and village residents, there were more students (61%) in the former group, while the latter one had many unemployed people (46%). The last fact mirrors the current

situation in the country, where the majority of youth moves to cities for studying or working, while aged people remain in villages (Figure 8).

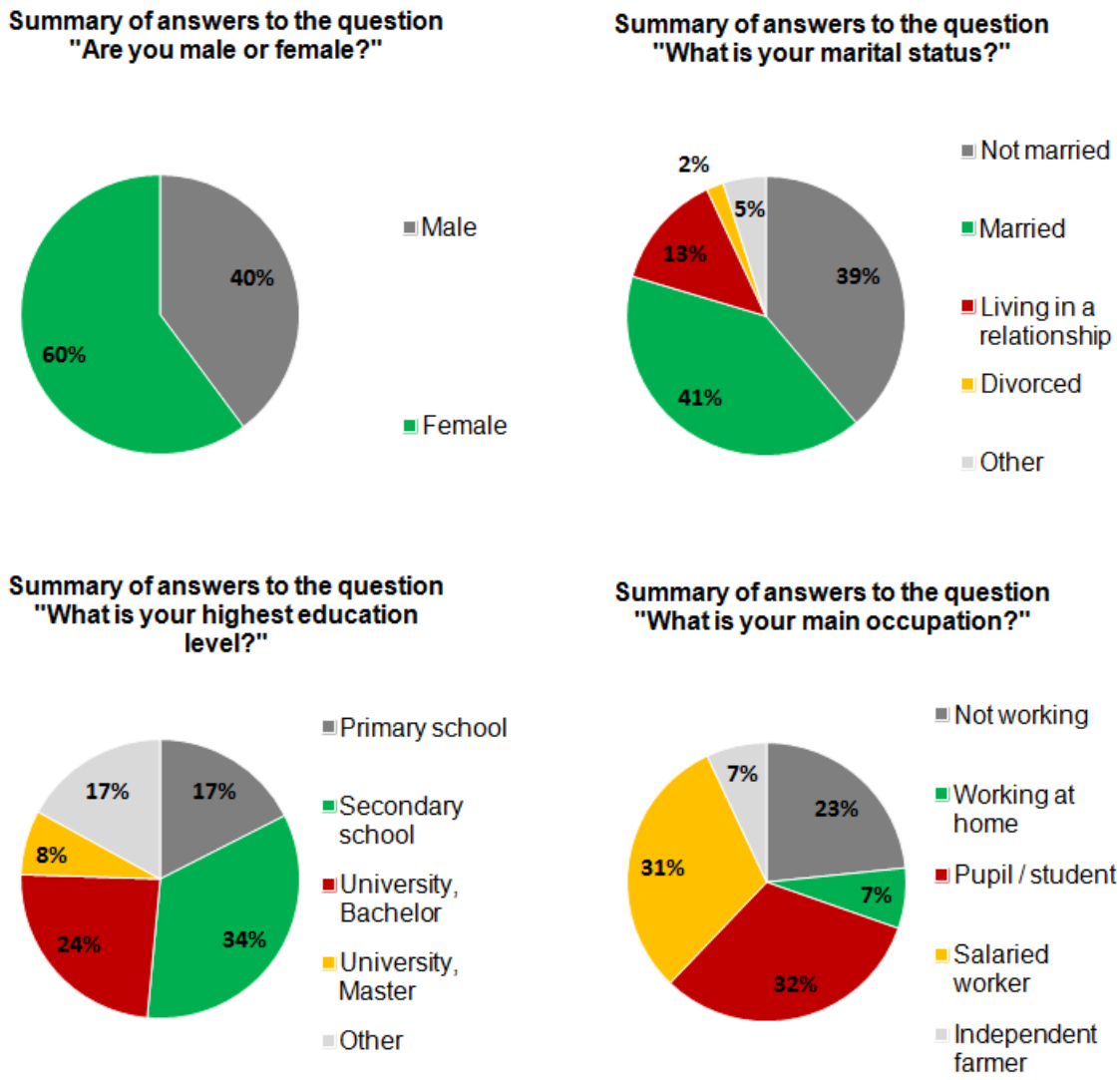

Figure 8. Socio-demographic profile of the Codru Quest respondents.

Besides the main occupation, the respondents were also asked whether they are involved in any environmental organization (as member / activist / volunteer / supporter). Their answers show that only 16% of them volunteer for an environmental NGO, while the rest do not. This should add credibility to the Codru Quest results, as such fact suggests that the majority of the respondents had not been biased by strategic behaviour as environmentalists.

Last but not least, among the respondents, who agreed to share their personal and household income, the large majority (72%) was earning less than 3000 MDL (approximately

140 EUR) per month. And while 3000 MDL was the mean personal monthly income among city residents, this amount was much lower among villagers: only 1000 MDL (about 47 EUR) per month. The last number signals about widespread poverty in Moldovan villages, which is even more obvious when looking at the household income levels. Overall, 62% of all respondents stated that their households had lived on less than 5000 MDL (approximately 235 EUR) per month, while having 2 – 3 family members. In the rural area the share of respondents' households earning below the 5000 MDL level reached 72%, reflecting a typical economic situation in the villages of this developing country (Figure 9).

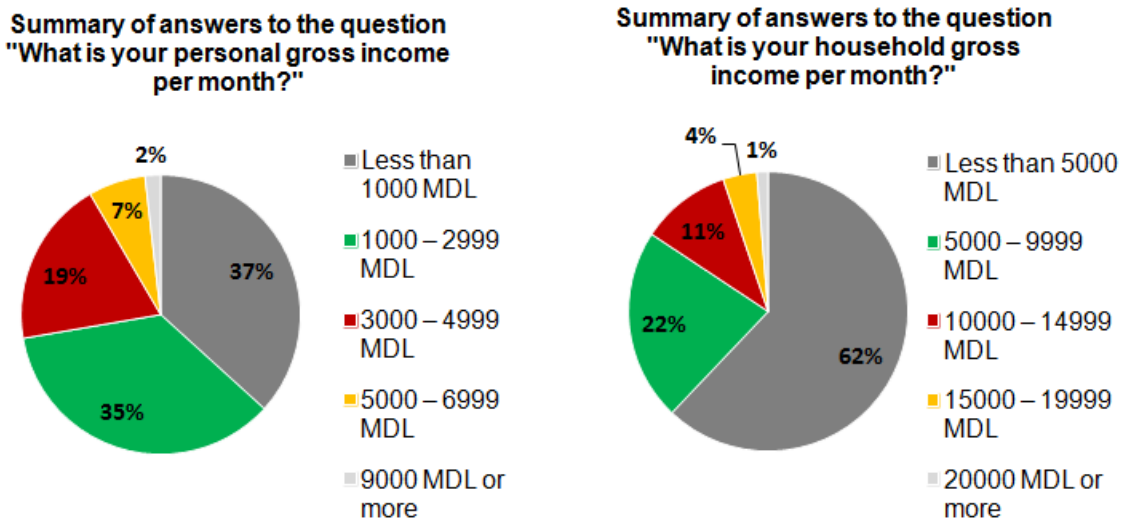

Figure 9. Economic profile of the Codru Quest respondents.

9.3. Relation and Attitude towards the Environmental Good

The relation of the respondents to the environmental good such as forest ecosystem was evaluated based on a number of criteria. To start with frequency of visiting a forest, the survey outputs showed that almost half of the respondents (49%) had made from one to five visits to a forest in the last 12 months, while 38% visited a forest more than 6 times. The distribution of visit frequency is practically the same for city and village residents viewed separately. The average duration of a visit was about 2 – 3 hours, while the majority of the respondents (56%) stated they had spent more than 3 hours during the last visit to a forest. These numbers indicate that, while the respondents are direct users of the forest ecosystem, they are infrequent beneficiaries of its services, at least directly. Nevertheless, when they visit a forest, they prefer to stay there for a long time (Figure 10).

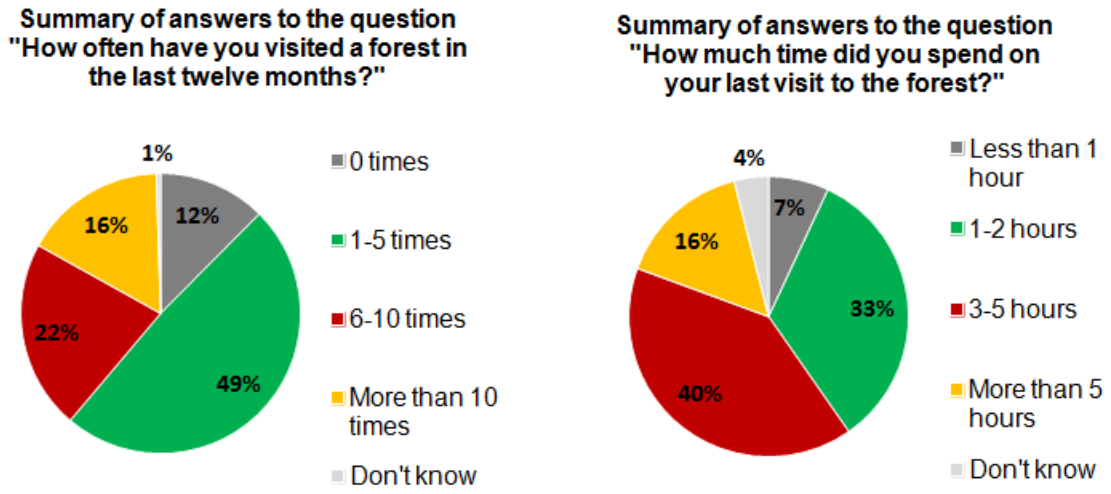

Figure 10. Frequency and duration of visits to a forest by the Codru Quest respondents.

When visiting a forest ecosystem, the respondents mainly enjoy its recreational benefits. From the survey outputs it can be seen that Moldovan citizens use forests for having a walk among the nature, enjoying silence and relaxation, and having a picnic among the woods. This output indicates that forest ecosystems should have strong recreational values that are important to consider in CBA, land use planning, policy making, and nature conservation strategies regarding forests in Moldova (Figure 11).

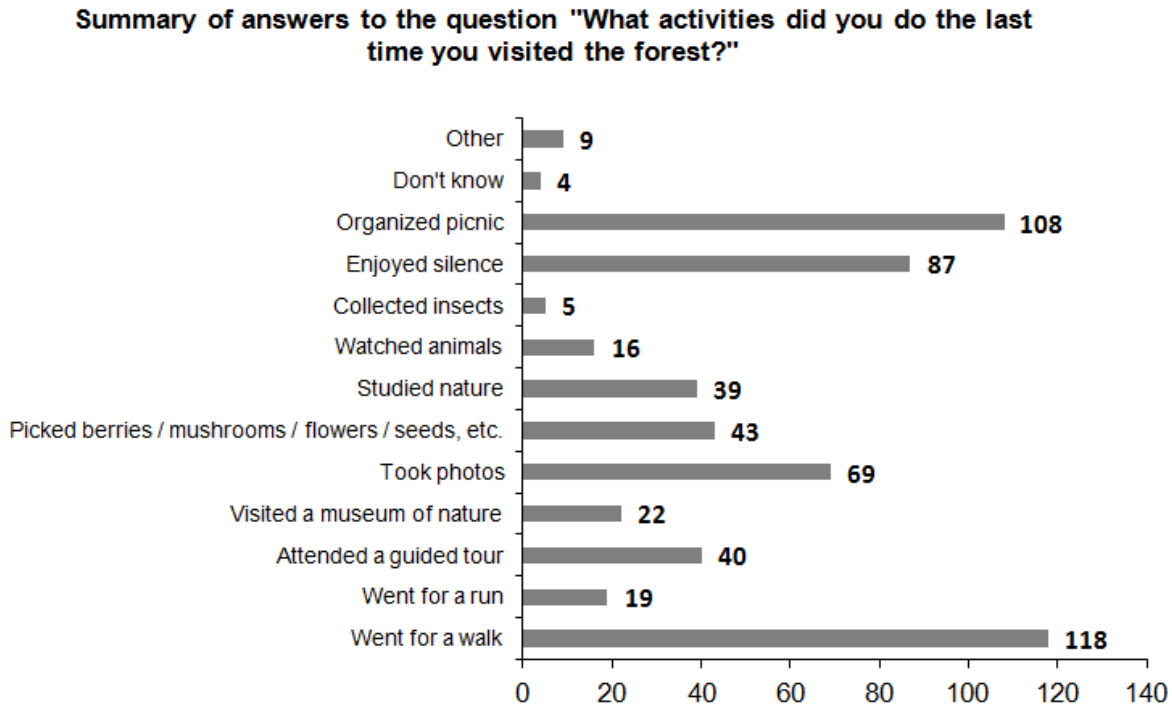

Figure 11. Different uses of a forest ecosystem during a visit by the Codru Quest respondents.

Consumption of timber and non-timber products is practiced by the respondents to a small extent. However, considering the effects of corruption and poverty described in the chapter "Problem Addressed", it was unlikely that anyone practicing logging and/or picking up endangered plant species would confess about such activities in the survey. Therefore, one should not fully rely only on the respondents' answers. Also on-the-field research on direct use of the Codru forest by local communities is necessary to be conducted in the future.

The accessibility of a forest ecosystem to the respondents was assessed through the proximity of the Codru Nature Reserve and the Codru forest to the respondents' place of residence and availability of another forest (substitute environmental good) besides Codru nearby. With regard to proximity, the majority of respondents (77%) were living close to the Codru forest: within the distance of 5 km. Certainly, such large share was affected by the presence of village residents, 97% of whom resided around the Codru Nature Reserve and the Codru forest. However, at the same time more than half of the respondents (66%) claimed that they had had another forest nearby that they can access. Unlike the case of proximity, this large share was driven by city residents, 73% of whom could visit several other forest ecosystems located much closer to the capital city Chisinau than the Codru forest. This presence of substitute environmental goods might have affected the city residents' WTP for the ecosystem services and biodiversity conservation in the Codru forest, which is located farther from the city. However, whether this is true or not and if yes, what is the magnitude of the substitution effect, is unknown (Figure 12).

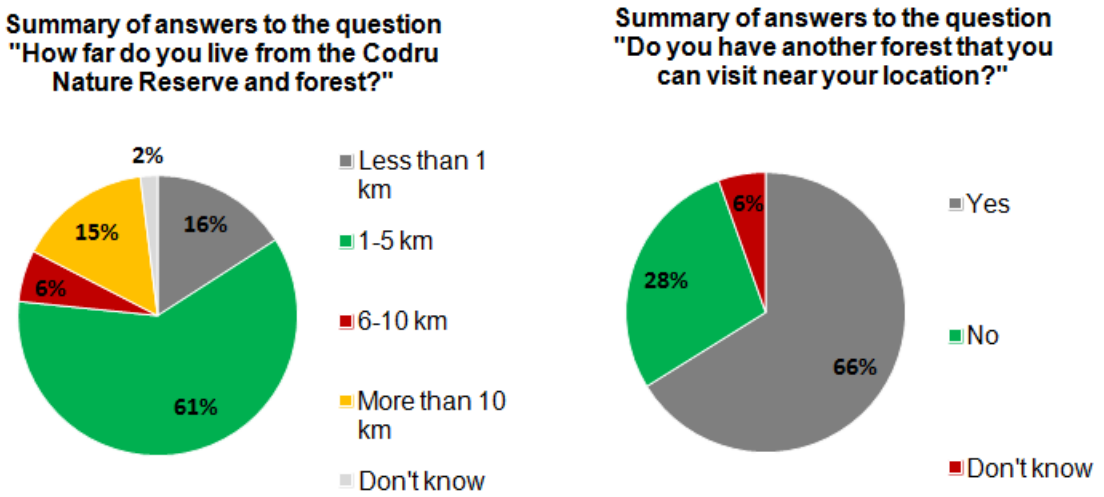

Figure 12. Proximity to the Codru forest and availability of another forest near the place of residence of the Codru Quest respondents.

With respect to the attitude of the Codru Quest respondents to the environmental good, it is worth mentioning that the general interest in nature and environment protection is rather high among them. 51% of the respondents characterized it to be large, 46% expressed medium level of interest, while only 3% stated that environment protection is of little to no interest to them. This distribution is practically the same when looking separately at the city and village residents databases. Such survey output suggests that the respondents should truly have values attached to the target environmental good, but can also indicate possible strategic behaviour towards more nature conservation.

In relation to specifically protected areas, nature reserves, and forest ecosystems in Moldova, the large majority of the respondents (approximately 89%) chose either very positive or positive attitude towards all three aspects that the survey had inquired about: current state of existing Nature Reserves with forests in Moldova, their potential expansion, and establishment of new ones in the country. Only 3 – 4 village residents expressed negative attitude towards these aspects (Figure 13).

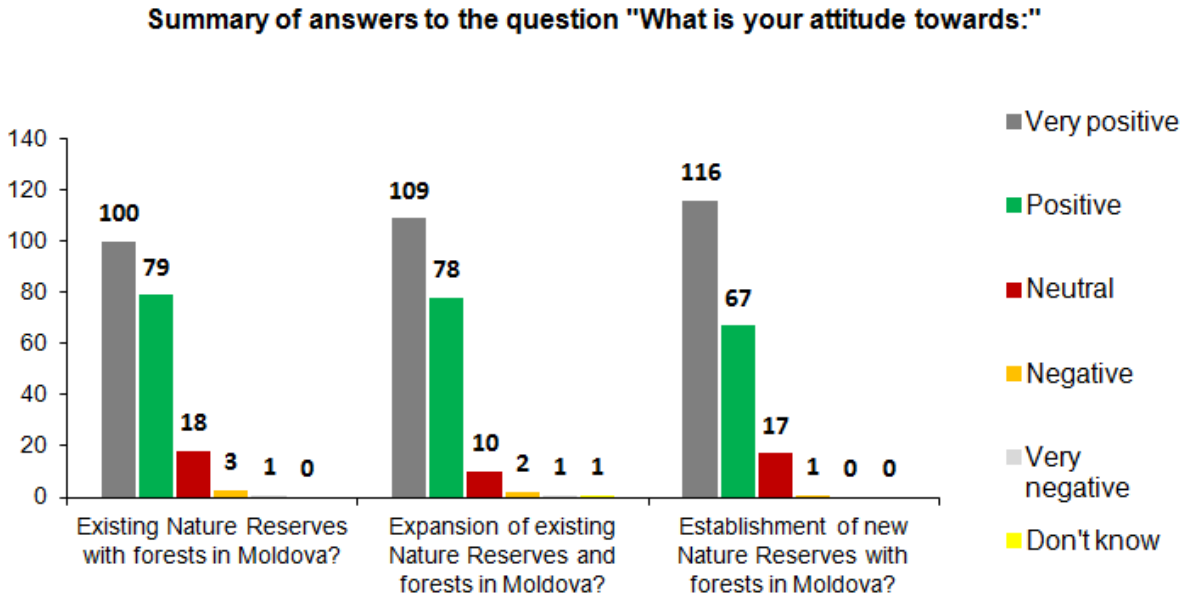

Figure 13. Attitude of the Codru Quest respondents towards Nature Reserves in Moldova.

This is a curious output from the survey, especially when considering WTP estimates of rural area residents. While their general attitude towards expansion of Nature Reserves and establishment of new ones is either very positive or positive, it is shown further that the village residents' mean WTP value for the Codru Nature Reserve territory attribute is actually

negative. This conflicting observation might be explained by the respondents' appreciation for expansion of PAs and forest areas in the country, but only when it is not done at the expense of their own land, the idea that they seemingly fear.

9.4. Willingness to Pay

The respondents' WTP estimates show a very interesting picture about the attitude of Moldovan citizens to ecosystem services and nature conservation in the Codru Nature Reserve and the Codru forest, as well as their valuation of benefits they receive from such environmental good. Due to very small final sample size the confidence intervals are quite large. However, the results still bring important data on how much Moldovan citizens are willing to pay to improve the quality and provisioning of ecosystem services in the study area (Table 5).

Table 5. Final results of the Codru Quest data analysis with the respondents' mean WTP estimates and confidence intervals for each attribute of the target environmental good, in MDL.

Attributes	Parameters	City Residents	Village Residents	Sample Average
Territory / area	Mean WTP	8.93	-11.94	-3.94
Territory / area	95% Confidence Interval (+- on mean value)	9	- 10.99	5.83
Territory / area	Extended CI boundaries*	17.71	17.71	17.71
Species of plants	Mean WTP	-4.53	-16.01	-11.65
Species of plants	95% Confidence Interval (+- on mean value)	9.02	14.28	10.22
Species of plants	Extended CI boundaries*	5.35	5.35	5.35
Species of insects	Mean WTP	22.42	12.54	16.3
Species of insects	95% Confidence Interval (+- on mean value)	16.14	11.803	12.54
Species of insects	Extended CI boundaries*	15.88	15.88	15.88
Symbolic species	Mean WTP	26.57	13.33	18.36
Symbolic species	95% Confidence Interval (+- on mean value)	19.86	12.71	14.37
Symbolic species	Extended CI boundaries*	24.56	24.56	24.56

*Note: "Extended CI boundaries" refer to the extension of the confidence interval boundaries to account for the different preferences across the sample.

The first curious thing that catches the eye is the difference in valuing the size of the PA and forest territory between the respondents from the city and villages. While city residents appreciated the expansion of the Codru Nature Reserve and were willing to pay about 8.93 MDL (0.42 EUR) per person for such PA development, the village residents expressed negative WTP for the territory attribute of approximately -11.94 MDL (0.56 EUR) per person. This negative value can be treated as willingness to pay to prevent the expansion of the PA territory. The average WTP from both city and village residents thus becomes -3.94 MDL (0.19 EUR) per person.

The second curious observation is about the number of plant species conserved. Both city and village residents expressed negative WTP in relation to this attribute: -4.53 MDL (0.21 EUR) and -16.01 MDL (0.75 EUR) respectively. The sample average WTP is then -11.65 MDL (0.55 EUR) per person. This amount the respondents are willing to pay in order to not have more plant species being included under the conservation status. At least this is what can be understood from the results of the Codru Quest data analysis.

Regarding the other two attributes of the target environmental good, the number of insect species conserved and the presence / abundance of endangered species on the example of small-flowered black hawthorn (*Crataegus pentagyna*) and stag beetle (*Lucanus cervus*), both groups of respondents had quite common preferences and valuation. For both city and village residents they were significant and positive. The ones from the urban area were willing to pay 22.42 MDL (1.06 EUR) for conservation of more insect species and 26.57 MDL (1.25 EUR) for increasing the abundance of endangered species in the Codru Nature Reserve and the Codru forest. The residents from the rural area were supporting insect species conservation with WTP of 12.54 MDL (0.59 EUR) and valuing endangered species with WTP of 13.33 MDL (0.63 EUR). In terms of population sample average, conservation of more species of insects was valued at 16.30 MDL (0.77 EUR) per person and abundance of endangered species at 18.36 MDL (0.87 EUR) per person.

A review of all WTP estimates suggest that the highest willingness to pay the respondents express for the presence / abundance of endangered species, followed by the number of species of insects conserved. Conservation of plant species received negative WTP from all respondents. With regard to the territory of the Codru Nature Reserve, the preferences here differ between city and village residents with the former supporting its expansion with positive WTP and the latter protesting against it with negative WTP (Figure 14).

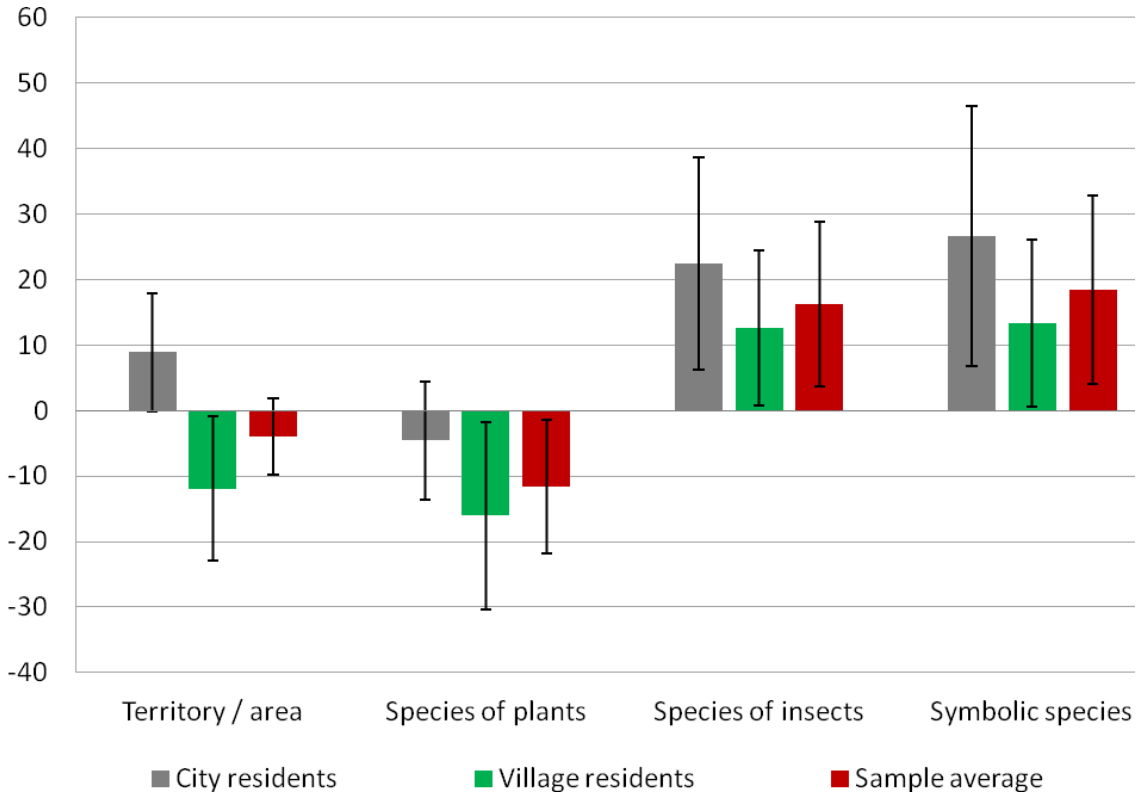

Figure 14. Comparison of mean WTP values and confidence intervals of city residents, village residents, and population sample average in the Codru Quest project, in MDL.

When aggregated to 3500 people, the approximate number of visitors to the Codru Nature reserve per year, the economic values of different attributes of the target environmental good become the following (Table 6):

- Expansion of the Codru Nature Reserve territory is not appreciated, resulting in negative WTP of -13 798 MDL (650.16 EUR) per year;
- Protection of more plant species is also not welcome, which is unanimously expressed through negative WTP of -40 775 MDL (1921.31 EUR) per year;
- Conservation of more insect species is desirable and valued at 57 050 MDL (2688.19 EUR) per year;
- Presence / abundance of endangered species, such as small-flowered black hawthorn and stag beetle, is valued the most among all the attributes: at 64 260 MDL (3027.92 EUR) per year.

Table 6. Aggregated WTP values for each attribute of the target environmental good, in MDL.

Attributes	Parameters	Aggregated WTP Values	WTP per ha
Territory / area	Mean WTP	-13 798	-55
Territory / area	95% Confidence Interval (+- on mean value)	20 405	82
Territory / area	Extended CI boundaries*	61 985	248
Species of plants	Mean WTP	-40 775	-
Species of plants	95% Confidence Interval (+- on mean value)	35 770	-
Species of plants	Extended CI boundaries*	18 725	-
Species of insects	Mean WTP	57 050	-
Species of insects	95% Confidence Interval (+- on mean value)	43 890	-
Species of insects	Extended CI boundaries*	55 580	-
Symbolic species	Mean WTP	64 260	-
Symbolic species	95% Confidence Interval (+- on mean value)	50 295	-
Symbolic species	Extended CI boundaries*	85 960	-

*Note: “Extended CI boundaries” refer to the extension of the confidence interval boundaries to account for the different preferences across the sample.

The aggregated WTP estimates are quite low, mainly due to the low number of visitors in the Codru Nature Reserve, low income levels, and other specifics of socio-economic situation of a developing country, such as Moldova.

The mean WTP values for different attributes of the target environmental good expressed by the respondents, their aggregation to the full target population sample, and significance levels can be represented in a visual form as “bubble” diagrams. There the size of bubbles reflects the magnitude of WTP, their colour – the WTP sign (green for positive and red for negative), and the level of bubble transparency – the significance of WTP estimates (solid for significant estimates at a 5% significance level and translucent for the opposite). This representation allows for better comparison between WTP for different attributes and by different groups, as well as immediate understanding of attitudes and preferences of Moldovan citizens for ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest (Figure 15 and 16).

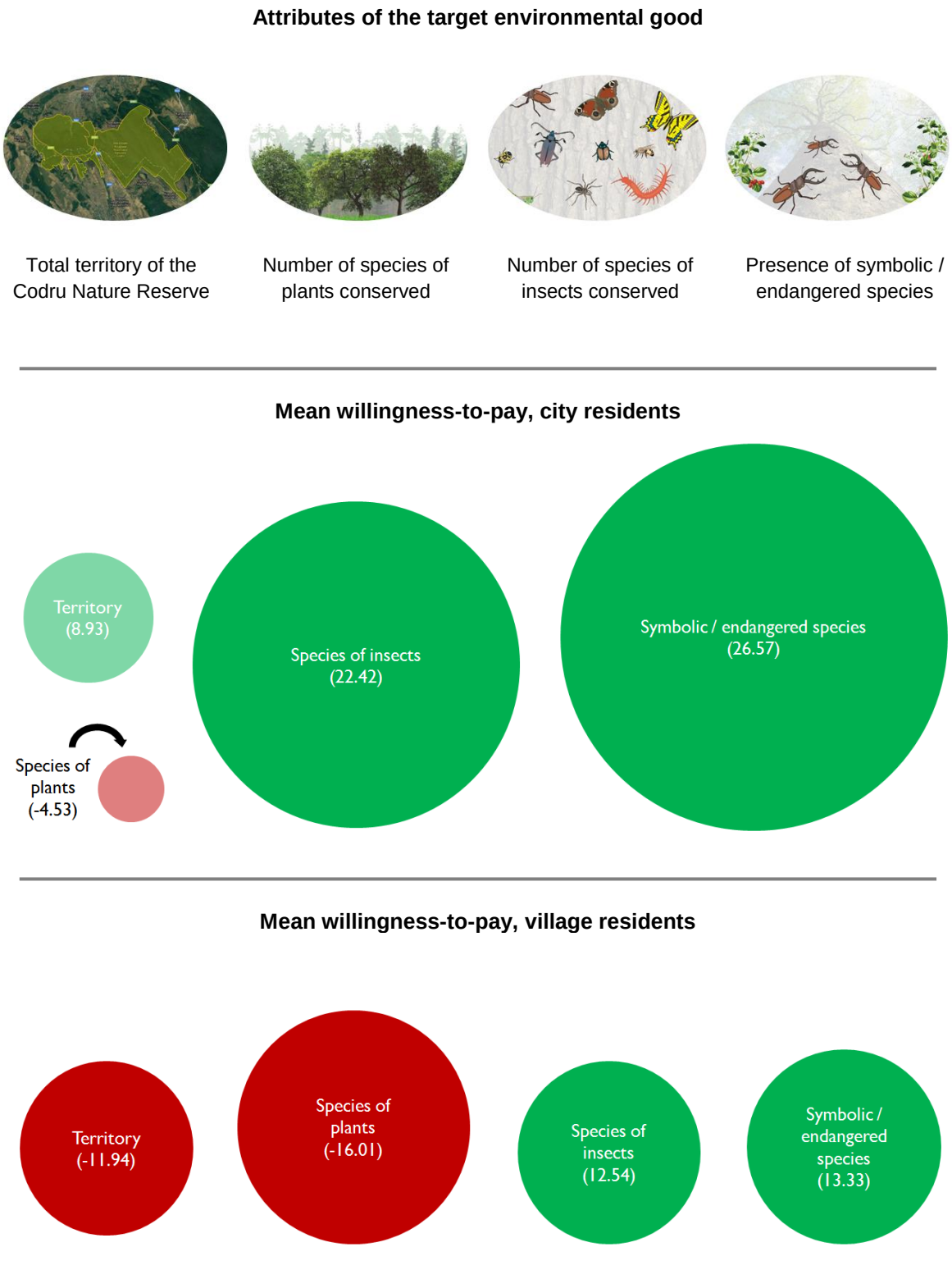

Figure 15. Visualization of WTP of city and village residents in the Codru Quest project, in MDL.

Note: Size – WTP magnitude, colour – sign (**positive** and **negative**), transparency – significance.

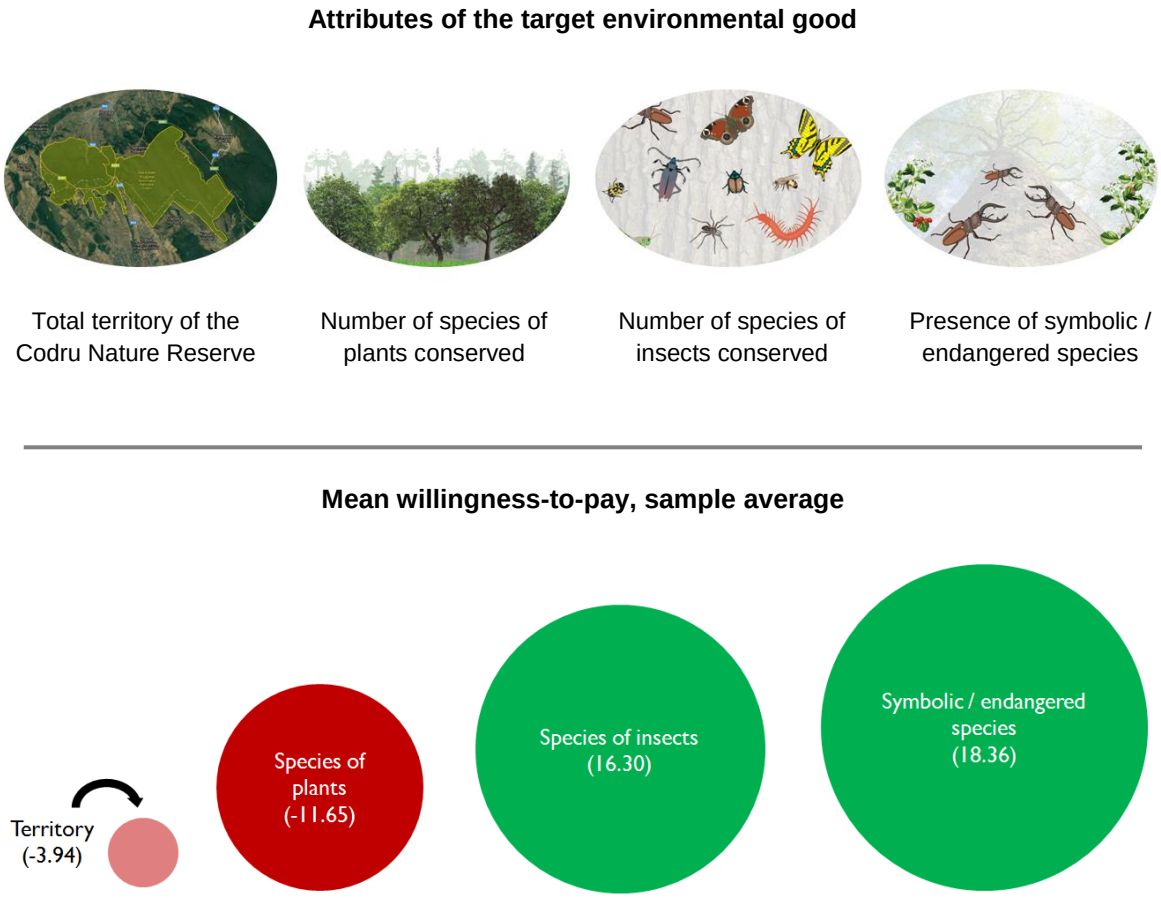

Figure 16. Visualization of population sample average WTP in the Codru Quest project, in MDL.

Note: Size – WTP magnitude, colour – sign (**positive** and **negative**), transparency – significance.

*Aggregation is based on the approximate number of visitors to the Codru Nature Reserve per year.

9.5. Reasoning behind Willingness-to-pay

While choosing alternative scenarios in the choice sets of the Codru Quest survey and in such way expressing their WTP, more than half of the respondents (55%) considered that they should not be paying for the quality and provisioning of forest ecosystem services, even if they benefit from them. Such opinion was dominant (78%) mostly among village residents, while in the group of city residents many (43%) were supporting the concept of payment for ecosystem services (PES) (Figure 17). Based on their comments in the survey, the respondents opposing PES did not consider fair and ethically correct for them to fund ecosystem services and biodiversity conservation, when the state already takes much money from them through taxes and bribes. Here one can see influence of corruption and lack of trust in state agencies in the country.

Lack of trust in state agencies and taxes might have affected the respondents' attitude to the increase in local tax as a possible alternative payment vehicle to the visitor price chosen in the Codru Quest study. 36% of all respondents claimed that their WTP would have been lower, if increased local tax was presented instead of visitor price. This was very obvious in the group of rural area residents, where 48% expressed such an idea. At the same time 28% of all respondents considered that with the local tax as payment vehicle their WTP would have been greater, 23% had the opinion that it would have remained the same as stated in the survey, and 13% were not sure. Such distribution of opinions regarding the payment vehicle speaks in favour of the choice of visitor price (Figure 17).

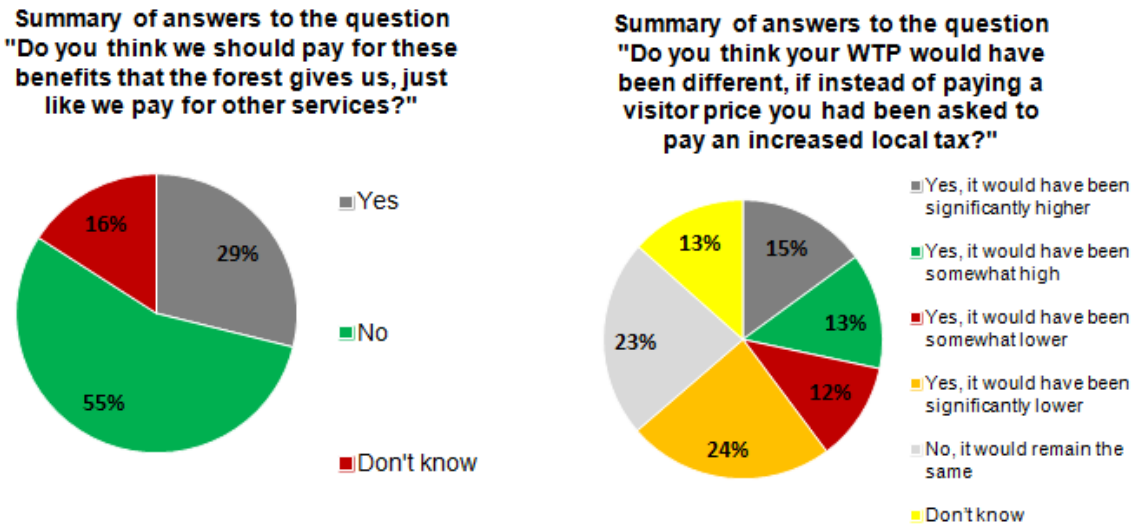

Figure 17. Attitude of the Codru Quest respondents towards the concept of payment for ecosystem services and the choice of the payment vehicle.

While deciding on the alternative scenarios in the choice sets and considering their WTP, the majority of respondents (53%) took all attributes of the target environmental good into consideration. Besides this majority, 36% of the respondents preferred to focus on the characteristic, which they considered to be the most important one, and 11% could not give a clear answer.

With regard to the influence of specific attributes on the respondents' choices and resulting WTP, their answers to the survey indicate that the territory of the Codru Nature Reserve and the number of plant species conserved represented very influential decision-making factors. Interestingly, these attributes also received the respondents' negative WTP values. The price attribute, however, was the most influential attribute, especially among village residents. This suggests that the respondents were conscious about the consequences of paying visitor price for their income and treated it as realistic and credible welfare measure (Figure 18).

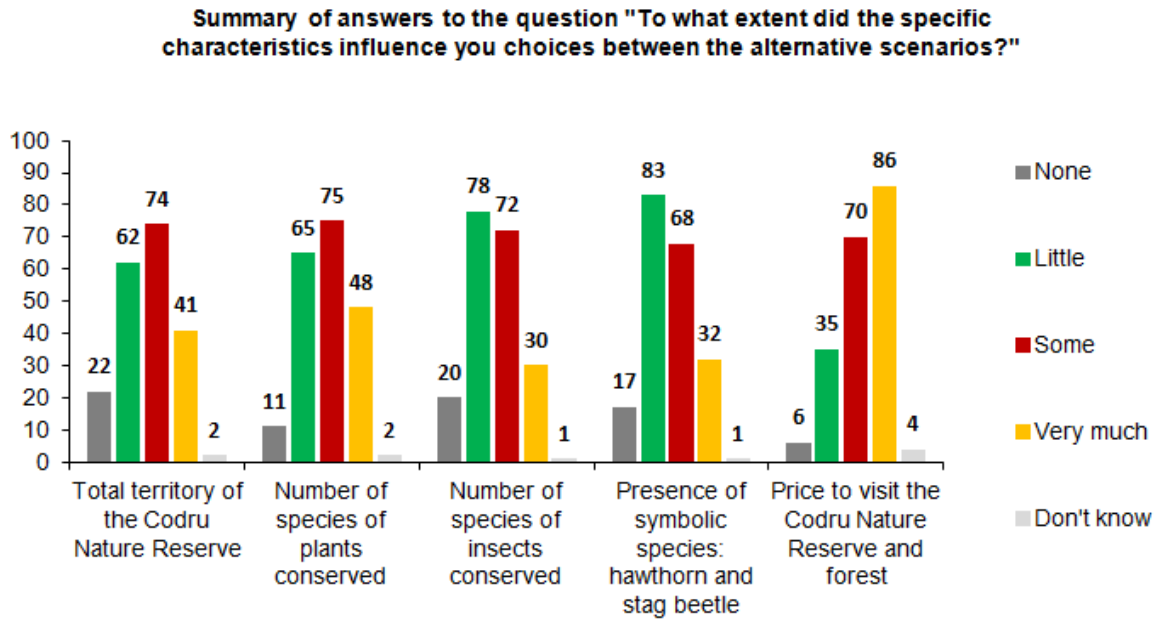

Figure 18. Influence of attributes of the target environmental good on the scenario choices and WTP of the Codru Quest respondents.

The respondents also indicated that in choosing alternative scenarios and expressing their WTP they had considered all aspects of scenarios' influence on the target environmental good, including the state of plants and animals, recreational opportunities in the forest, well-being of communities living nearby, and personal use of the good. This output confirms the

assumption that the respondents had direct use, indirect use, and non-use values attached to the ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest and that they included these values in their WTP. At the same time city residents showed slightly higher preference for conservation of flora and fauna, while village residents were considering personal use of the forest ecosystem as a bit more important decision-making factor (Figure 19).

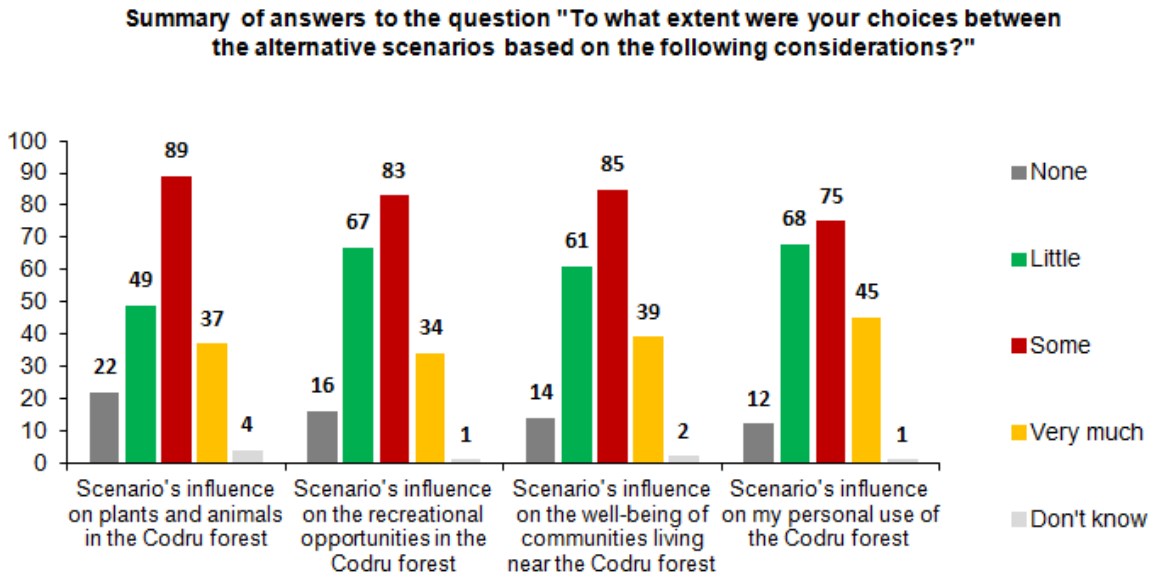

Figure 19. Effects of considerations regarding the use of the target environmental good taken into account by the Codru Quest respondents when choosing scenarios and expressing their WTP.

When asked about the motives of WTP for attributes of the target environmental good expressed through alternative scenarios, the respondents, who chose non-baseline scenario in at least one of the choice sets (54%), indicated significant non-use values, specifically bequest and existence values, attached to the Codru Nature Reserve and the Codru forest. They argued that their WTP had been driven mainly by the understanding that the Codru forest ecosystem should be protected for symbolic / endangered species of plants and animals and preserved for future generations (Figure 20).

Talking about the respondents, who chose status quo in all choice sets (46% in total with 26% among city residents and 66% among village residents), their zero bids were mostly influenced by personal income considerations in a way that they could not afford to pay visitor prices presented in alternative scenarios. This was most obvious among the group of village residents, confirming the effect of poverty in rural areas of Moldova on WTP. Another

important motive for the respondents, both from city and villages, to select status quo in all choice sets was their lack of trust in state institutions and protesting against paying for improvements in the target environmental good, which in their belief would not happen (Figure 20).

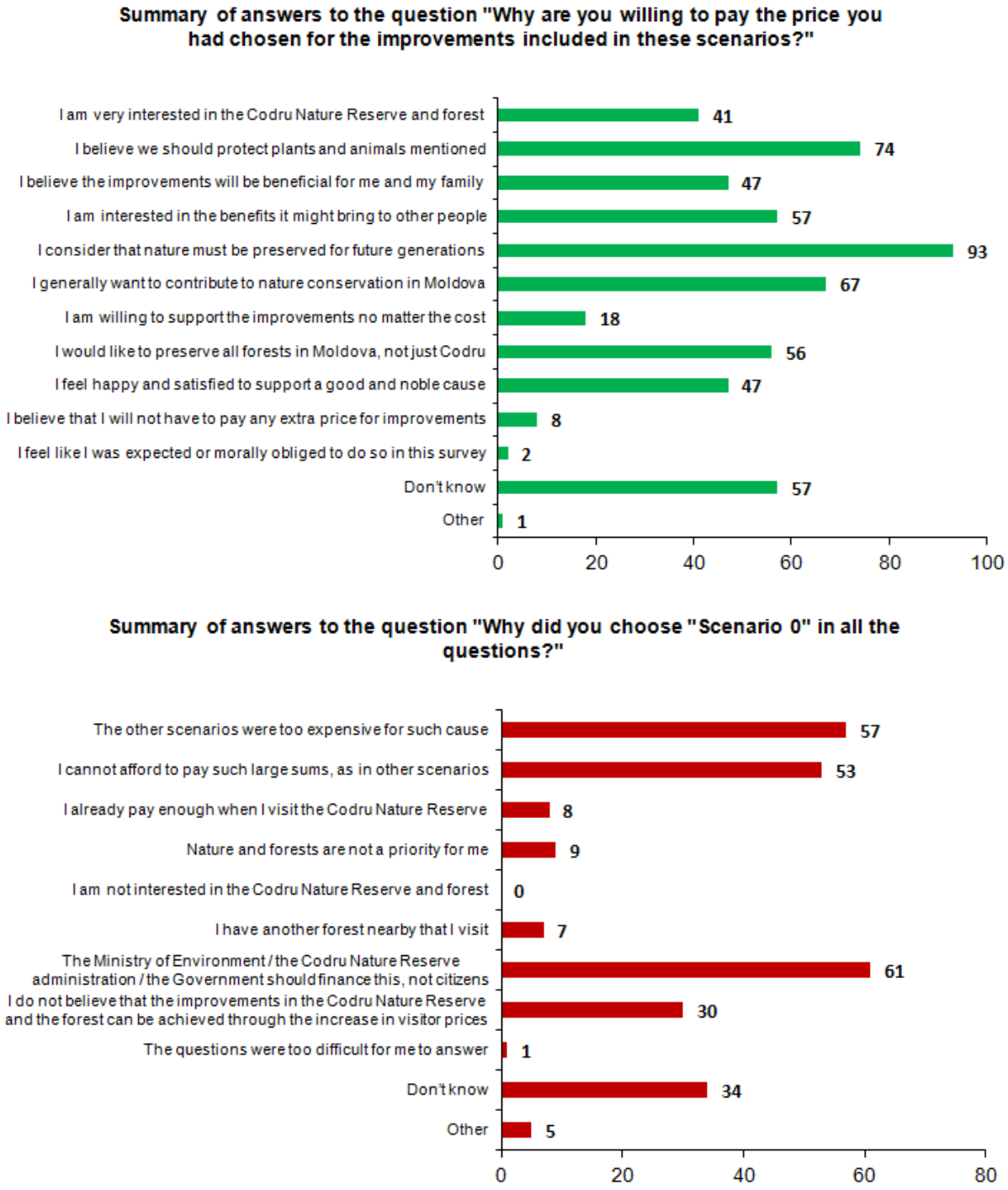

Figure 20. Motives for WTP and zero bids expressed by the respondents in the Codru Quest survey.

Certainly, protest zero bids were removed from the final target population sample. Still, they communicate an important fact that the presence of corruption and lack of trust in institutions responsible for provisioning environmental good can be a serious challenge in ensuring necessary sample size and validity of results of an economic valuation study.

9.6. Influence of Socio-economic Variables

In order to assess the effect of socio-economic characteristics on the likelihood of a respondent expressing WTP for the target environmental good over the no-cost baseline scenario, the econometric model of the Codru Quest project was connected with socio-demographic and economic variables. These variable included age, gender, marital status, education level, occupation, personal / household income, and proximity to the Codru Nature Reserve and the Codru forest.

Among all socio-demographic characteristics gender represented the most influential one for determining the probability that a person would be willing to pay for the environmental good. Specifically, women were not only the majority of all respondents in the population sample, but also were more likely than men to select a non-baseline scenario. It means that they were more supportive for the improvements in the quality and provisioning of the target environmental good and were more willing to bear the cost of these improvements. However, this correlation did not translate directly into higher WTP values.

The other socio-demographic and economic characteristics, such as marital status, occupation, and distance to the Codru Nature Reserve and the Codru forest were somewhat important in explaining the respondents' preferences and WTP, but not as much as gender. Surprisingly, personal / household income characteristic did not have significant effect on the choices of alternative scenarios of the respondents. This might be due to the fact that the income effect was already captured by the heterogeneity and specifics of the different groups of respondents: city residents with higher level of income and village residents with lower income level.

X. Discussion and Recommendations

The final results of the Codru Quest project paint an interesting picture regarding the relation and attitude of Moldovan citizens to ecosystem services and biodiversity conservation in the protected area Codru Nature Reserve and the Codru forest. Based on the estimated and aggregated WTP values obtained from the respondents' answers to a CM survey, people value various aspects of ecosystem services and biodiversity conservation differently.

The territory of PA designated for nature conservation activities and the possibility of its expansion is valued negatively, at -13 798 MDL (650.16 EUR) per year. However, this aggregated negative WTP is driven mostly by the significant negative WTP of village residents. City residents express positive yet insignificant WTP for the PA territory and its possible expansion.

Another aspect of ecosystem services and biodiversity conservation that is valued negatively by their users and beneficiaries is the conservation of species of plants in the Codru forest, at -40 775 MDL (1921.31 EUR) per year. Here both urban and rural area residents agree on the negative valuation of wider protection of flora, although the WTP of urban residents is insignificant.

What both city and village residents also agree upon is the positive valuation of two other aspects included in the hypothetical valuation scenario and choice sets: conservation of species of insects and especially of endangered species of both plants and insects, such as the symbolic small-flowered back hawthorn (*Crataegus pentagyna*) and stag beetle (*Lucanus cervus*). Insect species conservation is valued at a total of 57 050 MDL (2688.19 EUR) per year, while protection of endangered symbolic species at 64 260 MDL (3027.92 EUR) per year. The magnitude of WTP is higher among city residents, which might be due to their higher personal / household income than of village residents.

The positive WTP reflects a monetary metric and a measure of welfare, which communicate the importance and values that Moldovan citizens attach to ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest. Among the values attached to such environmental good the strongest ones are existence values for preserving nature and its biodiversity for the sake of their continued existence and bequest values for protecting natural assets in a state, which future generations would also enjoy and benefit from. Moldovan citizens also assign use values to the environmental good in the

Codru Nature Reserve and the Codru forest, but they are not as significant as existence and bequest values.

When viewing the presented WTP and economic values, one should keep in mind that they neither refer to a monetary amount that can be appropriated directly by Moldovan citizens, nor reflect the market value of the Codru Nature Reserve. The Codru Quest results should be used primarily to:

- explain the current situation with nature conservation in the PA and forest;
- compare interests of various stakeholder groups and their attitude towards different nature conservation activities and environmental policy making regarding the study area;
- provide additional objective economic inputs for any CBA, land use planning, and policy making that affect or likely to affect ecosystem services and biodiversity in the Codru Nature Reserve and the Codru forest;
- present recommendations to stakeholders in terms of intervention points that might be used for creating collaborative sustainable management and governance of the Codru Nature Reserve and the Codru forest.

Connection between the Codru Quest results, explanation of reasoning behind them, and how they can be used in practice is described further.

10.1. Explanation of the Final Results

The Codru Quest final results can help in understanding Moldovan citizens' attitudes and interests in relation to ecosystem services and biodiversity conservation the Codru Nature Reserve and the Codru forest. They also allow one to see the social welfare gains achieved when they are better managed and expanded through reforestation and nature conservation activities. But before this is possible, additional explanation of the estimated WTP values and reasons behind them is needed.

Firstly, attention should be paid to the difference between WTP values of urban and rural residents in relation to the territory of the Codru Nature Reserve. Such heterogeneity can be expected for a developing country, such as Moldova, as it reflects the socio-economic polarities and related preferences of the two prevalent societal groups in a developing country.

One group, city residents, includes citizens of middle or upper middle class living in a large city and its suburbs. In the Codru Quest project the chosen city was Chisinau, the capital of Moldova. City residents have more or less stable daily job and source of income. However, besides urban parks, they have very limited interaction with outside green spaces and are mostly non-users of forest ecosystems and PAs. City residents can still attach some non-use values (existence and bequest values) to a forest or nature reserve situated not so far away from the city of their residence. Therefore they might be expressing positive WTP for preservation and even expansion of forests outside the city and conservation of biodiversity in them, even if these people are not using forest ecosystems in any way. Still, as the respondents' answers to the Codru Quest survey show, some city residents are visiting outside forests once or several times per year for recreational purposes. So, they are likely to be supporting nature-related improvements in their favourite recreational sites, as well as their expansion to have more place for walks, picnics, and enjoyment of natural environment in peace and silence outside the daily hustle and urban noise pollution.

The other group, village residents, is comprised of mostly aged citizens, who either prefer to live in rural areas or have no other way but to stay there. They are usually independent farmers, unemployed, and retired people, whose only source of income are remittances from their children working in the cities or abroad and possibly some small sales of fruits and vegetables from their gardens and farms, as well as of non-timber products from the nearby forest. In the Codru Quest project the respondents were from 9 villages (Lozova, Stejareni, Capriana, Micleuseni, Huzun, Horodca, Bursuc, Dragusenii Noi, and Condrita) situated very close to the Codru Nature Reserve and the Codru forest. They are direct and indirect users of natural resources and ecosystem services of the forest, especially timber and non-timber products, and largely depend on them for their wellbeing and welfare. Village residents also have their land with gardens and farms situated close to the Codru Nature Reserve and the Codru forest. Therefore, when presented the scenario with enlargement of the territory of PA, they could have experienced fear of losing their land, as well as access to the forest for gathering timber and non-timber products. Such situation would have been a terrible blow to their already weak economic situation. Especially if there were cases of similar situation actually happening or threats for it to happen, then the villagers' fears can be justified. This state of affairs is likely to be the reason for the negative WTP of rural residents in relation to the attribute of the size of the PA territory and its possible expansion.

Next, it is important to reflect on possible reasons of why both city and village residents express negative WTP for the conservation of more species of plants. For city residents it

may be related to the recreational value placed on the Codru Nature Reserve and the Codru forest. People want to have space while spending recreation time in a forest. The respondents from the city may associate protection of more plant species with additional tree planting, which would limit available space, and allocation of conservation zones, which would be restricted for people's access. In addition, with more species of flora under protection visitors of the Codru forest would be limited with the variety of flowers, berries, mushrooms, etc. they are allowed to collect. All this may not be desirable for city residents, hence they express negative WTP.

Similar reasons may be relevant for village residents, who are dependent on timber and non-timber products of forest ecosystems. In villages people still use wood for heating and often collect it in nearby forests. So, they may be against conservation of more plant species, considering that it would limit their possibilities for collect fuel wood in the forest. Also, they occasionally sell timber to third parties, an economic activity that would also be affected by developments in plant conservation practice. Besides selling timber, another source of income (although illegal one) for people in rural areas living near forests is the collection and commercialization of endangered plant species, especially during national holidays. For example, in spring it is common practice to pick up and sell different species of snowdrops (*Galanthus plicatus*, *G. nivalis*, and *G. elwesii*), all of which are included into the Red Book of Endangered Species of the Republic of Moldova and listed there as either vulnerable or critically endangered (Ministry of Environment of the Republic of Moldova, 2015). Even the fine of 2000 MDL (about 94 EUR) does not stop people from collecting them and selling at the sides of roads and in cities, as even a person doing such an activity is caught and fined, the profit earned is likely to exceed the fine (Point.md, 2016). However, village residents practicing this collection and selling of plants are expected to be against conservation of more plant species, fearing that more plants protected would reduce their possibilities to collect and sell them. Even law-abiding residents of rural areas may be resistant to such nature conservation initiative, as it may restrict collection of medicinal and other plants for their own personal purposes. Last but not least, village residents are mostly independent farmers having their agricultural lands near forests. They may consider that extensive protection of more plant species would result in spreading of weeds and invasive plants that it would be difficult for them to deal with due to additional flora conservation restrictions.

Positive WTP was expressed for conservation of more species of insects and for protection of endangered symbolic species by both city and village residents. For city residents such aspects of nature conservation may represent not only existence and bequest values, but

also use value in the form of visual pleasure of seeing rich biodiversity of beetles and butterflies when coming to a forest for recreation. At the same time village residents may attach additional use value of richer biodiversity of forest ecosystem with pollination for their lands: the more insects there are in a forest nearby, the better the “pollination job” is done by them for agricultural plants on their fields. Certainly, there may be also fear for more insect pests coming to the fields. However, they are easier to deal with than in the case of weeds, so villagers may not be much concerned about insect pests. When it comes to symbolic endangered species, significantly positive WTP for their conservation of both urban and rural area residents may be influenced by the factor of scarcity and fear of losing something that is rare and symbolic to the country.

All these reasons of negative and positive WTP for different aspects of nature conservation should be taken into account during any CBA, land use planning, and policy making regarding the Codru Nature Reserve, the Codru forest, and possibly any other PA and forest ecosystem in Moldova. However, in doing so one should bear in mind that the presented explanation of the Codru Quest final results relies mainly on the researchers’ assumptions and prior knowledge. It may well be that negative WTP for conservation of plants and positive WTP for protection of insects and endangered species were affected by visual representation of these attributes in the Codru Quest survey. There images of insects (colourful beetles and butterflies) and noticeable stag beetle might have appeared as more visually interesting and attractive than plain forest and plants. So, there may well be an effect of the survey design on the resulting WTP. All in all, additional research and consultations with the respondents are needed to clarify the exact reasons behind the WTP values.

10.2. Recommendations to Stakeholders

The Codru Quest final results can be of good use to different stakeholders (local communities, PA administration, environmental organizations, Ministry of Environment, policy makers, researchers in environmental economics, and others) as objective economic inputs and intervention points for solving the problem addressed by the Codru Quest project and creating collaborative sustainable management and governance of the Codru Nature Reserve and the Codru forest. Below is a list of recommendations on how this can be done and how the Codru Quest results should be used properly:

- Local communities and citizens concerned about the state of ecosystem services and biodiversity in the Codru Nature Reserve and other PAs can use the results of the Codru Quest to claim that their voice should be heard and their opinion should be taken into

consideration when both nature conservation and land conversion initiatives are planned.

- The administration of the Codru Nature Reserve and other PAs in Moldova can account for recreational, existence, and bequest values of ecosystem services and biodiversity conservation in their PA management plans. Their staff can also consider estimated WTP values as an economic input to design and establish payment for ecosystem services (PES) scheme. Last but not least, judging by the Codru Quest results, they should work together with local communities and possibly frequent and devoted visitors valuing nature and biodiversity in their PA.
- Environmental organizations can include WTP for ecosystem services and biodiversity conservation in their educational initiatives and raising awareness campaigns as additional argument in favour of environmental protection and its connection to social wellbeing. In addition, on the basis of the Codru Quest inputs, they should consider approaching local communities and collaborating with them before starting tree planting and biodiversity conservation projects. Otherwise, environmental NGOs may face resistance from local community members, who might fear of unpleasant consequences of such projects on their welfare and freedom.
- Ministry of Environment and policy makers can refer to the Codru Quest results as an objective economic input to decision-making regarding the development of PAs in Moldova, sustainable land use planning, and environmental policy-making. They should consider economic values of ecosystem services and biodiversity conservation estimated in the present Report for assessing and comparing different scenarios of developments related to the Codru Nature Reserve and possibly other PAs in Moldova. Also, from the Report policy makers can see different interests and attitudes of citizens and local communities towards various aspects of nature conservation. These should be taken into consideration in environmental policy-making, as they could help design and implement effective and cost-efficient policies and action plans that establish collaborative sustainable management and governance of PAs and forest ecosystems in Moldova.
- Researchers in environmental economics can use the Codru Quest project as the first CM study conducted on ecosystem services in a PA in Moldova to continue researching and exploring the subject of economic valuation of ecosystem services and biodiversity in a developing country. The Codru Quest project has its limitations and gaps, therefore

it is desirable that other environmental researchers and economists capitalize on its outputs and lessons learnt to design and implement a much more thorough, complete, and reliable economic valuation study of ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest.

However, while using the Codru Quest results in environmental education, CBA, land use planning, policy-making, and other applications, one should be cautious and keep in mind that the WTP estimates presented and described refer only to several aspects of nature conservation in the Codru Nature Reserve and the Codru forest and represent mainly existence and bequest values that Moldovan citizens attach to such environmental good. The results do not include WTP for other possible uses of ecosystem services and biodiversity in the PA and forest and do not cover direct use values, which can be far greater in magnitude than the ones presented in the Report. In order to account for them and be able to use them in CBA, policy-making, and so on, economic valuation research on the problem addressed and the subject of the Codru Quest project should be continued.

Concluding Remarks

Economic valuation of environmental goods, such as ecosystem services and biodiversity, represents a useful tool for assessing and demonstrating how important and valuable these environmental goods are, especially when there is no actual market for them. Specifically for non-market environmental goods choice modelling, one of the economic valuation techniques, is applicable, as it is able to capture non-use values of these goods, such as existence and bequest values. Due to this and other advantages, the CM technique was selected for estimating indirect use and non-use values of ecosystem services and biodiversity conservation within the Codru Quest project.

While working on the project and estimating WTP, the researchers have discovered that attitudes of Moldovan citizens differ in terms of aspects of nature conservation in the study area. The results demonstrate that activities for conservation of more species of insects and especially of symbolic endangered species, such as small-flowered black hawthorn and stag beetle, are appreciated by both city and village residents. They suggest monetary value of 2688.19 EUR per year for insect species and 3027.92 EUR for endangered species. However, one should be careful when designing and implementing initiatives for protecting more plant species and expanding the territory of the PA without preliminary public consultations, as these could meet resistance from local communities.

In conclusion, as the results of the project show, the Codru forest ecosystem with its biodiversity is important and valuable for Moldovan citizens not only as a source of timber and non-timber products. People also receive benefits from knowing that it simply exists and plants and animals thrive there and that it will exist further on for future generations to enjoy. These existence and bequest values should not be neglected; instead, they should be considered as additional weights on the scale pan of nature conservation and sustainable use of forest ecosystem. Still, consideration of only these values in constructing the argument for better conservation and collaborative sustainable use of ecosystem services and biodiversity conservation in the Codru Nature Reserve and the Codru forest is not enough. They should be supplied with direct and indirect use values of such environmental goods. Estimation of these additional values requires further economic valuation research.

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Terminology

Altruistic value	One of non-use values. Altruism is the opposite of egoism and refers to the desire to assure an improvement in the wellbeing of others. So, altruistic economic value is when individual A is willing to pay its part in order to make sure that individual B will be better off in his/her wellbeing.
Attribute	Distinctive characteristic of a good or service. For example, attributes of a forest can include size of its territory, species of flora and fauna, recreational possibilities, etc.
Benefit transfer	Method, where values of a good are estimated in one site (study site) and then applied, with some adjustments, to another site (policy site). An example is the application of values from one research project concerning a river at a particular location to another project with similar river ecosystem at another location.
Bequest value	One of non-use values. It measures individuals' willingness to pay for ensuring that future generations are able to access and use environmental good or service in the future.
Choice experiment (CE)	Method from the family of choice modelling approaches, where respondents receive a variety of alternative scenarios regarding environmental good or service and asked to choose the most preferred one, thus expressing their willingness to pay or willingness to accept compensation.
Choice modelling (CM)	Economic valuation approach from the family of the stated preference technique. Also known as conjoint analysis or conjoint choice analysis. It is based on respondents' preferences for environmental goods, where goods are

	described in terms of their characteristics and the levels that these take. Choice modelling is able to measure non-use values of environmental goods or services. It includes such methods as choice experiment, contingent ranking, contingent rating, and paired comparisons.
Content validity testing	Form of valuation of study results. It helps evaluate whether the study had its survey questions formed in a clear, understandable, and appropriate way in order to obtain valid estimates, for example, to assess the maximum willingness to pay for a specific environmental good.
Cost-benefit analysis (CBA)	Procedure to value and compare benefits (gains) and costs (losses) of changes in environmental good expressed in monetary terms based on individuals' preferences in order to enhance their utility, welfare, or wellbeing.
Direct use value	One of the components of the total economic value of environmental good or service. It measures people's direct use of a natural resource or ecosystem services, who receive benefits from it. Direct use values can be for consumptive use or for recreational purposes.
Economic value	Monetary measure of people's wellbeing related to the change(-s) in quality or provisioning of environmental good or service. It is related to the willingness to pay or willingness to accept compensation for this change(-s). It should not be confused with monetary value or financial value.
Ecosystem services	Gains from natural ecosystems that mankind uses and benefits from. Ecosystem services include four broad categories: provisioning, regulating, supporting, and cultural services.
Existence value	One of non-use values. It measures the value that people put on the existence of environmental good or service, for instance,

	the Amazonian forest, even if they might never actually use this good or service.
Fractional factorial design	Statistical experimental design, which is applied to narrow down the number of choice sets that will be used in the stated preference survey.
Free-rider	Individual, who takes advantage of the benefits of a good (usually public good) without paying for it.
Gamification	Concept of applying game design, mechanics, and features to a non-game context, such as environmental research. It is aimed mostly at attracting, engaging, and motivating participants to a certain project or cause.
Heterogeneity	Scientific term for the word *diversity*. It is an opposite of homogeneity. Heterogeneity is used in statistics to explain the lack of uniformity in population sample, experimental design, etc.
Independence of irrelevant alternatives (IIA)	Axiom in decision theory and social sciences. It indicates that the relative probabilities of two alternatives are independent of the introduction or removal of other alternatives, and therefore their choice will not be affected by these changes. Also known as binary independence or the independence axiom.
Indirect use value	One of the components of the total economic value of environmental good or service. It measures the benefits that individuals receive from environmental good or service by not using it directly. Examples are water purification, carbon sequestration, pollination, etc.
Logit model	Statistical regression, where the dependent variable is categorical: it takes on one of a limited, and usually fixed,

	number of possible values. Also known as logistic probability unit or logistic regression.
Non-use value	One of the components of the total economic value of environmental good or service. It measures the value that people put on the environmental good or service, which they do not intend to use themselves. Components of non-use values are altruistic, bequest, and existence values.
Non-market good	Category of goods, characterized by the fact that their economic value is not revealed in market prices. For this reason their economic valuation relies on non-market techniques, such as stated preference technique. Examples of non-market goods are clean air, clean water, wildlife habitat, biodiversity, etc.
Payment vehicle	Representation of monetary value of environmental good or service. This is a specific type of payment mechanism that is decided in exchange for benefits of the good or service. Payment vehicle can be a market price, entrance fee, tax levy, voluntary donation, etc.
Pilot survey	Early version of a survey used to test its design and structure among a small sample of population prior to preparing and releasing the main survey.
Protester	Individual, who expresses the value of willingness to pay or willingness to accept compensation that is either zero or unrealistically high. In such way he/she protests against different aspects of the valuation scenario, survey design, and/or underlying economic theory.
R software	On-line software with language and environment for statistical computing and graphics. Similar to R are such software packages as Stata, SAS, and SPSS.

Regression	Set of statistical procedures aimed to estimate the relationships among different variables. More specifically, regression helps to understand how the typical value of the dependent variable changes when one of the independent variables is varied, while the other independent variables are held fixed.
Reliability testing	Form of valuation of study results. Along with validity testing, it ensures that the economic valuation method used has produced reliable estimates of willingness to pay or willingness to accept compensation. Reliability refers to the degree of replicability of these results. In other words, one should be able to rely on them in giving the same estimates in repeated experiments under controlled conditions. However, it is possible to have a highly reliable study results, but it does not imply that they are valid as well. To verify that validity testing should be used.
Stated preference (SP)	Economic valuation technique, which is based on interviews and surveys eliciting respondents' willingness to pay or willingness to accept compensation for environmental good or service. This is the only economic valuation technique able to elicit non-use values of a good. It includes such approaches as contingent valuation and choice modelling.
Status quo	Baseline / no-change scenario in an economic valuation survey, which represents the current situation of environmental good or service. By choosing status quo, an individual shows preference for the "do-nothing" policy.
Substitute good	Certain good that can be used instead of another good. This is a product or service that an individual perceives as similar or comparable, so that having more of one product or service makes him/her desire less of another one.

Total economic value (TEV)	Aggregated measure of the economic value of environmental good or service. It includes use and non-use values of that good or service.
Use value	One of the components of the total economic value of environmental good or service. It measures the value that users of the environmental good or service put on it. Components of use values are direct and indirect use values.
Validity testing	Form of valuation of study results. It indicates how successful the survey has dealt with possible biases and how close its results reflect the true willingness to pay or willingness to accept compensation of the respondents.
Willingness to accept compensation	Monetary measure of the value of what an individual is willing to receive as compensation in order to allow negative changes to environmental good or service or to stop benefitting from it.
Willingness to pay	Monetary measure of the value of what an individual is willing to pay / to give up in order to benefit from environmental good or service or to avoid the loss of it.

Indexes

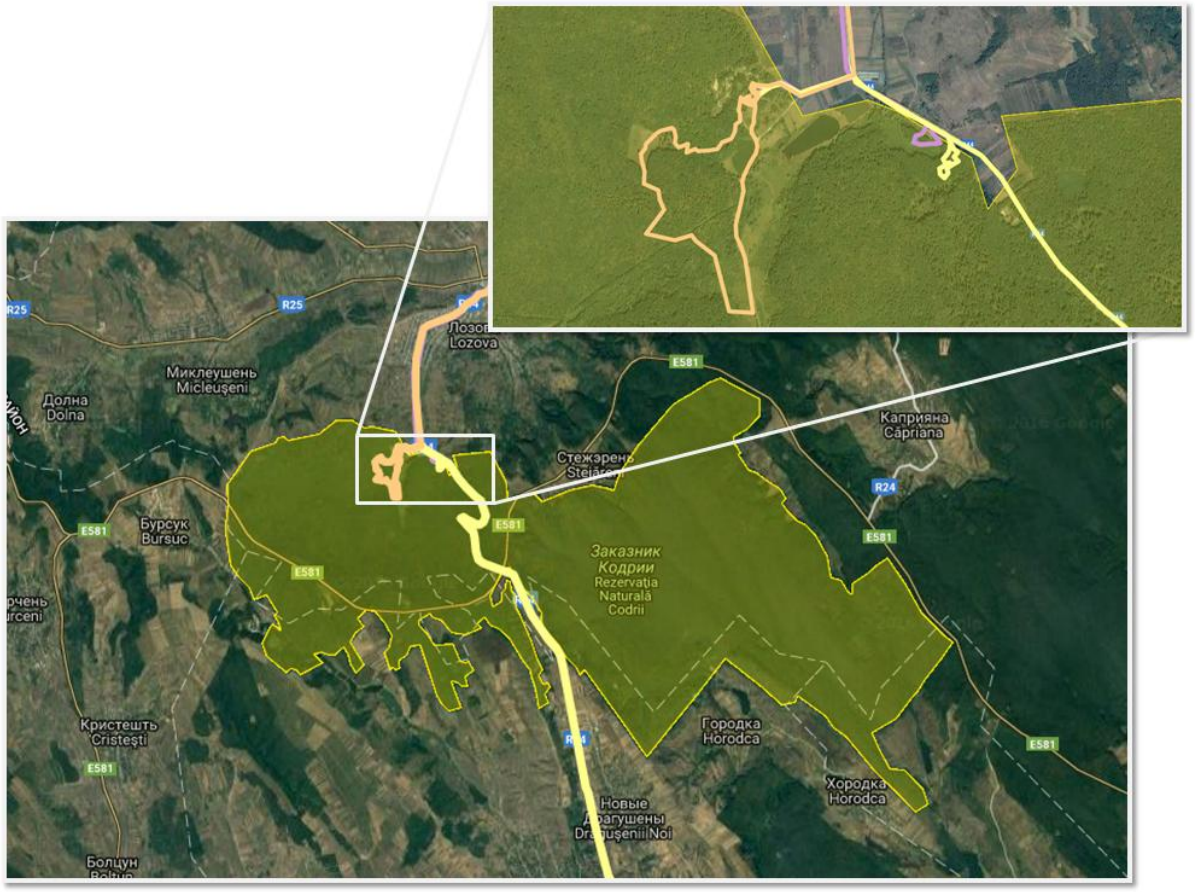
Annex

Annex A. Links to Surveys, Datasets, and Publications of the Codru Quest Project.

#	Title	Brief Description	Link Address
On-line Resources			
1	The Codru Quest	Official web page of the Codru Quest project.	http://megaimpact.md/the-codru-quest
2	The Rufford Foundation: The Codru Quest	Web page of the project with its updates on the website of the Rufford Foundation.	http://www.rufford.org/projects/alexandr_iscenco
3	MEGA Blog: The Codru Quest	Stories about the Codru Quest research work on the MEGA Blog.	http://blog.megageneration.com/tag/the-codru-quest
4	MEGA Game: The Game with Impact	On-line gamification platform MEGA Game with the Codru Quest and its missions.	http://megagame.megageneration.com
Surveys			
5	The Codru Quest: Your Choice (Phase I)	Pilot version of the choice modelling survey used in the Codru Quest project.	EN: https://goo.gl/forms/NfRIo6Ke7246wdvr2 RO: https://goo.gl/forms/LHdm2glFhmrTaXjh2
6	The Codru Quest: Your Choice (Phase II)	Final online version of the choice modelling survey used in the Codru Quest project.	EN: https://goo.gl/forms/dePBm9ttic6pp9CV2 RO: https://goo.gl/forms/HEQep3Vpo4djonne2 RU: https://goo.gl/forms/qEBUQJAnlHpdtvTh1
7	The Codru Quest: Your Choice (Phase II)	Final printed version of the choice modelling survey used in the Codru Quest project.	EN: https://issuu.com/megageneration/docs/mega_-_the_codru_quest_-_your_choic_c693af527b6995 RO: https://issuu.com/megageneration/docs/mega_-_the_codru_quest_-_your_choic_c9097d54277bdf RU: https://issuu.com/megageneration/docs/mega_-_the_codru_quest_-_your_choic_647c2192c3e2c0

#	Title	Brief Description	Link Address
Datasets			
8	The Codru Quest: Datasets	Datasets for Phases I and II with separation into city and village residents.	https://goo.gl/DJE4KD
9	The Codru Quest: Final Dataset	Dataset with final WTP data from Phase II.	https://goo.gl/X35DBh
10	The Codru Quest: Socio-economic Data	Dataset with socio-economic data of the respondents from Phase II.	https://goo.gl/xPr2st
11	The Codru Quest: Codru.RData	Data from Phase I processed in the R software.	https://goo.gl/iffLiA
12	The Codru Quest: Codru2.RData	Data from Phase II processed in the R software.	https://goo.gl/KEhUfv
Publications			
13	The Codru Quest: Phase I Results. Second edition	Summary of raw WTP data and feedback collected with the pilot version of the survey.	https://issuu.com/megageneration/docs/mega_-_the_codru_quest_-_phase_i_re_7d8864fd8d80bd
14	The Codru Quest: Methodology	Methodological guidebook to economic valuation with choice modelling technique based on the Codru Quest project.	https://issuu.com/megageneration/docs/mega_-_the_codru_quest_-_methodolog

Annex B. Expeditions to the Codru Nature Reserve and the Codru Forest done within the Codru Quest Project.



Legend:

-> First expedition to investigate the state of the Codru forest ecosystem and biodiversity;

-> First expedition with the first respondents to the forest and the Museum of Nature;

-> Expedition with the guided excursion to the buffer zone of the Codru Nature Reserve.

Source: Google Maps, 2017.

Annex C. Photos representing Ecosystem Services and Biodiversity in the Codru Nature Reserve and the Codru Forest taken during the Codru Quest Expeditions.

Photo C1. 3D map of the Codru Nature Reserve in the Museum of Nature.
Source: Alexandr Iscenco, 2016.

Photo C2. Farms and orchards near the Codru Nature Reserve and the Codru forest.
Source: Alexandr Iscenco, 2016.

Photo C3. Entrances to the territory of the Codru Nature Reserve. Source: Alexandr Iscenco, 2016.

Photo C4. Inside the Codru forest in summer and autumn. Source: Alexandr Iscenco, 2016.

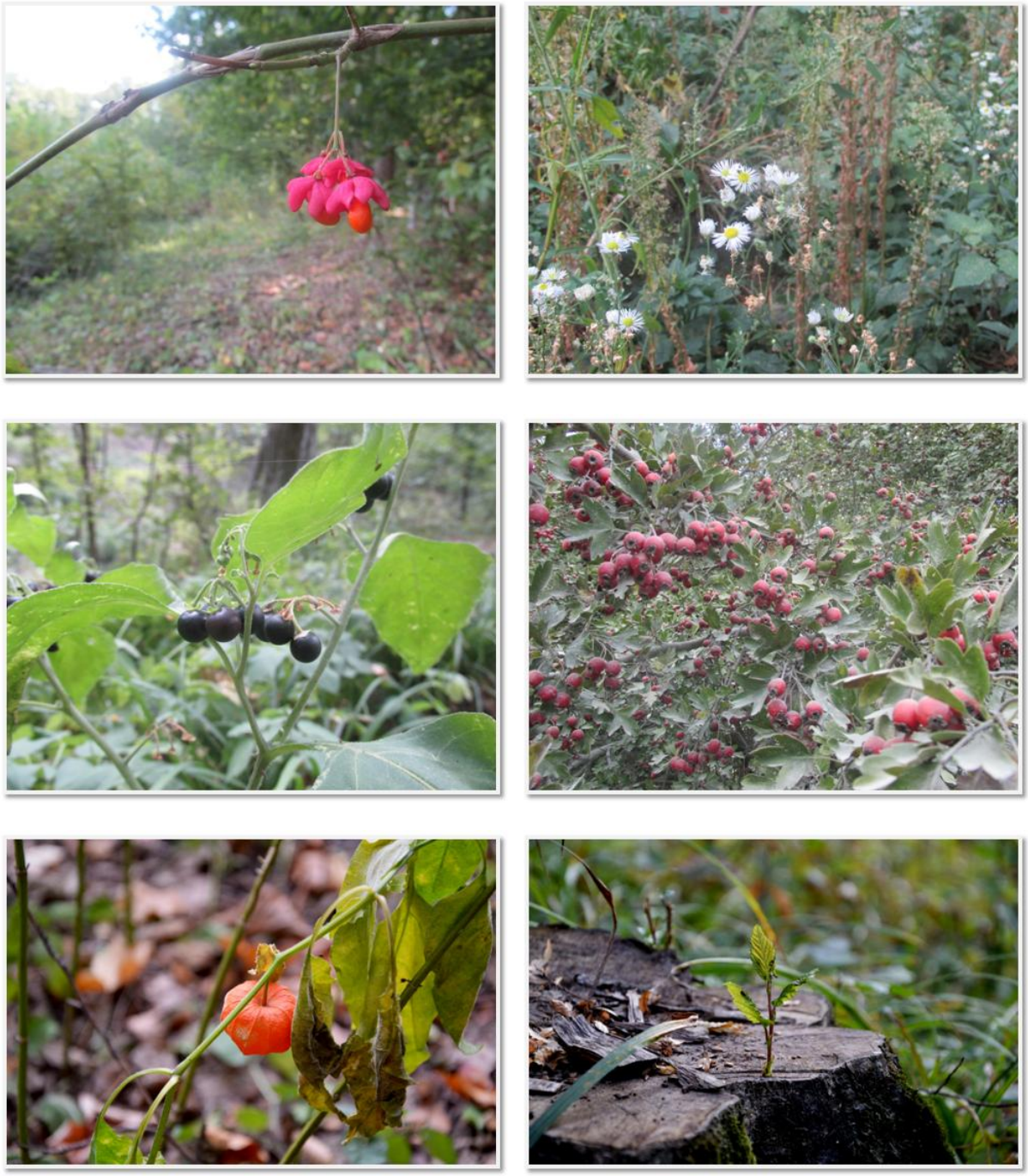


Photo C5. Samples of biodiversity of plants in the Codru forest.

Source: Alexandr Iscenco, Cornelia Sirbu, 2016.

Photo C6. Small-flowered black hawthorn (*Crataegus pentagyna*) included in the Red Book of Moldova with the status of critically endangered species. Source: Alexandr Iscenco, 2016.

Photo C7. Samples of biodiversity of fungi in the Codru forest. Source: Iuliana Sipitca, 2016.

Photo C8. Samples of biodiversity of insects in the Museum of Nature, including stag beetle (*Lucanus cervus*) listed as endangered species in the Red Book of Moldova. Source: Alexandr Iscenco, 2016.

Photo C9. Samples of biodiversity of insects in the Codru forest.

Source: Alexandr Iscenco, 2016.

Photo C10. Samples of biodiversity of other animals in the Codru forest.

Source: Alexandr Iscenco, 2016.

Photo C11. Samples of biodiversity of other animals in the Museum of Nature.

Source: Alexandr Iscenco, 2016.

Photo C12. Evidence of human activities in the Codru forest.

Source: Alexandr Iscenco, Gabriela Isac, 2016.

Dear Friend,

We, the researchers from MEGA, hope you have found the publication "The Codru Quest: Final Report" relevant and valuable for your environmental study, cost-benefit analysis, land use, planning, environmental policy proposal, or any other uses.

We welcome your comments and feedback on the design of the Codru Quest project, the methodology used in it, the final results, and our discussion and conclusions on their basis.
To share them with us,
please visit our website www.megageneration.com,
or send us a message to hello@megageneration.com.

We wish you MEGA great success in your own environmental projects, studies, and endeavours!

Yours Truly,
The MEGA Team

MEGA, 2017. The Codru Quest: Final Report.
Prepared by: Alexandr Iscenco, Elena Ungureanu, Evdokia Roidou, Felipe Fausto, and Tim de Kruiff
Design: Alexandr Iscenco

Playing for Impact