Food and Agriculture Organization of the United Nations

The Regional Environmental Centre for Central Asia

ASSESSMENT OF ECOSYSTEM SERVICES IN KYRGYZSTAN

GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

ASSESSMENT
OF ECOSYSTEM SERVICES
IN KYRGYZSTAN

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Preface

This book was prepared upon an initiative of the GEF/FAO project on “Sustainable Management of Mountainous Forest and Land Resources under Climate Change Conditions”. It is based on the international experience in implementing the principles of ES provision, the results of CAREC projects on the assessment of ES and PES, the report of the UNDP/UNEP Poverty and Environment Initiative on the assessment of ES of the Chon Kemin State Natural Park and the Karakol National Park, and other materials.

This publication does not necessarily reflect views of FAO, UNDP, UNEP, and other UN agencies and organizations.

Edited by Rodina E.M., DScTech, Head of the “Sustainable Development of Environment and Life Safety” Head of chair of the Kyrgyz-Russian Slavic University

List of abbreviations

SAEPF	State Agency for Environmental Protection and Forestry
SNP	State Natural Park
UNECE	UN Economic Commission for Europe
IPCC	International Panel on Climate Change
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
NABU	National Anti-Corruption Bureau of Ukraine
NSC KG	National Statistical Committee of the Kyrgyz Republic
NGO	Non-governmental organization
PA	Protected area
OECD	Organization for Economic Cooperation and Development
TEV	Total economic value
UNDP	United Nations Development Program
PES	Payments for ecosystem services
CAREC	The Regional Environmental Centre for Central Asia
KB CAREC	Kyrgyz branch of the Regional Environmental Centre for Central Asia
REDD	Reducing emissions from deforestation and forest degradation
RWUA	Rural water users associations
SEEA	System of Environmental Economic Accounting
SDGs	Sustainable Development Goals
EEA	Experimental Ecosystem Accounting
ES	Ecosystem services
UNEP	United Nations Environment Program

UNCED	United Nations Conference on Environment and Development
CICES	Common International Classification of Ecosystem Services
ESMC	Ecosystem Services Market Consortium
MAES	Mapping and Assessment of Ecosystem Services
MEA	Millennium Ecosystem Assessment
PAGE	Partnership for Action on Green Economy
TEEB	The Economics of Ecosystems and Biodiversity
WRI	World Resources Institute
STATA	Integrated statistical software package that provides all your data science needs
SPSS	Statistics are Proprietary statistics software solutions

Introduction

Ecosystems provide a range of services that are absolutely necessary not only for sustainable functioning of the environment, but also for economic and social development. While the demand for these services is constantly increasing, the capacity of ecosystems to provide such services is decreasing as a result of their growing degradation, which reduces the prospects for sustainable development. This situation is caused by a number of reasons, and not only by the economic growth and demographic changes, in particular, by the fact that the value of such environmental services is often ignored and, therefore, not taken into account in the decisions-making. Decision makers prefer investing, for example, in the water infrastructure (e.g. dams to prevent floods, drinking water purification facilities), then in the measures to improve water ecosystems for lowering the risk of floods and ensuring water purity.

In recent years, the innovative financing mechanisms, and in particular, PES have been recognized as an important tool to address a number of specific environmental management gaps. The importance of PES is that it allows taking environmental issues into account. If serious environmental issues arise, but financial resources are limited, PES can attract additional alternative resources, reallocate funds to the environmentally sound technologies and efficient production methods, create conditions to encourage investments and increase participation of the private sector in the issues of environmental protection.

This book prepared by a team of authors is intended for decision makers on the environmental management, as well as for students of the environmental and economic disciplines. It explains how PES can solve the problems of natural resource management, and what legal, administrative and institutional mechanisms are needed for PES implementation. It covers the issues of ecosystem assessment, and the fundamental principles of various PES mechanisms. It also highlights other measures of supporting the implementation of PES.

I. Key definitions of ecosystem services

1.1. Definitions of ecosystem services

Currently, the importance of such issues of economic development as uneven economic growth, environmental pollution, social inequality is increasing. These problems have a growing impact on the economy, social life, and, so the importance of such models and methods, which consider the influence of these factors for socio-economic growth, is significantly increasing.

To address these and other issues, the Sustainable Development Concept was adopted at the UN Conference on Environment and Development (UNCED) in 1992, one of the main principles of which is the need to simultaneously carry out the processes of socio-economic development and environmental protection. The basis of this approach are the concepts of ecosystems and the services they provide.

The ecosystem approach was formally adopted by 182 countries at the Fifth Conference of the Parties to the Convention on Biodiversity in May 2000 in Nairobi, where it was described as a strategy for the integrated management of the land, water and biological resources, aimed at their protection and sustainable use based on the principle of justice.

Ecosystem services are the benefits and services flowing to human societies and are the results of the condition and the size of natural capital (TEEB, 2010). This definition is presented in a report of "The Economics of Ecosystems and Biodiversity" project, which has been implementing as part of the United Nations Environment Program (UNEP).

Currently, in literature there are several versions of the "ecosystem services" term. The UN's most widely accepted definition is: "Ecosystem services are the benefits that ecosystems provide to humanity."

The modern history of the ecosystem concept dates back to the early 70s of the last century with the publications, which raised public interest in the biodiversity conservation, defining the useful functions of ecosystems as a service. A term "natural services" was first used in the scientific literature in 1977, in the publication by W. Westman "How much are nature's services worth?" (Westman, 1977). A term "ecosystem services" was first mentioned in the work of P. Ehrlich and A. Ehrlich in 1981 (P. Ehrlich et al.,1981)

In 1970-80 there was a trend to discuss environmental issues in terms of economics in order to emphasize human dependence on the natural ecosystems. Specifically, in 1973, E. Schumacher used a term "natural capital", which in the future would significantly impact the modern practice of calculating macroeconomic indicators. The term is based on the concept of accounting natural production resources that society is endowed with. After E. Schumacher's publication, many scientists began to use the term *ecosystem (environmental, natural) services*. In the same years, a new interdisciplinary branch of knowledge, the ecological economy emerged. It was based on the close connection of the environmental and economic issues. From the very beginning, the ES have been an essential part of research in the field of environmental economics.

In 1995, a historic meeting for development and further spreading of the ES concept took place, when a group of scientists led by G. Daily, R. Costanza, P. Ehrlich et al., decided to publish a book on ecosystem services. More than 30 authors worked on the book, which was published in 1997, under the title: Services of nature: dependence of society on natural ecosystems (G. Daily et al., 1997). This collective monograph discussed the concept of ecosystem services, history, economic assessment, etc.

In 1997, R. Costanza with co-authors published an analysis of the studies on the value of ecosystem services, which showed a total value of the global ES accounting to USD 16-54 trillion annually (R. Costanza, 1997), an average of USD 33 trillion, which is twice the total value of the global gross national product. The article caused a huge number of both positive and negative opinions, and gave rise to the interest of the scientific community in further studies and assessment of the value of ecosystem services.

In late 1990s and early 2000s, the concept of ES was established in the international political arena as well. The Millennium Ecosystem Assessment report (MEA 2003, 2005), the result of the collective work (of more than 2000 authors) undertaken at the initiative of UN Secretary General Kofi Annan, is the key insight of the development of the ES concept in the political agenda. The purpose of the assessment was to describe a current state of the planet's ecosystems, and create a scientific basis for the actions required for their conservation and rational use for the benefit of mankind.

The next important step in the development and practical use of the concept of ES was the approval of the global initiative The Economics of Ecosystems and Biodiversity (TEEB), the resolution on which was adopted at a meeting of the environmental ministers of G8 + 5 in 2007. The study focuses on the benefits received from biodiversity by the global economy, price to pay for its loss and refusal to take protective measures compared to the efficient environmental management (TEEB, 2017). The TEEB publications for various fields of activity: for business and production, for decision-making at the national and international level, in the local and regional politics, etc., create the basics for mainstreaming the economic values of biodiversity and ecosystems in the decision-making mechanisms. The TEEB research programs work in many countries, assessing the value of natural capital and ES of both the countries and regions as well.

In 2015, the UN General Assembly, including heads of states and governments, approved the 2030 Agenda for Sustainable Development, which set new benchmarks for environmentally responsible activities for governments, private sector, and civil society organizations. ES are included in the Sustainable Development Goals, in which a commitment was made to "ensure conservation, restoration and rational use of the terrestrial and inland freshwater ecosystems and their services".

Currently, the researching, practical accounting and monitoring of the ES are conducted in many countries at the government level. Application developments on the inclusion of ES in the economic practice, in the financial sector, the so-called Green finance, Green economy are emerging. In 2019, the first Ecosystem Services Market Consortium (ESMC) was created to finance farmers and land owners who use sustainable land management practices, reduce greenhouse gas emissions, improve water quality, etc.

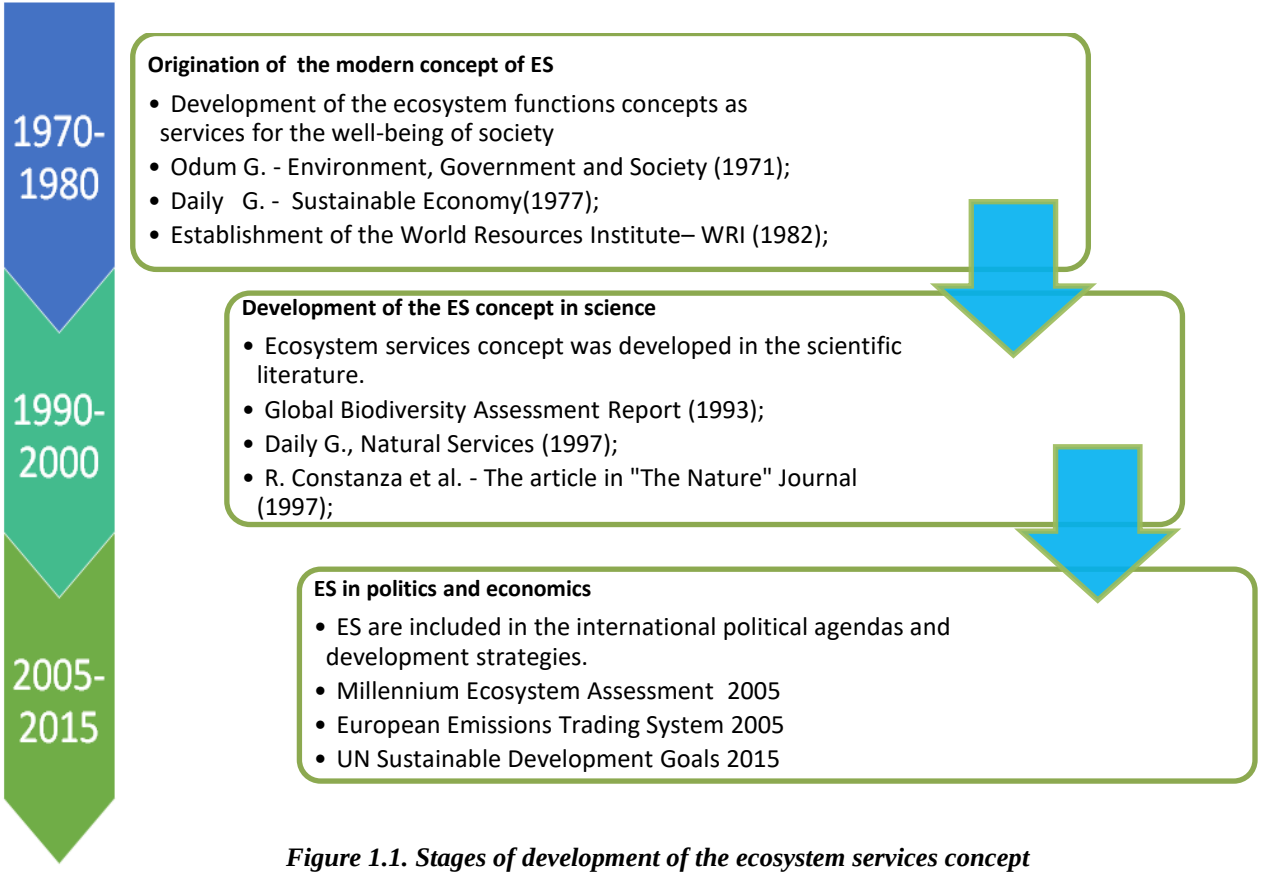


Figure 1.1. Stages of development of the ecosystem services concept

The categories of ES

Currently, the most part of the research papers on ES are dedicated to the development of the schemes of classification, terminologies, and definitions. There are three main international classifications of the ES categories:

1. Classification in the report of the international program Millennium Ecosystem Assessment (MEA). This classification is used at the global ES assessment level.
2. Classification of the international project TEEB is used to assess ES at the national level.
3. The most detailed and comprehensive classification system of the European Union is the "Common international classification of ecosystem services" (CICES), which focuses more on the economic assessment of ES, and mainstreaming ES at the national, regional and local levels.

These classification systems include three main groups:

Provisioning services - material benefits and resources generated by the ecosystems used by humans (drinking water, natural materials, wood, fish resources etc.). This group of services is quite easy to identify, account and assess, since many of the indicators used here are directly related to the indicators of economic activity.

Regulating services - natural environmental mechanisms providing climate control, soil protection, water treatment, pest control, flood prevention, etc., which affect human well-being. Regulating services are difficult to assess as a benefit for individuals or companies, since the benefits of these services concern society as a whole in the form of reducing the risk of negative impact.

Cultural services - benefits received by people from the use of natural environment for recreational, cultural, scientific and spiritual purposes. An example of the cultural services is the value of a beautiful landscape, picturesque views, sacred places. From the commencement of the ES concept, an

assessment of cultural services has gained popularity, people often consider the value of cultural services higher than the provisioning ones.

The MEA and TEEB classifications include the fourth group: **supporting services –** the processes indirectly providing possibility for the ecosystems to function, therefore, the provision of ES as well. Such processes as nutrient cycle, photosynthesis, soil formation, biodiversity are not direct benefits from ecosystem and it is very difficult to assess them.

The differences between classifications come from the fact that the category of "supporting services" used in the Millennium Ecosystem Assessment can actually be attributed to the ecosystem functions or processes. TEEB uses a different category instead of the term "supporting services" - services on the formation and maintenance of habitat (habitat services). The 2017 CICES classification does not have the fourth category, thus "supporting services" are included in the regulating services (Regulation and Maintenance).

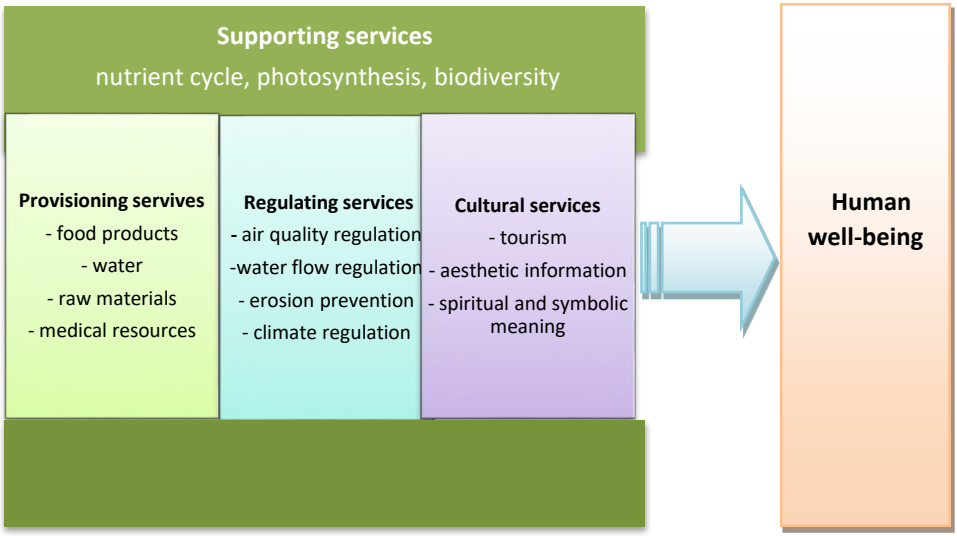


Figure 1.2. The categories of ecosystem services

Table 1.1. Comparison of various ecosystem services classification systems

	MEA	TEEB	CICES 2017
Provisioning services	Food products, Livestock feed Fresh water Wood, Fiber Genetic resources Biochemical components Decorative resources	Food products Water Raw materials Genetic resources Medical resources Decorative resources	Biomass (food) Water Biomass (wood, energy and other materials) Biomass – mechanical energy
Regulating services	Air quality regulation Water purification Climate regulation Water regulation Erosion regulation Soil formation (supporting service) Pollination Pest Regulation Disease Regulation	Air quality regulation Water purification Climate regulation Water flow management Mitigation of extreme events Erosion prevention Maintaining soil fertility Pollination, Biological control	Gas and air flows regulation Regulation of the climate and atmospheric composition Regulation of liquid flows Waste and toxicants management Solid flow control Regulation of soil composition Life cycle support, protection of habitats and gene pools Pest and disease control
Supporting services	Nutrient cycle, photosynthesis	Life cycle support	Life cycle support, protection of

	MEA	TEEB	CICES 2017
	Primary productivity Biodiversity	Conservation of genetic diversity	habitats and gene pools
Cultural services	Recreation and ecotourism Aesthetic value Cultural diversity Spiritual and religious significance Knowledge and the value for education	Recreation and tourism Aesthetic Information Importance for culture, art and design Spiritual experience Information for cognitive development	Physical interactions, experience Intellectual interactions Spiritual and symbolic meaning Intellectual and representative interactions Spiritual and symbolic value

Along with the above basic classifications, there are many others. For example, in Russia, to assess ecosystem services, they use an approach based on the characteristics and functions of the natural ecosystems and on the possible consequences for natural ecosystems caused by the use of ES by humans (Bukvareva E.N. at al., 2016). In United States of America is using the National ES classification system - (National Ecosystem Services Classification System (Landers F., 2015) similar to CICES, which was developed by the Environmental Protection Agency in the United States of America.

1.2. Payments for ecosystem services: basic terms

The main idea of the ES concept is to use economic and market mechanisms to conserve ecosystems and biodiversity. Before this, the basic mechanism of the environmental protection was the "polluter pays" principle, which represented a wide range of limits, penalties, sanctions and taxes, intended to compensate for the harm being caused to nature. According to scientists' estimates, the polluter pays principle is able to repay no more than 1/10 of the real cost of the environment damage. The 2008 UNEP study

found that global environmental needs amount to USD 6.6 trillion, or 11 percent of the global GDP, and may reach USD 28.6 trillion by 2050 (UNEP FI, 2010).

Environmental taxation is aimed at compensating for losses caused by various types of economic activity and at maintaining the quality of the environment within the basic level, as defined by the legislation and standards of the environmental protection. The laws and regulations are aimed at controlling and monitoring the state of the environment and its compliance with a certain basic level. The environmental degradation caused by economic activities is punishable by fines and compensation for damage, while its improvement is usually not encouraged at all, and this does not give sufficient motivation for economic entities to restore and preserve ecosystems.

Another weakness of this principle is that the collected payments often go not towards improving the environment directly at the place of the damage, but are directed to the state budget, from where they are allocated according to the approved plans, which does not always allow conducting prompt environmental protection activities.

A new effective economic instrument that can overcome some of the shortcomings of the "polluter pays" principle and complement it, is the Payments for Ecosystem Services mechanism (PES), which is designed to support conservation and rational use of all natural capital functions.

According to a definition of UNECE, PES means "a contractual deal between buyer and seller in relation to an ecosystem service or land use/management practice capable of providing such a service".

PES is a voluntary agreement where the recipient of a service encourages the provider to provide an ecosystem service, if the provider ensures the quality of the service in order to conserve the ecosystem.

Unlike the "polluter pays" principle, which requires payment for a permit to use natural resources, the PES mechanism allows to receive financing to improve the quality of ES and sustainable use of natural resources.

PES is working at various levels, the local, regional and national ones. The largest number of projects is observed at the local and regional levels. The PES schemes at the national and international level are not widely spread and require finalization of the regulatory documentation.

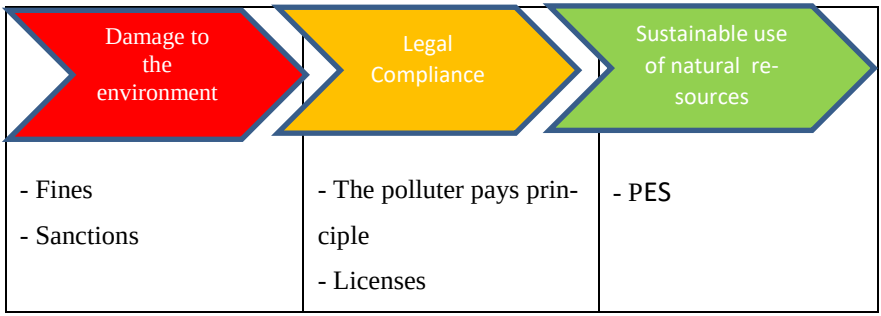


Figure 1.3. Payments of ecosystem services and the polluter pays principle

In the development of the PES mechanism, various schemes have been summed up in terms of agreements between participants, payment methods and participation of sellers and buyers of ecosystem services. In the framework of the general classification, the following main PES schemes can be distinguished:

Private PES schemes (User-financed PES) – the users of ES agree to pay landowners for the ES they provide. Users can be companies, NGOs, private individuals, farmer associations, or community organizations.

Government-financed PES – The main buyer of ES is the government, represented by the government, local governments or municipalities. Programs are carried out at the local or national levels, for example, the forest conservation programs to protect from floods, improvement of water quality and other ecosystem services.

Public-private schemes – the government allocates funds from the state budget to the owners of land, pastures and acreages to maintain or improve the existing ES.

Commercial exchange schemes (Compliance PES) – a party that exceeds its environmental pollution limits compensates and finances other parties that maintain or improve comparable ES in exchange for a standardized loan. These schemes imply founding markets for exchange, sale or lease of the established rights or quotas, for example, a market for trading in quotas for the greenhouse gas emissions, water quality, and wetlands.

Economic instruments of Payments for ecosystem services

PES schemes use a variety of financial mechanisms to charge recipients and pay compensations to the providers of ecosystem service.

The most widely used instruments are:

1. **Direct public payments**. Payments are made by the government directly to the entities providing ES. This form of payments is the most typical, there is a growing number of projects supported by the governments of various countries. The main scheme is when the government pays landowners for changing the land-use practices towards more environmentally sustainable ones.
2. **Direct private payments.** Payments are made according to the scheme above, but a financing party is not the government, but NGOs or companies that act as beneficiaries of ES.
3. **Tax incentives and reliefs.** This instrument is a form of indirect government compensation for landowners who agree to maintain the quality of ES provided in their territory, for example, switching to the organic farming or agreeing for the conservation easement, which establishes the regime of a protected area on their site.
4. **Limitation and emissions trades.** Government or a regulatory body sets acceptable limits for the degree of environmental degradation or pollution permitted in the area (hunting licenses, fishing permits, etc.)

5. **Voluntary markets.** These are the markets where buyers and sellers conduct transactions on a voluntary basis, for example, Voluntary Carbon Market.
6. **Certification programs.** Buyers choose certified products, thereby paying not only for the product, but also for how it was produced. These are the products labeled as organic, eco-friendly, etc. Thus, manufacturers are encouraged to use environmentally friendly production methods.

Payments for ecosystem services practices

The most widespread practice is the use of **PES for water resources**. This is explained by the fact that at the facilities related to water resources, it is quite easy to identify direct suppliers and beneficiaries of ES and develop the schemes of PES movement. For example, all participants of the scheme will see the relationship between the land management upstream and the quality and amount of water received by residents living downstream. In the last 20 years, many successful projects on improving the quality of water through implementation of the PES schemes have been implemented, and the number of such programs is increasing every year.

Biodiversity and environmental protection

PES in this sphere is difficult to develop and assess, because the number of ES beneficiaries is very wide, and it is practically impossible to evaluate direct and indirect benefits they obtain. Basically, the PES biodiversity programs are subsidized by the government and implemented by local NGOs.

Forest resources and land use

The use of carbon credits from the market mechanisms and activities in the field of land use, the changes in land use and forestry is an example of successful implementation of PES schemes at the global and local levels.

The main tools for carbon offset projects are the afforestation and reforestation programs, the improved forest management, sustainable land use in agriculture, and the reduction of emissions from deforestation and degradation of forests (REDD program).

1.3. Ecosystem services assessment methods: economic and other methods

The unsustainable use of natural resources is the result of underestimation of ES. Assessment of ES is carried out through various approaches and methods, the selection of which depends on the availability of the necessary reliable and high-quality data. The problem is complicated by the fact that some types of ES are extremely difficult to assess - it is almost impossible to evaluate the cultural and aesthetic aspects in monetary terms, it is difficult to assess supporting and regulating ES as well. The methodology of ES assessment is constantly developing, and as new studies conducted, the new methods are being presented, while the old ones are improved, and an economic assessment of ES is supplemented by the quantitative and qualitative characteristics. Such integrated assessment allows to move away from the monetary categories, and include those ES that usually not taken into account in decision-making by local authorities, in the management system.

When drafting long-term development policies in the environmental and economic sphere, it should be kept in mind that the monetary value of ES represents only a small part of the total value of ES (Figure 1.4).

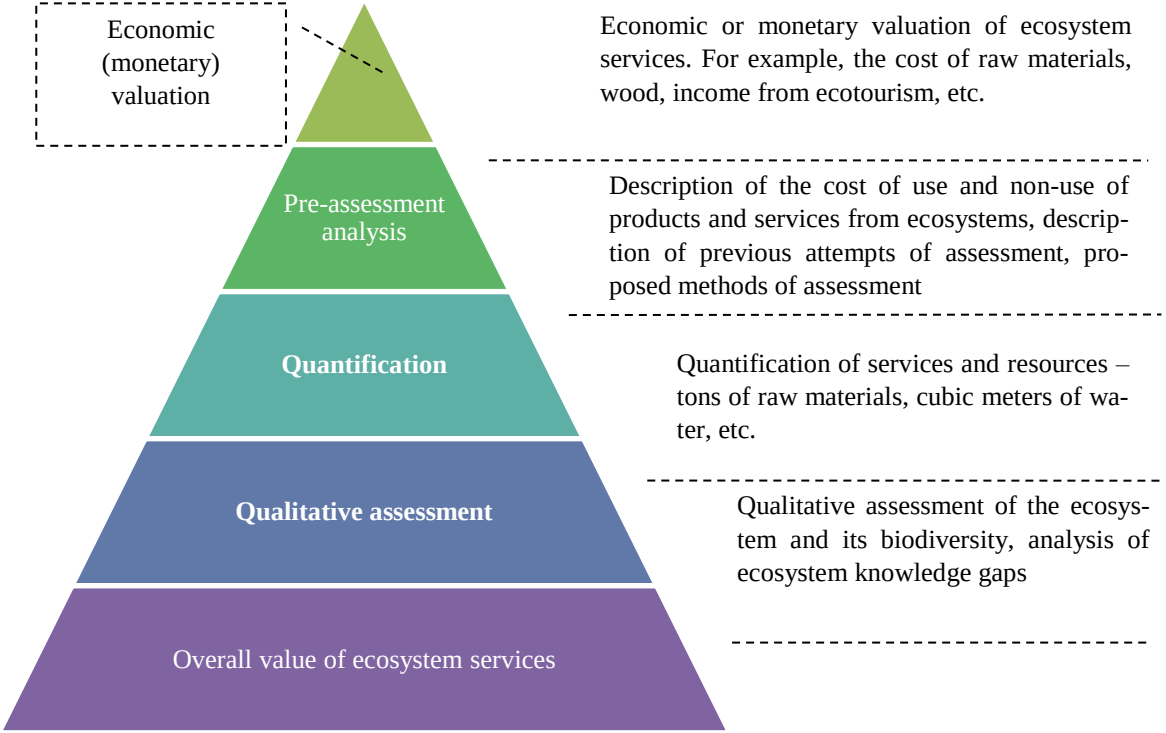


Figure 1.4. Pyramid of the ecosystem services assessment.

Economic assessment of ecosystem services

A methodological basis for assessing ES is the concept of the total economic value of natural benefits (TEV), which is instrumental in choosing a method for assessing any ecosystem service. TEV is recognized worldwide and almost all scientific and empirical work is based on it.

According to this concept, TEV includes the values of use and non-use.

TEV = UV + NUV (1)

where TEV - Total economic value;

UV - Use Values;

NUV - Non-use Values.

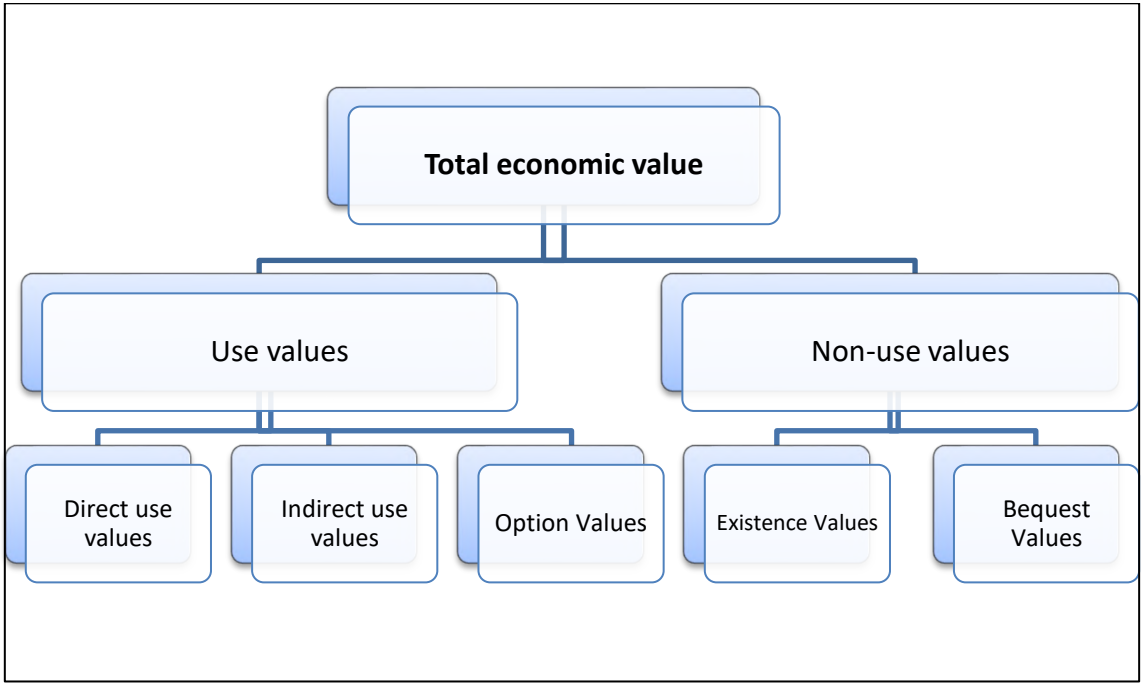


Figure 1.5. Total economic value and its components

Next, the use values are the amount of three sums:

UV = DUV + IUV + OV (2)

where DUV- Direct Use Values;

IUV - Indirect Use Values;

The non-use values, in turn, consist of:

NUV = EV + BV (3)

where EV– Existence Values;

BV– Bequest Values

Thus, the total economic value consists of five parts

TEV = DUV + IUV + OV + EV + BV (4)

The right side of this formula is the most difficult in practice, while the left side is more understandable. This is often because the left part of TEV has a direct market value and, therefore, the ES assessment in this case, is quite simple in terms of methodology.

As a rule, after the ES valuation, the data is used to analyze the benefits and costs to make a decision on the future use of the resource. The bottom line of the analysis is to compare benefits and costs, and it looks as follows:

$$NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t} \quad (5)$$

where: NPV – Net present value, B_t – Benefits for time t,

C_t – Benefits for time t, i – interest rate, n –number of intermediate periods

$$(B + B_e) - (C + C_e) > 0 \quad (6)$$

where B_e — environmental and economic effect of the project/program

C_e - environmental and economic damage of the project/program.

Table 1.2. Total economic value and ecosystem services.

Type of ES according to Millennium Ecosystem Assessment	Direct use	Indirect use	Option values	Non-use values
Provisioning	V		V	
Regulating		V	V	
Cultural	V		V	V
Supporting	Supporting services are included in other categories of the ES and are evaluated through them.			

Source: Adapted from Defra (2011)

As can be seen from Table 1.2., depending on the type of ES, they relate to a specific part of TEV. For example, provisioning and cultural ES fall under the direct use, while the regulating ES fall under the indirect use (Sukhdev, P. et al., 2014).

There are several methods for evaluating ES. The choice of the method depends on the character of the value being assessed and the locality in TEV.

Table 1.3. Methods for assessing ecosystem services

Group	Methods	Brief description
1. Direct market prices	Market prices	Analysis of market prices and identification of costs, as well as a possible building of the supply and demand functions.
2. Market alternative	Replacement costs	It is based on the search for artificial solutions for alternative delivery of a certain ecosystem service.

Group	Methods	Brief description
	Avoiding damage	It is based on the calculation of costs that have been avoided due to a particular ecosystem service
	Production function	It is based on determining the added value of an ecosystem service based on its contribution to the production process.
3. Surrogate markets	I. Method of hedonistic pricing	A real estate market is reviewed , as well as additional sums paid for a higher quality of the environment, for example, the presence of vapors near the place of housing.
	II. Method of costs	It is based on the calculation of the costs of visiting facilities: cost of the trip (travel, use of a car, etc.) and cost of the recreation time to build a demand function.
4. Established preferences	I. Contingent assessment method	It is based on a subjective assessment during the survey, how much the respondent is willing to pay to obtain more specific ecosystem services.
	II. Choice Experiments	A set of choices is proposed with various levels of ES and various costs. Which options are preferred?
5. Joint	Joint environmental assessment	Survey of the community members to determine the importance of non-market ES compared to the goods and services available on the market.
6. Benefits transfer	Benefits transfer	"Borrowing" or transferring a valuation from the existing study to obtain an approximate estimate for the current solution.

Market method

The market method, as its name suggests, assumes a market for this ES, i.e., ES has a market value and, as a rule, is freely exchanged between buyers and sellers. This method is based on the determination of the consumer and producer surplus. For example, medicinal herbs that are gathered by local people and sold to pharmacies. The value of this ES can be easily calculated if the volumes and prices are known. In this case, the costs associated with the ES gathering are usually also taken into account.

$$V = P * Q$$

where V – value, P – price, Q - quantity

Provisioning services are often assessed by the market method. The main advantage of this method is its simplicity and clarity. In the developing countries, prices may often be unavailable in the official statistics, so researchers are advised to collect data on the prices and volumes through field studies.

Alternative to the market method

If market prices are not available, indirect prices can be used, which are calculated using the following three methods:

- **Replacement cost,** i.e. the price of the alternative to the estimated ES. For example, spring water can be calculated at the price of water delivery.
- **Cost of the avoided damage**. For example, forests prevent soil erosion and protect the areas of the nearby communities from soil erosion.
- **Production function** is used to calculate the contribution of ES in the production of a certain product. The use of this method requires knowledge in the field of economic analysis and natural sciences

Surrogate markets

Another group of methods are the methods that reveal value by creating so-called surrogate markets:

- **Method of hedonistic pricing** uses the real estate market as a surrogate market. For example, an apartment block near the Erkindik Boulevard or another large park is more expensive than an apartment block located far from them. That means the price is changing depending on the environmental characteristics of real estate. The main weakness of this method is the hidden/implicit characteristics, which may correlate with the location of the real estate.
- **Method of transport costs** is based on the calculation of the costs associated with the trip, and the use of a particular ecosystem service. According to this approach, your costs for traveling to a certain place reflect the value that you give to the ES of this place. At that, it is necessary to use a detailed questionnaire on the expenses, motivation and demographic characteristics. The general methodology for calculating tourism is Zonal Travel Cost method. The essence of the method is the breakdown into zones and building a demand function.

Established preferences

A group of methods of the indicated preferences allows to take cultural and spiritual values into account, and at the same time is using the values of the "willingness to pay". This group is a complex and costly method, and the quality of assessment is largely determined by the quality of the preparation and implementation of a survey of the population.

- **Contingent valuation method** involves a survey of respondents, providing them with hypothetical environmental changes. For example, how many people in Bishkek are willing to pay

for maintaining the area of parks or getting compensation for their loss.

- **Choice modeling** provides respondents with various scenarios, where each scenario has different ES volumes, which allows revealing the respondents' margin preferences.

Perhaps this group is most susceptible to inaccuracy and data bias, due to its high sensitivity to the design and the use of this assessment. There is a long list of criteria necessary for the successful use of the identified preferences methods.

Benefits transfer

Another standalone method is a method of transferring benefits that implies the use of assessments already conducted in another locality and *the transfer* of these data on the object of assessment. This method is not that difficult to apply, but, usually, very difficult for justifying political decisions.

Let's see the order of the steps to assess the ES presented in Figure. 1.6.

Identification of territory

This is the most important step that will require a careful selection, and the quality of work will depend on this decision. In case the choice is available, as a rule, there is no single fundamental criterion, however a number of preferences exist. A properly selected territory must meet the following requirements:

- It must be an important source of ES that play a significant role in the economic and/or social life of the population;
- The territory is an important site in terms of biodiversity and ecosystem services;
- Availability and possibility to obtain data for assessment;

- Support and interest of the local population for sustainable use of natural resources of the site.

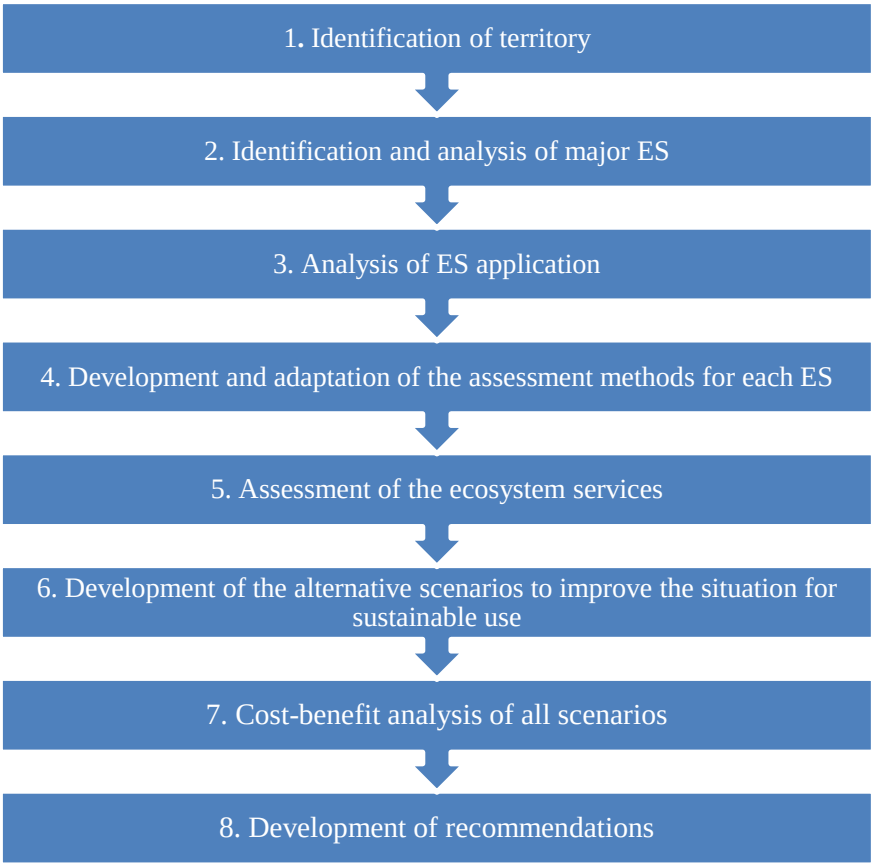


Figure 1.6. Steps of the ecosystem services assessment:

Often, these criteria are also added by the cases of irrational use of natural resources that lead to the degradation or disappearance of ecosystem services.

Identification and compiling a list of ES of the place

After selecting the territory, the next step is to identify its basic ecosystem services. This step includes dealing with the data describing the area, its biodiversity, ecology, geography, and the economics.

To achieve the best quality, the researcher should visit the place to add-on the conclusions obtained in the desk research. It is necessary to pay a special attention to the sources of income of the local population and find out if there are protected areas, or not. It is also very important to talk to local people for making a list of ES in the area. It is very useful to obtain the land-use cartographic database.

Selecting assessment tools for each ecosystem service.

After compilation of the list, it is necessary to split all ES into large categories. Then it will be clear what assessment methods are possible for these categories. When selecting the assessment tools, the below factors must be considered.

Financial opportunities

Required time

Quality of the available data

Whether unusual natural changes have taken place in the recent or present time (e.g., drought or floods)

A format of Table 1.4 is useful for selecting assessment tools.

Table 1.4. Selection of assessment tools

№	Ecosystem service	Method	Data
1	Picking mushrooms	Direct market	Information on the volume and price
2	…	…	…

If the data required for selection of an assessment method is unavailable, or it is impossible to obtain it, then it is necessary to choose another method for which data can be acquired.

Analysis of the existing data and primary information

The analysis of the existing data can significantly save time and finances of the researcher. Normally, the primary information directly related to the quantity and quality of ES is always available. For example, the socio-economic features of the place may give information on the availability and quality of the supporting services. For example, the existing tourism industry indicates the availability of cultural services. The primary data are very useful to assess supporting ecosystem services. The following data and materials can be the main sources of information:

- statistical reports of the government organizations, reports of the local government bodies;
- socio-economic data (population, livestock, land use, crop productivity, etc.);
- data on the existing market products (the sales volumes, cost of services, goods, etc.);
- scientific documentation, including researches in the nature conservation areas related to the functioning of ecosystems (for example, feeding potential of pastures), the species and numbers of plants and animals, etc.

Implementation of tools and the assessment

This step is operational only if the previous steps have been completed. If for any reason you doubt whether the previous steps were implemented, or question their quality, then it is advised to refrain from continuing their implementation. If you have doubts in the selected assessment tool, then it is better to double-check it, and hold back from starting the assessment. This step is most expensive in terms of time and financial resources.

If the selected tool requires field work, it is mandatory to pilot the area, prepare questionnaires and determine a focus group before starting the data collection. Interviewers must be thoroughly briefed, and all questions of the questionnaire should be tested during the selection of the pilot area or the focus group.

All assessment methods will require the basic knowledge in statistics, survey and eco-metrics. For more complex tools (for example, contingent assessment method), the knowledge in econometrics and building empirical models is required.

Summarizing and integrating into the management policies

The results of the ES assessment provide important quantitative and qualitative information for decision makers. A successful assessment provides useful information for implementing the decision in the sustainable development of the area, and will ensure well-being of local people, taking into account conservation of ecosystems and biodiversity.

As a rule, ES assessment is carried out to take certain political decisions. For example, local authorities are deciding where the highway of national importance shall pass: through forest or bypassing it. The first option may seem cheaper, however, assessment of the ES will reveal the exact net total economic value.

At the regional level, the results of ES assessment can be implemented within the benefit and cost analysis when making investment decisions, and for the development of social and economic policies. For example, assessment of ES enables revealing those benefits and revenues not covered by the national statistics.

At the national level, ES assessment can be implemented as part of the assessment of natural capital, through the system of the environmental and economic accounts. The compilation of such accounts is

important for the long-term national planning. The results of the assessment and the dynamics of such accounts shall be mainstreamed in the long-term development programs.

Qualitative and quantitative methods of ES assessment

Non-monetary methods of ES assessment, in contrast to the economic assessment represent valuation of the benefits and goods of ecosystems in the qualitative (good or poor condition), and quantitative values (the number of species conserved, the number of people affected, their property). Non-monetary assessments of ES are difficult to aggregate and analyze because the evaluation techniques, even for similar ES categories, may vary and be processed into different parameters.

The main methods of non-monetary assessment of ES are divided into advisory, biophysical and spatial methods.

The quantitative and qualitative assessment of ES is carried out through surveys, interviews with specialists, expert groups, focus groups and local people. These **consultative ES assessment** methods reveal people's attitudes to the environmental issues and concerns. The results can be expressed in scores (ranging from 1 to 10), in the qualitative definitions (deterioration or improvement of ES) (Christie, M.et al. 2012), and in the extended answers during interviews (expert opinions).

The consultative methods of ES assessment are carried out both individually and with expert groups. For example, when using the "Delphi" method, a group of experts are surveyed on a certain issue, to obtain a collective opinion with sufficient degree of reliability and credibility. The use of the method based on the analysis of public health allows to get information about the impact of ES on people living in certain locations (statistics of the diseases caused by the lack of access to clean water, air quality, etc.).

Biophysical methods of ES assessment are based on the objective measurements of the biophysical parameters with the use of the laws of thermodynamics. Unlike other methods, this one is not anthropocentric. For the analysis, the exergy and emergy concepts are used as objective characteristics of the quality of energy indicators, and do not depend on the economic factors.

Assessment of ES is carried out using the Howard Odum criterion and is based on the recalculation of all types of energy to a common basis - the sunlight energy (solar-equivalent joules) (Fominskay M.B. et al., 2014). So, it is possible to calculate the emergy of wood as equal to the amount of solar energy required to its production, the emergy contained in food, clothing, housing, etc.

Many researchers use a **spatial presentation of ES,** mapping ecosystems and their services, and creating maps of the supply and demand of ecosystem services. Such visualization of ES allows analyzing various parameters of ecosystems on the basis of various terrain maps, such as the maps of biodiversity, plants cover, topographic maps, and make a model of the potential of the ES provision. In addition, the development of the research using remote information, satellite imagery and three-dimensional terrain models allow not only to assess ecosystem services, but also to predict the likelihood of the risk of disastrous events.

II. Policy for implementing the concept of ecosystem services

The concept of ES was formulated in the late 1990s in order to define the economic value of natural ecosystems, environmental safety, environmental functions, and to ensure the interrelation of the environmental issues with the economic and financial instruments of the market economy (Konyushkov D., 2015).

The ES concept has been developing for more than 20 years. Its history is thoroughly reviewed in a collective monograph (Daily, 1997), and the history of the approaches to their assessment in the publication by Costanza et al. (2017).

This area of research is rapidly developing; over this period a lot of work has been done, ranging from the development of appropriate terminology to the interdisciplinary scientific field. Recently, the technologies for implementing the concept of ES into the sustainable natural resources management have been actively discussed. The main driving tool for this implementation is the policy that should guide the strive of Kyrgyzstan to rationally use its natural resources with consideration to ecosystem services.

Because of the increasing anthropogenic impact, the basis of many ES has been threatened. Among the main reasons are the imperfection of the traditional market model and the inefficiency of public policies, which do not take into account the values of ecosystem services. The root cause lies in the ignorance and inability of experts and specialists under people making decisions to assess the vast majority of ecosystem services. (Bobylev S.N., et al. 2009).

It is worth noting that throughout the world there is an acute need to assess the real economic value, the cost of the natural services and resources. In many countries, including Kyrgyzstan, the ecosystems and their services are considered free of charge, which often leads to their degradation and neglect.

Unfortunately, neither the former centrally planned economy, nor the modern market economy can correctly assess the value of nature (Bobylev S.N., 1999). This leads to the negative consequences, both for the nature and for the entire economic development. The lack of assessment or the low value of natural goods leads to the underestimation of the benefits of their conservation. When comparing different options for the development of the regions, the conservation option gives way to the traditional economic solutions that provide easily assessed benefits.

In order to implement the state policy on the sustainable development of Kyrgyzstan, there is an urgent need to integrate the ES concept into the strategic documents that would allow developing a roadmap and an action plan, and implementing the ES assessment concept into the regulatory framework. The need to develop such a policy is described in Clause 7.2.2. of Section 7.2. - the environmental aspect of the development in the Development Program of the Kyrgyz Republic until 2018-2022 Unity, trust, creation, approved by the resolution No. 2377-VI. of the Parliament of the Kyrgyz Republic dated April 20, 2018 (The concept of the green economy in the Kyrgyz Republic, 2018). It established that: In particular, an assessment system of the environmental impact shall become a permanent component of the national policy, providing a strategic environmental assessment of the plans, programs, legislative acts, economic and investment projects. The economic and social practicality of the projects shall not be considered without a comprehensive valuation of the cost of the development projects, including a cost-based assessment of the environmental damage and the applicable costs of their full restoration.

The more precise tasks for Kyrgyzstan are set in the Concept of Green Economy of the Kyrgyz Republic: *Kyrgyzstan is a country of green economy*, approved by the Resolution of the Parliament of the Kyrgyz Republic dated June 28, 2018 No. 2532-VI. (Concept of Green Economy of the Kyrgyz Republic, 2018), where sections 6 and 7 set

the following objectives: develop and implement the concepts, principles and international experience of the ecosystem approach at the state and local levels, and the economic and social practicability of any projects shall not be considered without a comprehensive assessment of the cost of development projects, which includes valuation of the environmental damage and applicable costs of full restoration. The objectives of the Green Economy Concept in the Kyrgyz Republic are discussed in Chapter 5 in detail.

The government policy of Kyrgyzstan should be aimed at conducting an economic assessment of the ES mandatorily in the following cases:

1) in determining the contribution of ecosystems to the economy of the republic;
2) in determining the benefits of an action/intervention leading to the changes in the condition of ecosystems;
3) when analyzing the distribution of the costs and benefits associated with ecosystems;
4) in identifying potential sources of financing for ecosystem conservation.

III. International experience in implementing the concept of ecosystem services

3.1. Experience in implementing the concept of ecosystem services on the regulatory documents of other countries

In 1982, the United States of America passed amendments to the United States of America Rare and Endangered Species Conservation Act. According to these amendments, in the case of accidental extermination of species listed as rare and endangered, the perpetrator must compensate for this damage by creating protected areas on their lands, taking measures to protect certain species and/or landscapes. On this basis, a whole market of the quotas for biodiversity has formed in the country: the protected areas and other environmental organizations are actively trading in the loans for biodiversity conservation. There are even specialized environmental banks have emerged.

3.2. Implementation of Payment of ecosystem services

Year by year, the PES are becoming a more popular tool for the development of green economy. At the national level, PES schemes were used for the first time in Latin America. FONAFIFO National Forestry Financing Fund was founded in 1997 in Costa Rica (Stefano Pagiola, 2005), the main activity of which was to introduce payments for forest services by users, to promote a careful treatment of the environment. This unique experience of PES implementation has shown excellent results for 20 years; during the program implementation, 13,000 contracts were signed, which covered more than 800 thousand ha of forests. Forestry receive different funds depending on the type of activity, thus the amount of financing for forest restoration, per hectare is higher than for conservation.

Currently, more than 550 active PES programs operate in the world, and the annual turnover on these programs, according to various estimates, reaches 36-42 billion USD (Salman et al., 2018).

The largest number of PES implementation projects and programs fall on the **water basins**; a total of 378 projects are being implemented in 62 countries with a total amount exceeding USD 24.7 billion per year. At the water facilities, it is easy enough to identify direct suppliers and recipients of the ES and develop the PES movement patterns. The apparentness of the relationship between the land management upstream and the quality and amount of water received by residents living downstream makes the management easier and increases transparency for all participants in such schemes.

The most well-known examples of the success of the PES water schemes are:

France: Perrier Vittel French company, producer of bottled water, pays compensation to farmers who own land upstream from the place of water production so that they use sustainable agricultural methods: replace the corn feed to alfalfa and hay, reduce the rate of stocking of domestic animals, decrease the use of chemicals, improve the waste management. These methods significantly reduce the groundwater pollution. The more "ecologically" the farmers run their farms, the better the quality of water produced by the company. Each farmer receives an average of 200 EUR per 1 ha of land. The payments are made for 5 years - within this time the farmer shall switch to a more sustainable agricultural practice. This is a "private-to-private" PES scheme, which has been operating since 1988.

United States of America: One of the most well-known examples of the use of water payments is the payments of the New York City Municipality to farmers whose lands are located upstream Hudson river, which is the foundation of the city's water supply system. In the early 1990s, the quality of water in the pipelines of a multi-million city has significantly deteriorated. In response to this, the Environmental

Protection Agency of United States of America demanded that the New York authorities build a filtration plant (the construction cost was estimated at 4-6 billion USD). In an effort to reduce the cost of improving water quality, the municipal authorities launched a PES program: they informed the farmers about financing of the activities aimed at improving the quality of water in the river and its tributaries flowing through their properties. These activities included: reducing the use of fertilizers, creating afforestation, creating private protected areas, and expanding the area of state-owned protected areas in this territory. Within 10 years, about USD 1-1.5 billion were spent on this. The funds for payments to farmers and protected areas were derived from the municipal payments of citizens (the average payment increased by 9 percent, however people were willing to pay for the quality of water) - a special organization, the Watershed Agricultural Council was set up, which conducted a large-scale awareness campaign in the media, collected funds from the population, and invested them in stocks, bonds, and created a specialized trust fund, which was replenished from the profit of these transactions - this profit was also directed to pay farmers. As a result, over 10 years, the water quality in the city has improved significantly, and there was no need to build the filtration plant, the authorities saved money, the protected areas and farmers received substantial support. Another example, in the United States of America, the state conservation program concludes 10 - 15 year contracts with farmers so that they allot part of their land to create private protected areas, thereby ensuring the conservation of biodiversity now and in the future.

Ecuador: The city of Pimampiro is supplied with water from the rivers flowing from the Ecuadorian Andes and located on the territory of the Condor Biosphere Reserve. After a significant deterioration in the quality of drinking water, the city authorities initiated a project to collect additional payments from the population of the city in favor of the land users of the upper Andes (638 ha). In their turn, the land users at the upper reaches of the river switched to the more environmentally

sustainable methods of agriculture and forestry. The substantial part of the payments was transferred to the biosphere reserve to implement its environmental programs. Overall, the citizens' payment for the ES (as part of the water use tariff) ranged from USD 0.5 to 1 per 1 m^3 of drinking water.

One more example, in the province of El Oro, a model project was implemented to use PES for financing the water quality preservation in the Rio Arenilas River Basin. A consumer of the service was the dam of the Takhuin hydroelectric power plant, the productivity of which decreased significantly due to an increase in the sediment content in the river water and clogging of hydraulic structures. Studies have found that the reason for the increase in the concentration of solid sediment is in the increased erosion caused by the intensive wood cutting in the upper river. Accordingly, the funds received under the PES mechanism are spent for the reforestation activities. The administration of the Takhuin Hydroelectric Power Plant paid an average of USD 32.7 per 1 ha of reforestation. Collection and redistribution of payments is carried out by the regional and local authorities.

China is a leader in implementing PES programs in the water basins. After serious consequences of the chain of floods and droughts in the 90s, the Chinese government began to take measures against deforestation and forest degradation threatening the quality and quantity of water. At the national level, the Sloping Land Conservation Program (SLCP) aimed at the transformation of the arable land into forests and meadows, and the Natural Forest Conservation Program were adopted, in which more than USD 50 billion were invested from 2000 through 2009, and also 32 million farmers and 120 million households were paid USD 12.98 billion, which makes this PES scheme the largest in the world. As a result, the studies have shown that over within 10 years of the program implementation, the number and quality of the provided ES increased, and the socio-economic indicators improved.

The complexity of the development and assessment of the number of the ES beneficiaries from the **biodiversity conservation and environmental protection** does not allow creating private markets, as a result the PES biodiversity programs are subsidized by the government and implemented by local NGOs. Currently, there are 120 biodiversity conservation programs in 36 countries around the world, with a total PES amount reaching USD 2.5 - 8.4 billion annually.

Examples of the PES biodiversity and environmental schemes:

United States of America: In the United States of America, there is a state program for the conservation of the reserves, which concludes 10 – 15 year contracts with farmers for the allocation of part of their land to create a private protected area, thereby ensuring the conservation of biodiversity in the present and in the future.

Australia: In 2007, the Biodiversity Offsets and Banking Scheme (BioBanking), was created in the New South Wales allowing investors to buy quotas for the conservation of natural resources. The general scheme of the work of BioBanking is as follows - the organizations working in the field of environmental protection "sell" the results of their work in the form of quotas and loans or receive financing for such work from investors.

Malaysia: Biobank sells "biodiversity conservation certificates", each one of them is a certificate for the protection and restoration of forests per 100 m2. for 50 years. Entrepreneurs and investors voluntarily buy these certificates to cover environmental damage caused by their activities.

Forest resources and land use

After the conclusion of Paris Agreement in 2015, which was an update of the 1997 Kyoto Protocol, declaring the countries' intention to reduce greenhouse gas emissions, the carbon markets got a new wave of development and financing. The PES schemes, including the use of carbon credits from the market mechanisms and the activities

in the field of land use, changes in the land use and forestry are reaching USD 2.8 billion and implemented in 36 countries of the world.

For 20 years of development, the main tools for PES schemes for carbon offsets have been afforestation and reforestation programs, improved the forest management, environmentally sound land use in agriculture and the reduction of emissions from deforestation and forest degradation (REDD program). A growing number of the international companies such as Microsoft, Disney and Natura Cosméticos are participating in the voluntary carbon markets by buying the carbon offset credits.

Working under the auspices of the United Nations, the Reducing Emissions from Deforestation and Forest Degradation Program plus the sustainable forest management and enhancement of the carbon sequestration forest resources (REDD +) is an important component of the global mitigation measures of climate change. One of the tools for implementing the program is the PES schemes, under which farmers or landowners are encouraged to use their lands through the methods that imply the provision of environmental services, for example, climate control, fresh water supply or improving the purity of atmospheric air.

Examples of PES schemes for forest resources and land use

Sweden: Under the Komet program, on the agreement basis, owners receive fixed payments to limit their economic activities for the protection of forests. The agreement can be valid from 1 to 50 years. The program covers 9 percent of the forest land.

Indonesia: The World Wide Fund for Nature, together with CARE and the International Institute for Environment and Development (IIED), finances forest conservation, including the Betung Kerihun National Park. Besides the project's own funds, money comes from the public utilities, regional and municipal authorities and industrial enterprises.

Salvador, Nicaragua and Honduras: The Sustainable Agriculture Development Program in the foothills of Central America, funded by the Swiss Development Agency, is implementing PES projects where municipal authorities are the purchasers of services, while farmers and their associations are service providers. Among the activities that receive funding in the framework of the projects: elimination of the consequences of fires, thinning of forest plantations, composting of coffee production waste, the decomposition of which clogs water bodies, etc.

3.3. Experience in economic assessment of ecosystem services

World experience

Assessment of ES is a recognized and widely used practice in the world. Perhaps the first world publication was the Millennium Ecosystem Assessment program in 2000. The goal of the program was to assess the impact of changes in ecosystems on the human well-being, and provide a scientific basis for enhancing conservation of ecosystems and their sustainable use. The results of their research are presented in five specialized books and 6 summary reports (UN, 2005).

Another global study of ES is the work of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) was created in 2012 to protect the planet's biodiversity, its ecosystems and the services they provide to humanity. One of the key tasks is to conduct regular and timely assessments of the data on biodiversity and ES and their relations. (Pascual et al. 2017; IPBES 2018).

European experience

In the countries of the European Union, as part of the biodiversity conservation strategy, the mapping and assessment of ecosystems and their services (MAES) are taking place. This work seeks to gain knowledge about ecosystems and their services in Europe. It is also clearly indicated that the assessment and mapping of ES is directly

related to the European Union industry policies, such as agriculture and fisheries. A single analytical framework was developed for the assessment, as well as the common typologies of the ecosystems for mapping, and the ES typologies, which should be used by the European Union and its member states to ensure coherent approaches. The 2014 second technical report proposed an initial set of indicators that can be used at the European and member states level to map and evaluate biodiversity, ecosystem condition and ecosystem services. The typology of the ES of the European countries is largely based on the development of the Millennium Ecosystem Assessment and associated with the UN System of Environmental and Economic Accounts.

Also in Europe, national ES assessments have been actively conducting. At the same time, there are significant differences in the scope of assessment, the methods used, and diversity of the services considered. (Schröter et al. 2016).

Other parts of the world

The number of assessments in Africa is growing, and the analysis shows that 52 ES assessment studies in the continent were published in 2016 (Burkhard, B. et al., 2009). The results indicate that most of the studies were conducted in South Africa and was focused on the water provisioning ES.

The number of ES assessments is growing rapidly in Latin America. Since 2009, studies for forest and fishing ecosystems have been conducted in Brazil, Mexico, and Costa Rica, with the emphasis on the interdisciplinary and public policy.

3.4. International organizations and partners on ecosystem services

From its origination, the concept of ES has come a long way from the sporadic scientific studies to the work of international and multidisciplinary teams of scientists, specialists and experts in the various

fields of activity. All international organizations working in the sphere of ecology, environmental protection and sustainable development, such as The Food and Agriculture Organization (FAO), the Global Environment Facility (GEF), German Corporation for International Cooperation (GIZ), the International Union for the Conservation of Nature (IUCN), the World Wide Fund for Nature Conservation (WWF), The Nature Conservancy (Great Britain), China Academy of Sciences (People's Republic of China), Stockholm Resilience Center (Sweden) and Institute on the Environment of the University of Minnesota (United States of America) support the ES research and assessment projects

Currently, there are several international organizations and partnerships bringing people together to work on the various aspects of ecosystem services:

- **NatCap Project** – The Natural Capital Project was organized in 2006 and brings together more than 250 working groups from different countries working on a systematic approach to the assessment of natural services (Schroter M. et al., 2016). The lead organizations in the project are the Stanford University (United States of America), World Wide Fund for Nature (WWF), Nature Conservancy (Great Britain), China Academy of Sciences (People's Republic of China), Stockholm Survival Center (Sweden) and Environmental Institute University of Minnesota (United States of America). The NatCap project engages politicians, the leaders of corporations, the universities and NGOs in its activities, and explores the possibilities of using assessment of the natural capital to ensure that both the nature and economics benefit. In addition, the NatCap project has developed the InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) program, which allows informed decisions by farmers, landowners and government officials based on the assessment of the cost of environmental damage in the present and

future. InVEST is used in more than 185 countries of the world for mapping and modeling of the valuable environmental resources, evaluating the balance in the use of the land and water resources and integrating the environmental protection and human development issues in the investment activities.

- **Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)** was established in 2012, and includes 132 member-governments, including the Kyrgyz Republic **(**https://www.ipbes.net**)**. IPBES is a global body that evaluates the state of biodiversity and the nature's contribution to people's lives in response to the requests from decision makers. IPBES is a global science and policy platform, which faces the challenge of providing the best evidence available for making more informed decisions on the nature by governments and businesses. In May 2019, IPBES on the UN basis, released a report on the impact of human activities on the environment. According to the findings of 145 scientists, who represent more than 50 countries, humans are transforming the natural landscapes to such an extent that there is currently a danger of the extinction of a million species of plants and animals in the coming decades, which will cause irreparable harm to ecosystems.
- **Ecosystem Services Partnership (ESP)** was established in 2008 by the Ganda Institute of Ecological Economics (United States of America) and is currently coordinated by the Environmental Systems Analysis Group at Wageningen University in Netherlands (http://www.unece.org). ESP unites more than 3,000 scientists, politicians and practitioners interested in the ES who are engaged in 40 working groups and national networks. The purpose of ESP is to strengthen communication, coordination and cooperation in the field of ecosystem services. ESP supports a variety of approaches to the research and practical application of ES in the economic activities. ESP also

holds annual meetings and conferences in which participants share the latest achievements and experience in applying the principles of the ecosystem approach to preserve the environment and implement the ES concept.

- **The Economics of Ecosystems and Biodiversity (TEEB) –** an international initiative aimed to draw attention to the economic benefits derived from nature. The TEEB project was founded in 2007 by the Germany and the European Commission to conduct a global study of the economics of biodiversity loss. The second part of the study was conducted as part of the United Nations Environment Program (UNEP) with the support of the European Commission. The TEEB project aims to link the biodiversity interdisciplinary science with the interests of the international and public policy to move towards a new type of economy that takes into account the worth and the value of the natural capital and ecosystem services.
- **The System of Environmental Economic Accounting (SEEA)** is the UN project to create a unified standard and the system of environmental and economic accounting adopted by the UN Statistical Commission in 2012 (https://seea.un.org). Currently, the SEEA London group has developed the standards, methodology and draft basic tables and accounts for the central basis of SEEA. Part of the SEEA project is Experimental Ecosystem Accounts (SEEA-EEA), in which an attempt is made to collect the data and indicators of the level and the condition of ecosystems and ES in physical and monetary values and to relate them to the economic indicators.
- **BiodivERsA** is a network of 35 environmental agencies and ministries from 23 European countries, established in 2005 to support biodiversity and ES studies. Since its launch, BiodivERsA has funded 70 studies of the Europe-wide and Latin

American region for more than 180 million euros. The main research topics are mapping, programming and scenario development of biodiversity and ES for practical application (https://www.biodiversa.org)

- **ValuES: The methods for integrating ES into the strategy, planning and practice** – it is a global project that simplifies adoption and implementation of the ecosystem services, in the strategies, plans and implementation of certain projects by decision-makers in the partner countries (http://www.aboutvalues.net). The ValuES project is being implemented by the German Corporation for International Cooperation (GIZ) in close collaboration with the Helmholtz Center for Environmental Research (UFZ).
- **The Sub-Global Assessment Network (SGAN) was** organized in 2007 by UNEP as a platform for bringing together experts involved in the practical ecosystem assessment at the sub-global level (the regional and national levels) to build capacity and strengthen the national ES assessment systems (https://seea.un.org).
- **Ecosystem Marketplace.** Launched as a web-based information platform in 2004, Ecosystem Marketplace publishes newsletters, breaking news, original feature articles and major reports about market-based approaches to conserving ecosystem services. Beginning in 2007, staff began collecting survey data to inform the first-ever "State of the Voluntary Carbon Markets" report.

IV. National experience in implementing the concept of ecosystem services

4.1. Experience of implementing ES principles in the regulatory framework

In order to implement the state policy on biodiversity conservation, there is an urgent need to integrate the concept of ES into strategic documents, which will allow to develop a roadmap, an action plan, and introduce an assessment of ES in the regulatory framework. The Kyrgyz Republic has already gained experience in implementing assessment of ES in some strategic documents. For example, the ES principles are integrated into the Concept of Forestry Sector Development of the Kyrgyz Republic until 2040, and in the Priorities for the biological diversity conservation of the Kyrgyz Republic until 2030.

The Concept of Forestry Sector Development of the Kyrgyz Republic until 2040 is a strategic document that defines the goals, priorities and objectives of sustainable development of the forest sector.

The goal of the forest sector development until 2040 is the forests sustainable management to ensure the economic well-being of people, social prosperity, environmental safety and favorable environment for the life of citizens of the Kyrgyz Republic.

To achieve the above goal, priorities are identified that ensure the sustainability of the development of the forestry of the republic, reflect all components of sustainability: the economy, social relations, ecology and institutional framework.

The biodiversity conservation priorities of the Kyrgyz Republic until 2030 define the strategy, program, principles and main directions of the Kyrgyz Republic in the field of biodiversity conservation. On its basis, the action plans, the sets of phased measures to preserve the biodiversity of the Kyrgyz Republic for the short, medium and long term are implemented.

The goal of the priorities is that Kyrgyzstan is a country that is steadily developing in the harmony with nature, in which, by 2030, biodiversity is valued, conserved, restored and wisely used, supporting and sharing the benefits of ecosystem services, contributing to the achievement of the Sustainable Development Goals.

The set goal is planned to be achieved through the integrated implementation of the following priorities and objectives, which are consistent with the strategic goals and targets of the Aichi Strategic plan for the conservation and sustainable use of biological diversity for 2011-2020, adopted at the tenth Conference of the parties to the Convention on biological diversity (https://www.cbd.int).

The application of the ES concept in practice can significantly improve the efficiency of management decisions, budget allocation and improve the quality of life in the regions. In order to include the ES in the economic turnover and in the system of economic decision-making, the analysis of the legal framework on ecology and forestry has been carried out.

In the current national legislation, no norms for ES exist, but there are standards for the management, regulation, and the use of natural resources (land, water, subsoil, flora and fauna, forests, pastures, etc.).

In order to conduct an economic assessment of any ecosystem service and its further application in the real economy, it is necessary to go through at least four stages:

- identification (definition) of an ecosystem service;
- determination of its economic value;
- determination of the beneficiary of the service;
- establishment of a payment (compensation) mechanism for ecosystem services.

Analysis of the regulatory framework for ecology and forestry was carried out for the four stages of the economic assessment of ecosystem services.

Based on the results of the analysis, the "Economic assessment of ecosystem services" article was developed for the draft Environmental Code, and the "Economic assessment of ecosystem services" section for the new edition of the Forest Code. The proposed article and section provide for the definition of the ES and their types, and the field of application of the economic assessment of ecosystem services, as well as the norms of the forest ecosystem assessment.

4.2. Experience in implementing payments of ecosystem services

The ecosystems of Kyrgyzstan provide population with a wide variety of vital services, however the existing environmental management practices are not always sustainable, and unfortunately, in many cases lead to the ecosystem degradation.

Despite economic difficulties in Kyrgyzstan in 1992-1999, it managed to maintain the forestry system, the functioning of leskhozs, national parks and reserves. The main activity of these forestry organizations was to conserve and restore the natural ecosystems. At the same time, one ought not to deny the existence of negative facts, such as the cases of mass forest logging, overgrazing on pastures and forest areas, unauthorized use of natural resources, poaching.

The government, with the support of various international partner organizations has developed numerous mechanisms and conditions for eliminating these negative cases of the destruction of natural ecosystems: establishment of the state structures for accounting and rational use of the flora and fauna elements (forest and hunting systems, wildlife accounting), conducting studies, the new relationships with the users of natural ES (introduction of the Community Forestry and Collaborative Forest Management), revision of the functions of leskhozs and national parks. Efforts are being done to change the attitude of citizens of the republic on the natural and anthropogenic ecosystems,

rural residents started appreciating the importance of nature conservation and its growth for future generations, learned how to rationally use natural resources and create conditions for the ecology tourism.

In their turn, the large and small companies engaged in the development of subsoil resources comply with the environmental requirements, participate in the restoration of natural ecosystems. Here, an important role was played by international organizations, the support of which was primarily aimed at reforming the government bodies and improving the social and economic situation of the rural residents. Their support was not only in the financing of projects, but also technical, expert and consulting support. Assistance is provided in applying the positive experience of other countries in the conservation and rational use of natural resources, and in the development of the new accounting methods and management plans.

The current state of the environment and economy of Kyrgyzstan leads us more than ever to the need to use new principles of the natural ecosystem management, one of the tools of which is the payments for ecosystem services.

One of the first organizations working on the implementation of the concept of ES in Kyrgyzstan has become the Regional Environmental Centre for Central Asia (CAREC). Since 2008, CAREC has been working towards the application of the ES concept in the pilot areas of the Central Asian countries. In these areas, the experts of CAREC carried out an economic assessment of the ES and ensured the implementation of a system of the incentives for ecosystem services.

The projects were implemented on a phased basis:

1. Exploring the possibilities for the ES principles implementation
2. Implementation of the pilot projects on economic valuation, ES and opportunities for introducing incentives for ecosystem services

4.3. Experience in economic assessment of ecosystem services

The initial experience of the economic assessment of ES in Kyrgyzstan was based on:

- assessment of the capacity and identification the needs of ES in the Issyk-Kul region –El Pikir Public Opinion Study and Forecasting Center
- assessment of ES for sustainable river basin management: a case study of the Chon-Aksuu River Basin, Issyk-Kul Oblast - Aida Kaptagaeva
- development of the "Guidelines for ecosystem services payments" - F. Balbakova, 2010

El Pikir Public Opinion Study and Forecasting Center evaluated the capacity and needs of the ES in the Issyk-Kul region in five territorial zones (Karakol, Balykchi, Komsomol, Ton, Oi-Tal, Kuturbu) located around Lake Issyk-Kul. The criteria for selection of the zones were the climatic conditions, geographical features of the location and specific ecosystem features.

According to the results of the study, the analysis of the average scores of the population and economic entities shows that the heaviest deterioration is observed in the condition of the nearby forests (decrease by 1.15 points) and in the ecosystem of the Issyk-Kul Lake (decrease by 0.94 points). Deterioration of other ecosystems over the past 10 years is estimated significantly lower - the assessment of the rivers condition decreased by 0.57 points, the nearby high-mountainous pastures - by 0.4 points, and the remote high-mountain pastures - by 0.2 points.

The experts' opinion on the ecosystem changes were not as optimistic as those of the population and economic entities. Most experts noted a significant deterioration of all ecosystems, with the state of

Issyk-Kul Lake and rivers deteriorating the most. Noting the deterioration of the condition of forests, high-mountain pastures and distant high-mountain pastures, experts believe that so far these ecosystems have been performing their functions. At the same time, according to experts, the degradation of some ecosystems has reached critical values and without urgent conservation and restoration measures, the degradation will become irreversible.

The residents of the researched areas reported that they receive the following ES from the Issyk-Kul Lake: swimming and relaxation (30 percent), aesthetic enjoyment with the lake (24 percent), good climate (17 percent), health (15 percent), fish for food (7 percent). The ES such as water conservation (3 percent), the income from tourists (2 percent), and the income from the fish sale (2 percent) were mentioned way less frequently.

Analysis of the structure of ES showed that the largest share (41.8 percent) of them are the payments for the use of forests/rivers/pastures/lakes. A significant contribution to payments come from renting plots of forests/rivers/pastures/lakes, and installing apiaries - 17.4 and 14 percent, respectively. Payments for raising livestock and payments for haymaking are approximately the same - about 8 percent. Payment for wood in the structure of expenditures is 6.7 percent, a hunting license - 2.4 percent. The share of drinking water payments (0.7 percent) and payments for the gifts of nature (0.2 percent) are very insignificant.

In general, it can be stated that people are ready to take part in the environmental activities: forest planting, ecological tourism, fire protection and protection of forests from grazing. Most of the respondents were ready to expand their contribution to the conservation of ecosystems, however, companies see their participation very traditionally (in what others do) - environment greening (24 percent), Saturdays' voluntary work (18 percent). Interestingly, about 12 percent of the com-

panies surveyed are ready to do any work for the benefit of the ecosystem. However, a third part of respondents do not intend to take any part in preserving ecosystems in the future.

The study on the "Ecosystem Services Assessment for Sustainable management of watersheds: Case study of Chon-Ak-Suu River watershed" was conducted by A. Kaptagaeva, as part of the project "Integration of the concept of PES and reduction of emissions from deforestation and degradation (REDD) in Central Asia" (A. Kaptagaeva, 2013). As a result of the study, the potential for delivery of the provisioning, regulating and cultural services of the river basin was assessed.

One of the main objectives of the study was to assess the ecosystems and ES in the Chon Aksuu River Basin, develop a model to reduce the negative impact of the anthropogenic activities on the ecosystems of the region, and analyze the possibilities of attracting local communities to reduce the negative impact on the natural resources. To solve this problem, various scenarios of the pilot area development were simulated based on the ES assessment matrix with the use of the GIS technologies, and also the condition of the ecosystems in the study area was monitored.

Using the maps of the land use, pastures, ecosystem services, and the statistics on the economic activity of the local population, a map of the most degraded areas in the study area was generated.

The degradation of ecosystems leads to the decrease in the ability of ecosystems to maintain a consistent quality of life, and to the deterioration of the ES provided. In this area, the quality of drinking water received by the local population is already low in the lower reaches of the river because of the grazing erosion, the soil loss into the river caused by the weakening grass cover.

During the study, the following recommendations were made for this pilot area:

- Gradual shifting of the local population from practicing animal farming, which give the most strain on the natural ecosystems, to the other areas of economic activity, for example, to the development of ecotourism, organic gardening;
- Tightening of the rules for the use of pastures, establishment of a regulated system of the pasture turnover;
- Changing the structure of the animal farming to redistribute the burden on pastures;
- Restoration of the tree-shrubbery belt in the riverbed within the PES system;
- Introduction of a system of PES

Implementation of the pilot projects on economic valuation, ES and opportunities for introducing incentives for ES

- The Chon-Aksuu River Basin (Issyk-Kul region, Kyrgyzstan) - "Implementation of the concept of the PES and reduction of emissions from deforestation and degradation (REDD) in Central Asia." Implementation period: 2011 – 2014 (Scharre, S. & Matraimov, K., 2014);
- The Chon-Aksuu and Zerger River Basins (Issyk-Kul Oblast, Osh Oblast of the Kyrgyz Republic). CAREC Project "Supporting Local Initiatives in the Environmental and Water Management in Central Asia: Phase 2". Implementation period: 2015 – 2017. (Matraimov. K., 2017);
- In 2017-2018 the component "Implementation of Payments for ecosystem services in the pilot territory" of the GEF-FAO project "Sustainable Management of Mountain Forests and Land Resources of Kyrgyzstan under Climate Change" was implemented. The component was implemented by the CAREC branch in Kyrgyzstan. The pilot territory was the Tyup forestry

and the Sary-Bulak rural district of the Issyk-Kul region (Matraimov K., 2018).

Owing to the financial support of the Swiss Re Foundation, in 2011, CAREC developed an innovative project that integrates two economic mechanisms to solve the issues of the natural resources management in the Chon-Aksuu basin: a scheme of PES along with the afforestation/reforestation activities for carbon sequestration and the generation of alternative income. Moreover, the PES mechanism developed as part of this project was the first in Central Asia, raising many questions and at the same time outlining interesting prospects for further development of this tool in the region.

PES contracts were signed in the winter of 2011, and their direct implementation began in May 2012. In the first year of work, mushroom pickers and water users fully paid incentives to the leskhoz (30 and 10 average work days, respectively), which then were spent on tree planting. Four hectares were planted with Tien Shan spruce (13,000 seedlings) – the local species that form most of the forest in the area of the project.

Mushroom pickers also created an unofficial mechanism to look after plantations and keep animals away from the young trees.

In their turn, the leskhoz surrounded three plots (10 m x 10 m) with a fence to demonstrate the effectiveness of the pasture rotation.

In the first year of the project, the pasture committee faced difficulties because of the internal problems, which delayed decisions regarding the selection of the activities to be implemented owing to the incentives. Since this is a collective encouragement, the pasture committee must collectively (with its members) determine the activities that will positively impact the ecosystems and the herdsmen community as a whole. In the first year, the head of the committee changed, so the plan of the pasture management was not completed on time. The activities supporting the incentives were not clearly defined; 20 average work days were not used and were transferred to the next year.

Thanks to the incentives made by mushroom pickers and water users, in 2013, the leskhoz planted 7 hectares of forest along the watershed upstream.

Negotiations between the pasture committee and the water users' association allowed to determine the most suitable activities to be implemented. As a result, it was decided to use working days to improve the road that lead to the high-mountain pastures in order to unburden the degraded pastures closer to the village.

In 2014, the payment activities were the same, the leskhoz focused on the reforestation of the degraded slopes, while the pasture committee on the improvement of a different road.

After the focused studies and work with local stakeholders, the in-kind expression of the payment for the work turned out to be the most relevant for a positive impact on the state of ecosystems, and also matched the expectations and willingness of local residents. Moreover, this mechanism does not require a permanent administrative structure for transferring payments; therefore, it is simple and inexpensive to run, which strengthens the overall stability of the scheme.

The GEF-FAO project "Sustainable Management of Mountainous Forest and Land Resources under Climate Change Conditions" continued the implementation of this mechanism, which can be an element of the Joint Forest Management. Considering the CAREC's regional experience in the ecosystem services, a contract with the CAREC branches of the Kyrgyz Republic was signed to carry out the Implementation of incentives for ES in the pilot area component.

The PES implementation in the Tyup region has become another practical important example of the development of mechanisms of the joint management of natural resources. This project was implemented within a fairly short period (from August 2016 through October 2017) and had two results:

- The PES mechanism was introduced in conjunction with the Tyup forestry, the Sary-Bulak pasture committee and RWUA of the Kurmenty village. A PES contract was concluded till the end of 2018;
- An economic assessment and mapping of the ES of the Tyup forestry was carried out.

Implementation of the PES project component revealed that PES mechanisms can be implemented in the Kyrgyz Republic despite the legal and cultural problems in the development of a payment mechanism between communities. The existing PES mechanism was an interesting choice, having set a labor remuneration to meet legal opportunities, expectations and willingness of local people. This choice was most relevant to keep the mechanism working and reveal the best approaches for this type of payment.

The economic assessment of ES of the Tyup forestry resulted in taking a number of necessary decisions on raising awareness on the value of nature, on the measures for its conservation and expansion, on the sustainable and rational use of resources and making other important political decisions.

In 2016, in the framework of the regional project "Supporting Local Initiatives in the Sphere of Environmental and Water Management in Central Asia", an economic assessment of ES in the pilot territories of Kyrgyzstan was carried out.

To assess the ecosystem services, the CAREC office set up a team consisting of specialists in the field of ecology, GIS, forestry and agriculture, and environmental economics. The following activities were carried out during the project:

- desk-based statistics collection;
- work with GIS maps;
- identification of the main types of ecosystem services;

- development of the methods for analysis and evaluation of these services;
- pilot study and testing of questionnaire;
- development of four questionnaires: households, mushroom pickers, local tourists and foreign tourists;
- basic field data collection in the territory;
- focus groups and individual meetings with local people, NGOs and government agencies;
- creation and analysis of an array of the received data in SPSS and STATA.

As a result, ES were identified and evaluated: drinking water supply, forest products (wood and non-wood), animal feed, agricultural products, tourism, carbon sequestration and storage. In Chon Aksuu, the ES were valued at 648.6 million KGS or USD 28.6 million and in Zerger at 136.3 million KGS or USD 17.3 million.

Other international projects and NGOs in cooperation with government agencies are involved in the studies on ES and on PES implementation in the Kyrgyz Republic:

1. Experimental Ecosystem Accounting on the example of the Kyzyl-Unkur leskhoz (Jalal-Abad region) – the UNDP project. This work is carried out thanks to the expert support of Czech consultants of the Research Institute for Global Change of the Czech Academy of Sciences (Czech Globe). The project is funded by the Czech Trust Fund jointly with the UNDP-UNEP Poverty and Environment Initiative in the Kyrgyz Republic and is titled: Using Czech Experience: piloting of SEEA-EEA in the Kyrgyz Republic. This 6-month project is being implemented in close collaboration with the National Statistical Committee (NSC) and the State Agency for Environmental Protection and Forestry (SAEPF).

In 2016, a new initiative was carried out in the Kyrgyz Republic aimed at implementing the system of environmental and economic accounting – the experimental ecosystem accounts (SEEA and EEA) on the basis of the Kyzyl-Unkur leskhoz (Jalal-Abad region, the nut-bearing zone). This system allowed including environmental factors into the system of the basic economic development indicators.

2. A project funded by the United Kingdom of Great Britain and Northern Ireland ESPA program (grant number NE-K010239-1) "Adaptive management of mountain ES for poverty alleviation provided by virtual environmental observatories", has been conducting a study of the mountainous ES in Naryn, since 2014. Besides Kyrgyzstan, the studied territories include Mustang, Nepal; Lima, Peru; Lake Tana region, Ethiopia.
3. NEPCon conducted a certification valuation of the forest management system and the supply chain at the Association of Forest Users and Land Users of Kyrgyzstan (FSC-STD-KGZ-01-2017), which includes the environmental, silvi-cultural and socio-economic aspects of forest management.

Significant experience in the economic assessment of the ES in Kyrgyzstan has been gained on the basis of the economic assessment of ES of the Karakol State Natural Park and the Chon-Kemin State Natural Park, and on the efforts of CAREC, GIZ and others in the Chon Aksuu River Basin, the Kyzyl Unkur village district, the Son-Kol Lake high mountainous pasture.

Karakol state natural park

The economic assessment of the ES of the Karakol state natural park was carried out with the support of the UNDP-UNEP project "Poverty and the Environment" (UNDP-UNEP, 2017). The Karakol state natural park is a structural unit of SAEPF, located in the south-western part of the Ak Suu district of the Issyk-Kul region, and its lands represent protected areas.

The total area of the natural park is 38 159.3 ha, of which: the area of forest ecosystems is 5 138.9 ha, mid-mountain steppes and meadow steppes – 1 100.8 ha, subalpine meadows – 5 727.2 ha and glaciation area – 26 192.4 ha.

Natural park ecosystems provide the following services and benefits:

- Forest ecosystems: provisioning services (commercial wood, fuel wood, genetic product (seedlings), honey, medicinal plants, water supply, berries, mushrooms); regulating services (carbon sequestration and storage, water storage); cultural services (recreation and tourism, education, spiritual enrichment).
- Mid-mountain steppes and grassland: provisioning services (hay).
- Subalpine meadows: Provisioning services (meat, milk); cultural services (recreation (koumiss treatment).
- Glaciation: regulating services (water storage and control).

Under provisioning services of the natural park ecosystems, one should understand the useful tangible products, the source of which are forests, steppes and grass-steppes, for example, wood (commercial wood, wood fuel) and the non-wood ecosystem products (honey, berries, mushrooms, medicinal plants, seedlings, hay).

The wood obtained as a result of logging is sold to local population as commercial and fuel wood. Local people obtain non-wood products (honey, berries, mushrooms, medicinal plants, seedlings, hay) from ecosystems for personal consumption and for sale.

In accordance with the methodology of the environmental-economic accounting, it is accepted that, even if households collect non-wood products to meet their own needs, they receive an income that is adequate to the market one.

Wood and non-wood products have an economic value that can be calculated if the volumes and the market prices are known, and the

economic valuation of the provisioning ES is calculated taking into account the costs and capitalization.

Thus, the economic assessment of the provisioning services of the park amounted to 1.3 billion KGS (or USD 19.6 million).

Regulating services of the Karakol state natural park ecosystems are understood as the regulation of climate by sequestration and storage (accumulation) of carbon, and their assessment was carried out separately.

The absorption of carbon by ecosystems occur due to the growth of tree and shrub plantings and its calculation was carried out according to the IPCC Guidelines (2006).

The forest ecosystems of the Karakol state natural park on the area of

5 138.9 ha annually absorb 5 409.0 tons of carbon and accumulate 510 294.7 tons of carbon.

The value of climate regulation by forest ecosystems of the Karakol state natural park is more than 22.6 billion KGS (more than USD 332.5 million).

The recreational ecosystems services of the Karakol state natural park are considered cultural services.

Evaluation of the recreational ecosystems services is made by summing up the benefits received by visiting tourists and the net economic income received by the suppliers of recreational services. The benefits received by visiting tourists are determined on the basis of the transport and travel costs for consumer surplus. The net economic income earned by providers of recreational services is calculated using the direct market valuation method.

Thus, the value of recreational ecosystems services of the natural park is more than 135.1 billion KGS (more than USD 1.9 billion), and the economic valuation of the ES of the Karakol state natural park is more than 167.8 billion KGS (more than USD 2.4 billion).

Chon-Kemin state natural park

Chon-Kemin state natural park was founded in 1997 and its main goal is to conserve and increase the natural wealth for the present and future generations. The Chon-Kemin state natural park is a habitat for rare flora and fauna. Moreover, the park provides local population with a source of income by providing ES – the benefits derived from nature. The structure of the ES makes it possible to develop a comprehensive policy that meets the economic and environmental criteria of sustainable development (UNDP-UNEP, 2017).

The purpose of this study is to conduct a quick assessment of the basic eco-system services and describe the importance of the ecosystems of the Chon-Kemin state natural park for the well-being of people. Because of the limited resources, a quick assessment of the ES does not aim to evaluate all ES in the area.

The study identified the main ES of the natural park: 1. Provision of pastures (feed, meat gain), 2. Wood products (commercial wood, brushwood and firewood,3. Non-wood forest products 4. Tourism, 5. Biodiversity (provision of habitat), 6. Carbon sequestration and storage. The total value of the estimated ES amounted to KGS 9.5 billion.

As expected, the value of non-market ES turned out be much higher compared to other services. This is because, normally, non-market ES represent regulating services and have the national and international value, while the market ES are limited to the local market.

Assessment of the Chon-Kemin SNP ecosystem services

Ecosystem services were assessed by Rakhat Sabyrbekov, an expert of the UNDP "Biodiversity Financing Initiative" project, and the results are based on the report he presented (UNDP, 2018).

Ecosystem services of Chon-Kemin SNP

In the course of the field studies and analysis of the available materials, the following basic ES were identified for evaluation:

- Provision of pastures
- Wood products (commercial wood, brushwood and firewood)
- Non-wood forest products (raspberry, mushroom, sea buckthorn, medicinal herbs, honey, nettle)
- Tourism
- Biodiversity
- Carbon sequestration and storage
- Water: drinking and agricultural

The total value of the ES of the Chon-Kemin state natural park amounted to 9.5 billion KGS. More detailed information is presented in Table 4.1.

Table 4.1. Ecosystem services by the assessment type and method

Ecosystem service	Net value (KGS)	Method
Pasture	66 894 375	Production function
Forest	9 898 400	Direct market
Brushwood	313 800	Direct market
Firewood	472 000	Direct market
Mushrooms	1 274 000	Direct market
Raspberry	718 200	Direct market
Honey	460 000	Direct market
Sea buckthorn	1 225 800	Direct market
Nettle	90 000	Direct market

Dogrose	77 480	Direct market
Tourism	22 277 100	Zone Cost Method
Fish	45 000	Direct market
Water	30 811 898	Replacement cost
Biodiversity	3 462 312 000	Benefit transfer
Carbon	5 861 891 039	Direct market, forest valuation
TOTAL	**9 458 761 092**	

Ecosystem services of pastures

The pastures of the Chon-Kemin SNP represent massive spaces, and occupy the largest area. The Chon-Kemin SNP has 42,756 ha of pastures, of which about 6,500 ha of pastures are leased annually (6,600 ha in 2016, 6,271 ha in 2015). The prevalence of pastures in the park's land is explained by both the natural properties of the area and the land management practiced by local governments.

The pastures of the park have perhaps the most important impact on the well-being of local people who graze their livestock in the park. Livestock is the main source of income for rural people, and the quality of pastures often determines the quality of life of these households. The pastures of the natural park are mainly used by residents of the border village districts. In some areas, pasture degradation is observed because of the non-compliance with the load standards.

Productivity of the park pastures, depending on the prevailing type of vegetation, varied around 1.2 - 6.9 centners per hectare of the eaten mass in 2016. The high quality of the grass stand attracts many farmers, while the rental price is lower than leasing pastures from the village authorities.

At the same time, pastures also provide a feed base for the wild animals, ensuring conservation of the unique biodiversity. Theoretically, there is a risk of competition for food between the domestic and wild animals. However, based on the pro-analyzed materials, we can say that such a risk is low. The leased pastures amount to 6,600 ha to 42,756 ha, that is 15 percent. However, it is possible that the real grazing areas are larger.

The pasture ES were assessed based on the direct market method and production function for livestock (McCarthy and Morling 2014). The essence of the method is to bring the daily gain of meat to the market value. The productivity of pastures was calculated based on the analytical reports of NABU, SNP, and SPI Kyrgyzgiprozem. The price of meat was taken from the reports of the National Statistical Committee and the survey of local residents of the adjacent territories.

The capacity of the Chon-Kemin SNP pastures is 11,951 conditional heads (Rural Development Fund, 2016). Using the method, the average weight gain of meat was taken into account, 250 grams per day at a price of 250 KGS, and 90 days spent in the pastures of the Chon-Kemin SNP. The total economic value of the ecosystem pasture services amounted to 66,9 million KGS.

The gain in meat or the so-called output of the livestock production is a standard unit of the livestock productivity. The weight gain of meat is widely used for all types of the farm animals. Based on the above, the calculation of the gain was determined by the following formulas:

$$\bar{W}\_m = (\sum W) / \bar{(L\_x)} \quad (1)$$

where, $\bar{W}\_m$ – the live-weight gain per a queen head;

$\sum W$ – the total increase in live-weight of the total livestock in kg;

$\bar{(L\_x)}$ – average number of queens in stock.

Then, the following formula was used to calculate the economic value:

$$V= \sum_{i=1}^{n} \left[(p^* \bar{w}_m) *T \right]$$

where V – the market value in KGS;
p – the average market price in the current KGS;
T – grazing period in days.

The main threats to the loss of this ecosystem service are non-compliance with the pasture load standards. However, the pasture rental rates remain low.

Wood products

Wood supply is an ecosystem service of special importance. The ecosystem service providing fuel to the local population is based on the data of disposing the park to local population, on the data from the NABU project and the survey of the park's administration. The park sells the wood obtained from the thinning and sanitary cutting. The average annual volume is 600 m^3. Of these, about 200 m^3 is the construction timber (SAEPF and NABU, 2016). In the natural park, the timber stands with a dense close are 821.0 ha, with a free close of 11,251.2 ha, and with a rare close of 1,893.2 ha. The area of the stable timber stands is 6,592.9 hectares, and of the critical stands is 133.5 hectares.

The estimation was made using the direct market method (Carson et al. 2003). When assessing the service, the data of the Chon-Kemin SNP forestry plan were used as the sustainable volumes of timber production, including the thinning and sanitary cutting according to the Development Project of the Chon-Kemin SNP. The market prices were used to limit the effects of market distortions, such as subsidies. The market price of the construction timber is 8,000 KGS, the firewood and brushwood costs 600 KGS per 1 m^3. According to the Chon-Kemin SNP Development Project, the average sustainable level of

production is 1,237.3 m^3; firewood - 523 m^3 and the gathered brushwood - 800 m^3. The total value of this ecosystem service amounted to 10,684, 200 KGS.

Currently, the park administration considers timber logging as one of the priority sources of the park's income. Despite the attractiveness of this area, the concentration in this area is unstable in the medium-term development due to the limited wood resources and a large impact on other ecosystems of the park.

Non wood forest products

Along with wood products, the natural park provides the local population with a number of non-wood products such as raspberries, mushrooms, honey, sea buckthorn, other medicinal herbs, raspberries and currants. Among the fruiting shrubs, prevails the rosehip - 387.4 ha, followed by sea buckthorn - 136.2 ha.

- **Milk mushrooms**

According to the survey data, approximately one third of the local residents pick mushrooms. Milk mushrooms are gathered from the 20th of May to the end of August. The collected mushrooms are then sold in the markets of Tokmok and Bishkek. The mushrooms are either salted or canned. Approximately 100 people pick mushrooms in the Kok-Oyrok autonomous district, and 20 people from the Chon-Kemin Autonomous district (RDF 2011). The prices range from 110 to 196 KGS per kilogram with the costs ranging from 22 to 26 KGS per kilogram. The net value is 170 KGS for the salted milk mushrooms, and 110 KGS for the preserved ones, with the annual collection volumes of 3.5 tons and 9 tons, respectively. The total value of the mushrooms ecosystem service amounts to 1,274,000 KGS.

- **Sea buckthorn**

Sea buckthorn is gathered by local people mainly in the floodplain forests around rivers, from mid-October to the second decade of December. The sea buckthorn is collected mainly for sale and only the

small part is used for their own consumption. The average price of sea buckthorn amounted to 150 KGS, with the costs of 30 KGS per kilogram. The total declared volume was 13.6 tons. The total value of the ecosystem service for providing sea buckthorn amounted to 1,225,800 KGS

- **Raspberry**

Raspberry is gathered from late July to late August. There is no sales chain to the big cities and as a result the volumes of the collected raspberry are low. Averagely, one person collects 5-7 kg per day, a total number of pickers are 60. With the net price of 80 KGS per kilogram and the total volume of 12.6 tons, the total value amounted to 718,200 KGS.

- **Honey**

Despite frequent mentioning of honey, it was difficult to obtain honey production volumes in the field and desk studies. That is why, data from the previous park reports, NABU and the interviews with the foresters of the park were used. With the volume of 2.3 tons and the price of 200 KGS, the total value was 460,000 KGS.

- **Nettle and dogrose**

Local residents collect nettles, which the dealers then sell to pharmacological companies for medicines manufacturing. The volume is 2 tons, and the net price is 120 KGS. Comparatively low prices led to the total production value of 90,000 KGS. The production of dogrose amounted to 774 kg at a price of 100 KGS with the total value of 77,480 KGS.

The total value of non-wood products of the park amounted to 3,845,480 KGS, where the highest values correspond to mushrooms and sea buckthorn.

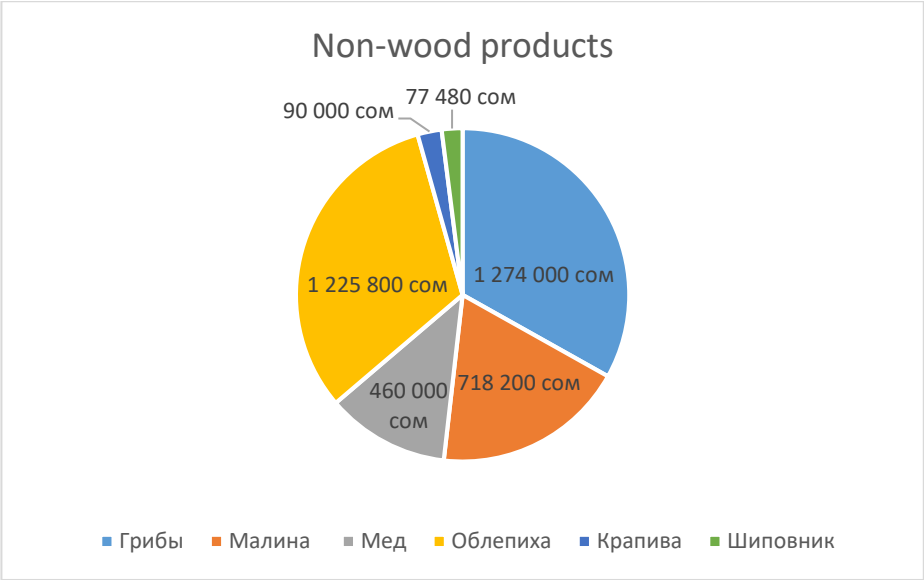


Figure 4.1. The values of non-wood products

Tourism

Popularity of the Chon-Kemin SNP among the local and foreign tourists is growing. The picturesque landscapes, the forest and a short distance from Bishkek, make this area very attractive for recreation. Tourism started to develop relatively recently and nowadays almost every village accept tourists (SAEPF, 2016).

The main tourist services include provision of the overnight stays, horseback riding and hiking tours, guide services, the display of national games (Kok Boru, Kyz Kuumai, Er enish), and the sale of souvenirs and handmade goods. In the villages of Chon-Kemin there are guest houses that accommodate tourists.

The guest houses are divided into the private hotels and guest houses of the Community Based Tourism network (CBT). According to our survey, there are about three dozens of guest houses there.

The local tourists, as a rule, come to receive kumiss treatment, and normally stay up to ten days. While foreign tourists arrive for 2-3 days, and then go through the Kalmak Ashuu pass to the Issyk Kul Lake. Nevertheless, according to the survey, the goals and types of recreation of the local tourists began to change, i.e., there is a growing number of local tourists who prefer tracking. There are also groups of tourists from the Middle East who stay several days, as a rule, in those guest houses that are located in close proximity to the natural park with more comfortable living conditions, for example, in the Kok Archa guest house.

Tourists are attracted mainly through tour operators in Bishkek and the neighboring countries. Depending on the agreements, the tour operators receive a certain percentage from the guest house or pay for tourists' accommodation on their own, that is, tourists buy a package that includes accommodation. The average cost of accommodation ranges from 800 KGS to 2,800 KGS per night, the food prices range from 350 KGS to 700 KGS, the horse tours from 1,400 KGS per day, and the organization of national games from 3,000 KGS.

There are official entry fees in the park, but their collection is inefficient and no exact data on the number of tourists is available. In 2015, the tourism revenues amounted to 53,700 KGS, that is, one percent of all park revenues. Nevertheless, the park administration and local residents consider tourism one of the promising areas for generating additional income. Within the NABU project, the administration developed several tourist routes, and calculated a recreational potential on one of them (TERR, 2016). These data were also taken into account in the assessment of tourism ecosystem services.

The general method for estimating tourism is the Zonal Travel Cost method (Carson et al. 2003). The essence of the method is the breakdown into zones and building the demand function.

The prices for arriving in Bishkek for foreign tourists are the same as for local people, since Chon-Kemin is not the main destination and,

as a rule, serves as a transit point on the way to other landmarks. According to the survey data, attendance of the zero zone is as follows - the local population of the nearby villages - 90 people, the first zone - Bishkek - 900 people, the second zone - foreign tourists – 3,000 people. For the second zone, the costs are the same, since they travel from Bishkek.

Table 4.2. Cost calculation

Cost calculation of 1 km trip	
Estimated car price	350,000 KGS
Expected max mileage	300,000
Cost of 1 km	0.86 KGS
Annual tax per km	3.333333 KGS
Fixed costs	4.19 KGS
Total cost for 1 km	**10.39** KGS

The calculation of the demand function included the attendance of three zones per 1000 people, the cost of one kilometer of trip is based on the fixed and variable costs, and the cost of time based on an hourly income.

Table 4.3. Input data for the demand function

Zone	**Visits**	**Number of residents of the zone**	**Visits per 1000 people**	**Distance, km**	**Time**	**Cost of 1 km**	**Total cost, KGS**
0	90	45,000	500	0	0.00	10.5	0.00
1	900	966,000	1,073	290	4.14	10.5	3,045.00
2	3,000	1,200,000	400	290	4.14	10.5	3,045.00

Continue of the Table 4.3.

Hourly income, KGS	Cost of time	Total cost, KGS
3.25	0.00	0.00
8.23	34.10	3,079.10
1,694.00	7,018.00	10,063.00

Then, using a regression analysis, the demand function was built. The calculation of the formula is based on the least square method.

Table 4.4. Regression analysis

Zone	Entry fee	Coefficient	Angle	Costs, KGS	Number of people
0	300	940	0.00026	300	940
1	300	940	0.00026	3,379	939
2	300	940	0.00026	10,363	937
					2 816

Also, to confirm the data, the method of individual calculation of the travel costs was applied, based on the survey of the guest houses employees. Both methods roughly matched at a difference of 66 visitors. Thus, the analysis showed that the total value is 22,2 million KGS.

In 2016, the accounting income of the park from tourism amounted to about 52,000 KGS, which shows a huge potential for increasing the revenues of the park. Obviously, the complexity of the tourist control lies in the fact that all eight villages have access to the forest, and provide services to tourists, and the park does not have enough staff.

Biodiversity

Provision of habitat is the main goal of the Chon-Kemin Natural Park. The Natural park is inhabited by species listed in the Red Book of the Kyrgyz Republic: 6 species of mammals, 11 species of birds (SAEPF, 2015).

The assessment was based on the benefits transfer method (Ferraro et al. 2011). The advantage of the method is its simplicity. The method involves transferring the cost of an ecosystem service from one locality to another. For the transfer, those research parameters were selected that are most suitable by the biodiversity composition and socio-economic development - the Chon-Aksuu River Basin. The area of the Chon-Aksuu basin has the same ecosystems as Chon-Kemin. The price per one hectare was 28,000 KGS.

Thus, the ecosystem service for provisioning the habitat for biodiversity was 3,4 billion KGS.

Carbon sequestration and storage

The dense vegetation and the untouched areas of the Chon-Kemin Natural Park represent a large storage of carbon dioxide, providing regulating functions and the circulation of substances. The challenging terrain of the park creates unique pockets for storage and sequestration of carbon dioxide. It is undoubtedly hard to overestimate the importance of the carbon sequestration and storage ecosystem service for the local climate, and also bearing in mind the close proximity of the Bishkek-Torugart highway.

The IPCC methodology was used to calculate carbon sequestration (2006). The average carbon storage values were also taken from the IPCC manual, three types of source (aboveground, soil, biomass) were included, and the lands were divided into 19 categories, and the carbon indicators were calculated for each category. Such characteristics as the crown density and the use intensity were also taken into account.

The total value of the carbon sequestration and storage ecosystem service amounted to 5.8 billion KGS at a price of 1 050 KGS (USD 15) per ton of carbon. Since there is no carbon market in the CIS, the price of 1 050 KGS was chosen based on the research of Economics Land Degradation Initiative (2016).

Drinking and agricultural waters ecosystem service

The Chon Kemin River is formed from the territory of the natural park. As was already mentioned, the total catchment area of the Chon-Kemin river is about 7200 sq. km. According to the observations within a number of years, the average annual flow rate is about 80 m^3/s. The water resources of the park provide drinking water to the entire local population, with the exception of the villages of Shabdan, Tegirmenti, Tortkol. The value of drinking water was calculated based on the replacement methodology "Methodological guidelines for determining prices (tariffs) for the services of the rural water users associations for providing consumers with drinking water". The methodology includes the cost of material expenses, labor remuneration and contributions to the social fund (SACRD 2012). The consumption rate of 60 liters per person a day was used, and the net cost of one cubic meter of water was set at 28 KGS. The total value of the ecosystem service for the provision of drinking water amounting to 5.1 million KGS.

Water resources of the park are very important for irrigation, not only of the local, but also of the regional level. The water of the Chon-Kemin River is used by all communities downstream for various needs. The cost of irrigation water was calculated on the basis of the data from the water sector development strategy and the data on the general indicators of the water use in the Chui oblast (Popova et al. 2011). For instance, it was found that 34 percent of the total water flows of the Chui oblast are used for irrigation.

Table 4.5. Estimated water data

Average water flow per hour	288 000 m^3
Average daily flow	6 912 000 m^3
Average annual flow	2 522 880 000 m^3
Coefficient of use for household needs - 34%	857 779 200
Total value at the approved rate in KGS.	**25 733 376**

In all, the total cost of irrigation water amounted to 25.7 million KGS. It is quite obvious that this figure is underestimated because of the subsidies, and does not reflect its full cost, while the more accurate methods have not applied because of the limited resources of this study. However, this indicator serves as a relatively important indicator of the value of this ecosystem service.

So, the total value of the ES for the supply of water amounted to 30.8 million KGS.

Conclusion

The total value of the ES of the Chon-Kemin SNP amounted to 9.4 billion KGS or 76 650 KGS per hectare. And, the non-market ES (biodiversity and carbon) dominate in the total value.

However, without considering the non-market ecosystem services, the pasture provision and tourism have the biggest value.

Table 4.6. The value of ecosystem services

Ecosystem service	**Net value in Kyrgyz soms**
Pasture provision	66 894 375
Forest	9 898 400
Brushwood	313 800
Firewood	472 000
Mushrooms	1 274 000
Raspberry	718 200
Honey	460 000
Sea buckthorn	1 225 800

Nettle	90 000
Dogrose	77 480
Tourism	22 277 100
Fish	45 000
Water	30 811 898
Biodiversity	3 462 312 000
Carbon	5 861 891 039
TOTAL	**9 458 761 092**

The assessment showed a huge contribution of the ES of the natural park to the well-being of population, of both the region and the country as a whole. Along with the direct market services and consumer goods, the park's ecosystems provide valuable climate mitigation services.

The data obtained are comparable with the other studies in the region. In particular, the obtained data were compared with the studies conducted in other areas of the Kyrgyz Republic, neighboring Kazakhstan, and some Asian countries. Hopefully, the data will persuade decision makers to improve the measures to protect and develop the Chon-Kemin SNP area.

The studies of GIZ and others

In the summer 2016, intensive interviews were conducted at the household level, in order to obtain data for calculating the costs and benefits of the use of high-mountain pastures. The calculations were coordinated with the data of Kyrgyzgiprozem (the Land Management Planning Institute under the Ministry of Agriculture) in order to analyze the functions of forage production, and the sustainable use of pastures. The ES and alternative scenarios for the sustainable land and pasture management have been analyzed in terms of economics. Three experimental summer pasture plots with a high level of land degradation were selected along with the dependence on the land and the land ecosystems for receiving the sources of the food and income,

inclusive of: the Chon Aksuu River Basin, Kyzyl Unkur village district, and the high-mountainous pastures of the Son-Kol Lake.

This study is the first one ever conducted in the Kyrgyz Republic and one of few in Central Asia aimed to assess the value of the pasture ES through the cost-benefit analysis. The study shows that there are a number of valuable ecosystem services. The high-land pastures are intensively used in such a way that there is a threat to the long-term sustainability, with pasture degradation in all three areas. If appropriate measures are not taken, the natural resources will be depleted, causing the damage to the quality of life of local population.

The cost-benefit analysis was made for the baseline scenario and two possible alternative scenarios: i) the increased pasture productivity by improving the management of pastures along with the favorable weather conditions and ii) the moderate pasture productivity obtained by the improved pasture management along with the adverse weather conditions. Both scenarios take into account the carbon accumulation and sequestration.

In the basic scenario, the productivity decreases annually by 2.5 percent, while in the first alternative scenario it increases by 5 percent per year, in the second one by 2.5 percent.

The studies and calculations have shown that the sustainable land management in the Chon Aksuu River Basin could lead to a net current profit of USD 9.4 million for a ten-year period with a 10 percent discount. In the conditions of Kyzyl Unkur, this value will amount to USD 4.1 million, and in Son Kole to USD 19.2 million.

V. Green economy and ecosystem services

In 2015, the UN General Assembly, including the heads of 193 states and governments, approved the Sustainable Development Goals (SDGs), which replaced the Millennium Development Goals. The outcome document, intitled "Transforming Our World: the 2030 Agenda for Sustainable Development" (UNDP-UNEP, 2018) contains 17 global goals and 169 tasks, and sets new targets for the socially and environmentally responsible activities of governments, private sector and public organizations.

Ecosystem services are included in the Sustainable Development Goals, in which commitments were made to ensure conservation, restoration and rational use of the terrestrial and inland freshwater ecosystems and their services. Accordingly, the conservation of the ecosystems that provide ecosystem services, should be a high priority in drafting the economic development strategies.

The Sustainable Development Goals recognize that the socio-economic development depends on the rational use of the natural resources of our planet, and so it is necessary to conserve and rationally use ecosystems.

Notably, the following Goals are dedicated to the protection of ecosystem:

To achieve Goal 2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture", it is necessary to create the sustainable food production systems, and introduce the agricultural methods that increase resilience and productivity, increase the production volumes, contributing to the conservation of ecosystems, strengthening the ability to adapt to the climate change, the extreme weather events, droughts, floods and other disasters.

To achieve Goal 6 "Ensuring the availability and the rational use of water and sanitation for all", it is necessary to protect and restore

the water-related ecosystems, including mountains, forests, wetlands, rivers, water bearing strata and lakes.

To achieve Goal 14 “Conserve and sustainably use oceans, seas and marine resources for sustainable development”, it is necessary to ensure the rational use and protection of the sea and coastal ecosystems in order to prevent significant negative impacts, including through enhancing the resilience of these ecosystems, and taking measures to restore them for ensuring good ecological state and productivity of the oceans.

To achieve Goal 15 “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”, it is necessary to ensure conservation, restoration and rational use of terrestrial and inland freshwater ecosystems and their services, including forests, wetlands, mountains and drylands, in accordance with the obligations arising from international agreements; ensure the conservation of mountain ecosystems, including their biodiversity, in order to increase their ability to provide the benefits necessary for sustainable development; ensure that ecosystem values and biodiversity are taken into account in the national and local planning and development processes, in the development of the poverty reduction strategies and plans.

The Kyrgyz Republic has committed to achieve the Sustainable Development Goals, emphasizing the development of **green economy, maximum energy conservation, and the use of alternative and renewable energy sources as the main vectors.** The Sustainable Development Goals are closely intertwined with all strategic program documents of the country. In 2020, it is planned to present the Voluntary National Report on the achievement of SDGs in the Kyrgyz Republic.

There is a direct relationship between ES and green economy.

First, the very concept of ES is designed to "open up" and identify those natural benefits that, as a rule, are not taken into account in the standard economic production process. Such situation leads to the degradation of natural resources or, at its best, to their inefficient consumption. In such a way, for example, the global climate warming takes place because ES for climate regulation have been ignored in the economy for centuries, and now the mankind is paying for it in the form of the adaptation and mitigation measures.

Secondly, ES increases the revenues of people through monetization of natural resources. For example, payments for water or improvement of the land management to absorb carbon by the soil.

Thirdly, implementation of the principles of green economy will improve social justice by introducing payments for ES, because usually the most vulnerable strata of the population are most dependent on ES in their socio-economic activities.

Both initiatives - SDGs and green economy are closely intertwined. So, in 2016, Kyrgyzstan became a member of the Global Partnership for Action on Green Economy (PAGE), joint initiative of five UN agencies - UNDP, UNEP, ILO, UNIDO and UNITAR.

With the support of PAGE, Kyrgyzstan began revising its economic policies and practices around the sustainability to stimulate economic growth, create jobs and increase incomes, reduce poverty and inequality, and strengthen the environmental foundations of economics.

In 2017, the "Inclusive Green Economy in the Kyrgyz Republic" report was prepared. It represents an analysis of the conditions, prerequisites and challenges for the introduction of green economy in the Kyrgyz Republic, describes the measures taken by the government to resolve the key problems, and identifies priorities and recommendations for the PAGE activities.

The green economy concept in the Kyrgyz Republic "Kyrgyzstan is the country of green economy" was approved by the resolution of

Parliament of the Kyrgyz Republic dated June 28, 2018 No. 2532-VI. In 2019, the "Development of Green Economy in the Kyrgyz Republic for 2019-2023" program was developed. To move to green economy, it is proposed to develop the "green areas" in 10 sectors. Two of them: the sixth and the seventh ones are almost entirely devoted to ecosystems.

The sixth section of this concept is titled Public policy, green public procurement and payments for ecosystem services. This section provides:

- Development of the system of economic indicators that ensure accounting of natural resources and assess the degree of the economic activity impact on their condition;
- Adaptation of the methodology and implementation of the system of the environmental and economic accounting of the key natural resources in the system of national accounts;
- Conducting a monetary assessment of all economically potential ES and biodiversity resources;
- Research and application of the approaches for the development of the ES market, including the following services - provisioning (food, water, forest, raw materials), regulating (climate impact, control of floods, natural disasters, water quality, etc.), cultural (recreational resources, aesthetic and spiritual values of nature), supporting services (soil formation, photosynthesis, nitrogen cycle, etc.) and local schemes for the system of the PES;
- Integration of the ecosystem approaches and accounting of natural capital in planning the economic development of Kyrgyzstan;
- Development and implementation of the concepts, principles and international experience of the ecosystem management at the national and local levels of government to maintain and

strengthen the state of ecosystems in order to meet the current and future needs;

- The seventh section is titled “Protection of Biological Diversity”, it notes that in the last 20-30 years there has been a clear tendency of the ecosystem degradation, habitat shrinking, and the decrease in the size and the number of many plant and animal species. Among the environmental factors affecting the biodiversity and ecosystem services, in Central Asia the ongoing climate aridization and altitudinal zoning are emphasized. Both factors place the biological communities of Kyrgyzstan under the conditions of extreme survival.

5.1. Contribution of ecosystems to the economy of the republic

Ecosystem services are often associated with natural capital, which is understood as the stock of natural resources and environmental services, i.e. natural capital is an economic model of the limited reserves of natural resources, and the decreased ability of ecosystems to provide services.

A concept of ecosystems as capital has received its practical interpretation in the innovation developments of the World Bank Ecological Department. Also, in the theory of Stefano Pagiola, Konrad von Ritter, Joshua Bishop, it was proposed considering ecosystems as capital (Stefano Pagiola et.al., 2005).

Natural capital significantly affects the current practice of calculating macro-economic indicators, which are determined through national accounts.

The forestry of the Kyrgyz Republic is not a pivotal sector in the country's economy. Its contribution to the country's economy is insignificant, the gross output of products from hunting and forestry is 0.05 percent of GDP.

The environmental role of the forests of Kyrgyzstan, the high mountainous terrain, a sharply continental climate and proximity of the arid zones, causing a slow regeneration of forests, are the reasons of the insignificant timber harvesting volumes, making Kyrgyzstan dependent on the deliveries of commercial timber and lumber for more than 90 percent.

Nevertheless, Kyrgyz forestry has the potential to increase its contribution to the country's economy through forest management: developing tourism in the forest ecosystems and marketing non-timber forest products: walnuts, almonds, pistachios, honey, medicinal herbs, etc.

Since 2015, the National Statistical Committee of Kyrgyzstan has been working on the implementation of the System of Environmental-Economic Accounting.

The System of Environmental-Economic Accounting (SEEA) is an international statistical standard, which represents a multi-purpose conceptual framework for considering the interaction between the economy and environment.

The Kyrgyz National Statistical Committee is developing forest accounts (part of SEEA) based on the economic assessment of the forest ecosystem services.

The forest accounts will show a real contribution of the forestry to the country's GDP. As mentioned above, the contribution of forestry is 0.05 percent, after experimental accounting of the forest accounts, this figure increased 26 times and amounted to 1.24 percent.

The process of the forest accounts development has shown that a reporting system at the level of leskhozs has been in a poor condition for 25 years. The statistics submitted by the leskhoz to NSC are not accurate. For example, the statistical data on gathering walnuts, medicinal herbs, honey, and cattle grazing on the lands of the forest fund are underrated or even unavailable. To eliminate these problems, the

statistical reporting forms of leskhoz were revised and officially introduced into the forestry reporting system.

5.2. Ecosystem cost-benefit analysis

Analysis of the distribution of benefits derived from the ES and recipients of such benefits, allows to understand the problem of the economic efficiency of the ecosystem maintenance and conservation. In accordance with the typical cost-benefit analysis of economics, the economic decision's effectiveness and adoption is determined by a ratio of the respective benefits and costs. If the benefits exceed the costs, the activity is considered cost-effective. In the case of ecosystem services, the costs/expenses for their conservation are quite identifiable and can be correctly estimated economically, but the benefits/effects are much more difficult to define.

Uneven distribution of the costs and benefits leads to certain consequences. It is important to understand exactly what benefits and costs are incurred by local users, as they can seriously influence the ecosystem use. If they benefit from a particular type of the natural resources use, then they will adapt the ecosystem to it, regardless of the size of benefits from the environmental measures for others. Similarly, if local users are more interested in keeping the current situation than in the consequences of any changes, then they are most likely to oppose it.

Thus, the notion of the "winners" and (especially) of the "losers" allows to understand the interest of specific groups in one form of the ecosystem use or another. By comparing the net benefits that these groups receive from a particular use of ecosystem (for example, if the environmental protection measures are being implemented, or not), it can be predicted which groups will most likely support the change in the use of nature, and which will oppose it. Through this approach, it is possible to get important information for the development of appropriate measures.

The benefits of an action/intervention leading to the changes in the state of ecosystems should be determined through an assessment of the economic expediency of a particular action/ intervention.

As a rule, economic problems are addressed without taking into account environmental consequences, and an economic assessment of ES can be a useful tool in the decision-making.

The examples of economic insolvency in assessing benefits of the ES maintenance and conservation, and real damage caused by neglecting them are the creation of the Khan-Teniri natural park and introduction of the amendments to the Water Code of the Kyrgyz Republic.

Initially, the Khan-Teniri State Natural Park was planned to be set up in the high-mountainous ridge zone of the Issyk-Kul region on the area of 375 thousand ha, but it was only possible to set it up on the area of 275 thousand ha. The park was established on the lands that were supposed to be withdrawn from the turnover of various land users, in this case, from the turnover of the village districts. The designed sections of the natural park are located in the inaccessible places and were difficult to use for any purpose by local population. Notwithstanding these lands had a high potential for the biodiversity conservation, the village councils did not support the idea of establishing a natural park on the area of 100 thousand hectares, because these sites were also interesting in terms of the subsoil use, and the members of the village council explained that the subsoil users could receive more benefits in a form of various payments.

Unfortunately, when making such a decision, they did not take into account environmental consequences of the subsoil use, the level of anthropogenic impact of the subsoil use on the environment, public health, and on ecosystem services. No calculations of the economic assessment of all damage and restoration of the disturbed ecosystems and their services were made. This is only one example of the situation

when the regional development that would consider nature conservation, gives way to the traditional economic decisions that gives easily assessed benefits.

If the mechanisms of the economic assessment of ES had been introduced, the decisions of the deputies of the village councils would have been obviously different, i.e. towards the creation of a natural park on the larger area.

Another example of solving economic problems without considering environmental consequences was also a proposal to amend the Water Code of the Kyrgyz Republic regarding the destiny of the Davydov and Lysy glaciers.

The public assumed that the areas of the Davydov and Lysy glaciers in Kyrgyzstan were significantly reduced as a result of the gold mining activities at Kumtor, and that the proposed amendments to the Water Code would impact the melting of the Davydov and Lysy glaciers, and the quality of water contained in them, etc.

Despite the picket held in front of the "White House" by public activists, and their previous protests in the media and social networks, the amendments to the Water Code were adopted by the law of November 23, 2017.

The public did not have sufficient results of the economic assessment of ES of these glaciers, which would allow to correctly assess the situation in the flow of costs and benefits on the Davydov and Lysy glaciers.

An example of the distribution of costs and benefits associated with ecosystems is the creation, not always fully developed, of specially protected areas. For example, in 2012, the Government of the Kyrgyz Republic decided to create the Dashman State Nature Reserve, which is located in the Bazar-Korgon district of the Jalal-Abad region. The reserve was established in order to preserve the genetic fund of walnut, as a relic and especially the valuable tree species.

Turning the category of the state forest land fund of the Kyzyl-Unkur and Arstanbap forestry to a protected area of the Dashman reserve, resulted in the change of the legal land use regime. As a result, the local population suffered, and their access to resources, which sustained their lives, deteriorated. This situation provoked constant offences, and therefore the reserve's protected area status is not respected.

In general, the analysis of the costs and benefits distribution is important because it helps to understand the impact on the well-being of the local population and to try to avoid harming the poor as a result of the environmental activities, and also to develop the projects, which would reduce poverty and promote social development.

Analysis of the distribution and receipt of benefits and costs allows that various stakeholders understand how environmental protection measures impact the lives of local population and other interested groups.

The analysis of the benefit distribution can accomplish another important task: with its help it is possible to identify those who benefit from the environmental measures, both in the country and abroad. Thanks to this, it is possible to determine the potential financing mechanisms for the environmental protection activities. The similar results indicate that appropriate compensation mechanisms for local communities need to be included in the ecosystem support system.

5.3. Potential sources of funding for the ecosystems conservation

The understanding that the services provided by ecosystems are of great value, does not mean much in itself if it does not result in the real investments in the conservation of such ecosystems. Experience has shown that relying solely on the government funding for ecosystem conservation is unrealistic. The countries with the limited budgetary

funds often do not want to devote significant resources to the environmental protection, even if the benefits of such a step are obvious. In addition, the budget shortfalls and other problems often lead to the cutbacks in funding, even though everyone is well aware of the benefits of the environmental protection activities.

Attempts are being made to create mechanisms through which it would be possible to ensure the maximum degree of self-financing of the environmental protection activity, so that it does not depend on the annual government decisions on budgets and grants. Among such attempts are both, a traditional approaches, such as, the fee collection from visitors of the protected areas, payments for land use, and new approaches, such as, payments for ecosystem services, through formation of the ES payment markets, introduction of the compensation mechanisms for ecosystem services, etc.

In Kyrgyzstan, the government owns most of the ecosystems, while the users of ES are the world community, private sector, local people, etc. It is obvious that in this case, the government should be the recipient of payments for ecosystem services, which will ensure implementation of the activities to preserve ecosystems using these funds.

An example of the use of ES by the world community is the absorption of carbon dioxide by forests, pastures, and the water ecosystems services etc. The first global breakthrough in the development of the systems for PES was the market of the greenhouse gas emissions quotas, the economic foundations of which were laid down by the Kyoto Protocol. Within this market, there are the prices for greenhouse gas emissions, their sellers and buyers. Therefore, the payment mechanisms for ES for climate regulation and water ecosystems are the key issues of interstate and transboundary negotiations.

Tourism is one of the priority sectors of the economy of the Kyrgyz Republic. Ecosystems have a great recreational potential for the development of the domestic and international tourism. As a rule, busi-

ness communities actively participate in the development of this potential, therefore there is the possibility of improving the mechanisms of public-private partnership, taking into account the payments for ecosystem services. In this case, the government as the owner of ecosystems can participate in the tourism development and receive its share of the net profit.

When creating protected areas, the interests of local population, unfortunately, are not taken into account, as a result, their access to the resources on which their lives depend, is deteriorating. Therefore, the government should provide a program for employment and retraining of the local population if they abandon using natural resources in the protected areas. In this case, the government is a payer, and the local population is a recipient, for whom new jobs should be created in other areas of activity.

The evidence from practice shows that PES are potential sources of financing for ecosystem conservation. For this, on the one hand, it is necessary to increase the interest of the owner of the ES to conserve them, and on the other hand, to make sure that all users of the ES pay, which will increase the owner's activity in the conservation and enhancement of these services.

VI. Assessment and monitoring systems of ecosystem services

6.1. International experience of mapping and monitoring, and systems of indicators

Ecosystem services have a spatial component, the ecosystem structures, functions and processes are producing services in a specific location, and the benefits will be derived and consumed in the same and/or other location. They are often associated with the land cover and the land use practices. Thus, it creates a geographic characteristic that can be identified, quantified and mapped by linking ES to the biophysical and socio-economic characteristics and processes, such as the land cover, forest maps, land use, habitat degradation, residential areas and human needs (UNEP - World Conservation Monitoring Centre, 2016)

Many ES experience the obvious pressure and dependence on the anthropogenic factors. ES mapping can help identify the ecosystem health risks, the unsustainable use of potentials for the delivery of services, the adverse impact on landscapes, interruption of the ES flows, and discrepancies between the ES supply and demand. Such information may help improve ES and set priorities for the conservation of nature and biodiversity.

Mapping of the ecosystem represents a spatial differentiation of ecosystems in accordance with the agreed ecosystem types, which are heavily dependent on the purpose of mapping and scale. Global approaches to the ecosystem classification and mapping use two main principles: the typological and regional ones (or their combinations). The typological approach divides the nature into the types of ecosystems – the classes, which can be represented on a geographical scale (for example, forests, agricultural land, etc.). Mapping of the ecosystems should also meet the management needs and, to a large extent, is determined by the data availability.

The Joint Conservation Committee of the Government of Great Britain has developed a useful methodological spatial framework, which serves as a detailed decision tree for ES mapping. Based on this decision tree, which answers to a question of the relevance of applying ES on the map, an approach to mapping was subsequently developed (Figure 6.1).

Applicability of maps

The most important phase in considering any ES mapping task begins with the questions “why is this being done?” And “for whom is this being done?”, and also very often - “what changes do we want to see as a result of this?”.

The maps can be used to spatially depict the priorities and identify the problems, especially regarding the interactions and trade-off solutions between different ecosystem services, and between ES and biodiversity.

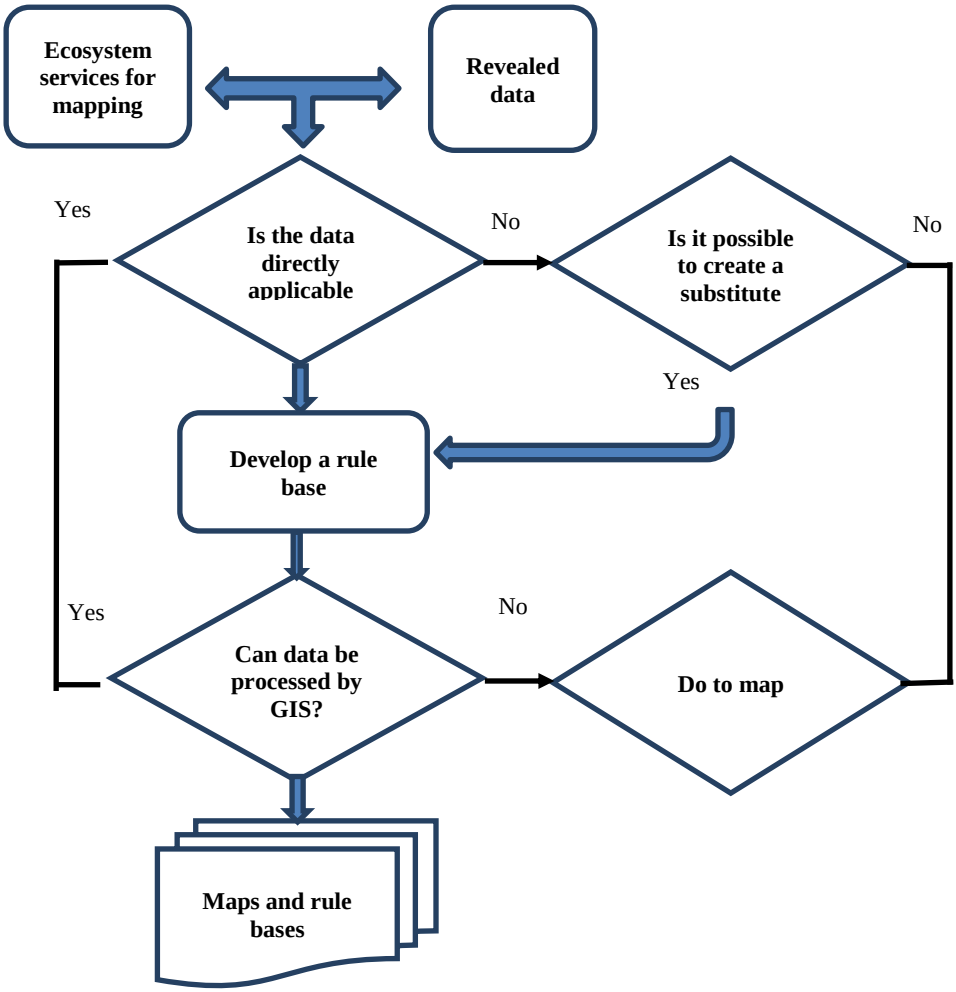


Figure 6.1. Approach to mapping

Besides, the maps can be used as a communication tool to start negotiations with stakeholders, visualize places where the valuable ES are produced and used, and clarify the importance of ES to the local population.

A spatial scale of maps

A geographic coverage (area) of the ES mapping task may vary from the small objects locally to the regional, national, continental and even global coverage. The provision, consumption and management of the ES resources are relevant at the local scale, while the benefits, values and demand are relevant in all scales. The decision to cover the mapping work will depend on the context of the expected end result of the ES mapping process, availability of data, the end-user needs and their relevance in terms of decision-making and the types of services mapped. For example, if a map of the water ES is being compiled, then the water basins should be included as a whole, while the production of mushrooms for local consumption will require significantly less mapping coverage.

Time scale

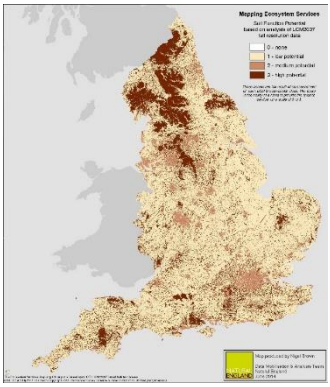
As with the spatial scale, the choice of timeline will depend on the expected outcome in the form of a map, and on the basic process of changes in the specific ES of the study. It is possible to consider the daily, monthly, quarterly, annual, and decadal levels. An optimal scale for one service may not be relevant for another one. For example, the daily calculations of the carbon reserves on the global scale will be unnecessary and require processing of huge amounts of data, while the daily values can be extremely important for creating models of the surface drains directed at determining the value of the extreme events control. The time scale selection issues also touch on the time elapsed between the creation of the ES and their final consumption by the beneficiary.

Mapping of ES originated in the late 90s and early 2000s. In that period, an active work was carried out to introduce the concepts and principles of ecosystem services. An impulse for creation of the ES maps was the results of the work on the economic assessment of ecosystem services. These tools (maps) served as the basis for decision-

making on the restoration and conservation of the ES flows. An example of the ES mapping in England is given in Figure 6.2.

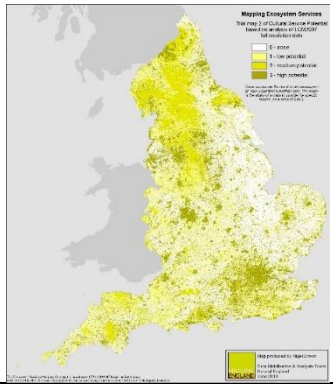
Example 1. Soil capacity map

0 - No potential;
1 - Small potential
2 - Average potential
3 - High potential **5**



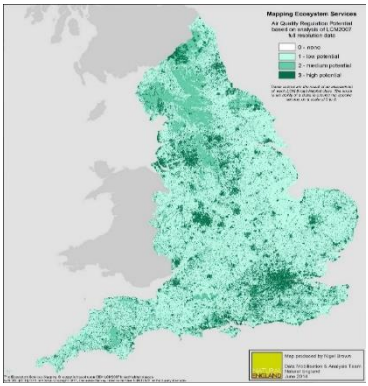
Example 2. Cultural services map

0 - No potential;
1 - Small potential
2 - Average potential
3 - High potential



Example 1. Air quality control map

0 - No potential;
1 - Small potential
2 - Average potential
3 - High potential



Example 1. Wild species diversity map

0 - No potential;
1 - Small potential
2 - Average potential
3 - High potential

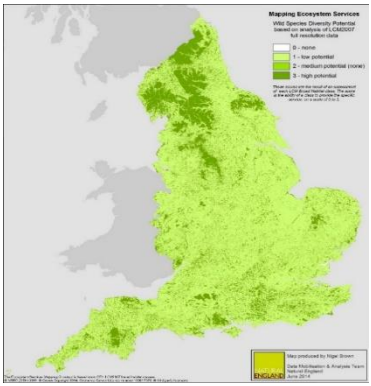


Figure 6.2. National mapping of ES in England

6.2. National experiences on the ecosystem services mapping

In Kyrgyzstan, the mapping of ecosystems and ES began as part of the projects of the Regional Environmental Center for Central Asia. Since this work was carried out for the first time, the local GIS specialists, who study the international experience and available materials for mapping ecosystems and ecosystem services, have developed their own approach. In all pilot territories, this approach was applied and tested, and the first feedback was received from the environmental specialists. Available materials for mapping ecosystems and ES were the accessible maps of forestry, the land use maps from rural authorities, satellite imagery (from Google Maps), topographic basics (roads, residential areas, terrains, rivers and streams, etc.).

An approach to developing ecosystem maps and ES was as follows:

- Digitization of the external borders of the land and forests using the land use and forest maps;
- Creation of the ecosystem maps (based on the list of ecosystems by E. Zh. Shukurov) from the digitized land use map;
- Overlap of the digitized boundaries of the land on the satellite imagery and refinement of their external boundaries;
- Overlap of the topographic fundamentals on the satellite imagery, refinement and the general overlay of the digitized ecosystem map.
- Ranking of the ES according to their economic value and importance;
- The relationship between the ecosystem maps and the ranking to reflect the importance of the ES for the pilot area.

The examples of the resulting maps by the pilot areas are given below.

In 2015-2017, the Supporting local initiatives in the field of environmental and water management in Central Asia: Phase 2 project was implemented.

The Chon Aksuu River Basin in the Issyk-Kul region and the Zerger Rural Administration in the Osh region were selected as pilot areas. The resulting maps of the ecosystems and their services are given below.

Ecosystem map of the Chon Aksuu River Basin

The Chon-Aksuu River Basin is located in the Issyk-Kul region. The total area of the river basin is 45,260 ha. It includes forest ecosystems, agricultural ecosystems, water and pasture ecosystems and other (glaciers, rocks and scree) and residential areas.

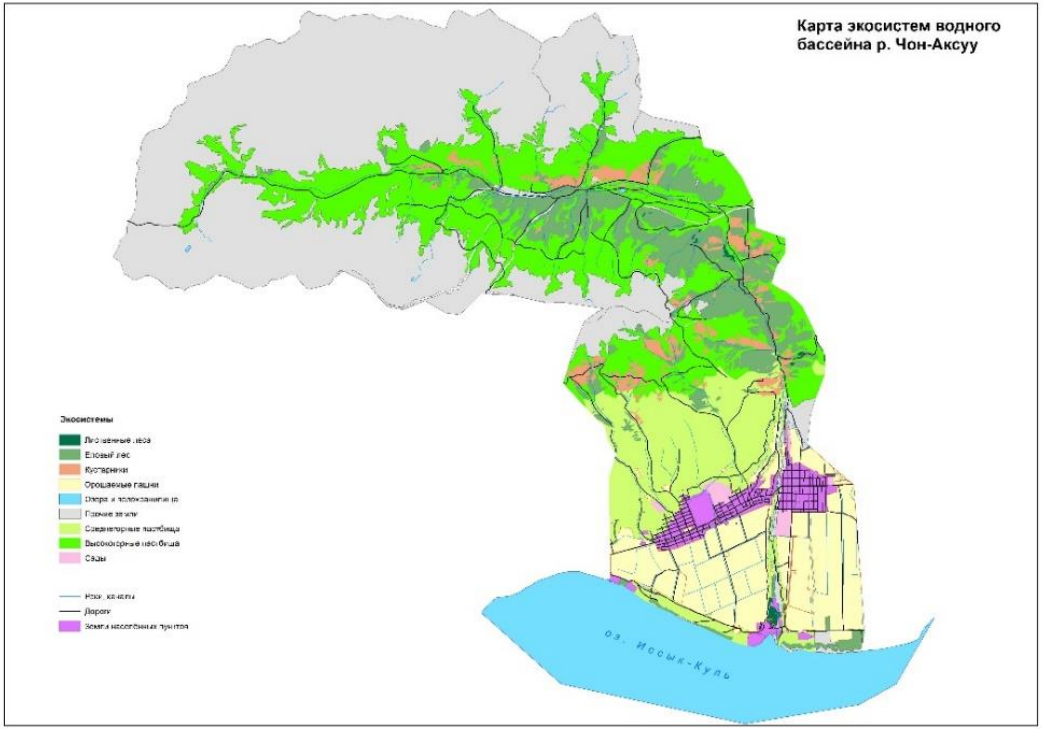


Figure 6.3. Ecosystem mapping of the Chon Aksuu River Basin

Mapping of the ES in the Chon-Aksuu River Basin was carried out after obtaining the economic indicators of the ecosystems, listed in Table 6.1

Table 6.1. Ecosystem services value of the Chon Aksu River Basin

Ecosystem services and products	Volume	Unit price in KGS	Price in KGS	in USD
Agricultural products	151 839		2 481 902	34 956
Haying (esparcet)	98 540	200	19 708 000	277 577
Using pastures	15 038 610	20	300 772 190	4 236 228
Picking mushrooms	12 840	450	5 778 000	81 380
Firewood for heating	14 015	400	5 606 000	78 958
Drinking water suply	14 015	20	3 363 600	47 375
Carbon sequestration (pastures+ forest)	155 215	1 349	209 384 671	2 949 080
Eco-tourism	22 560	4 500	101 520 000	1 429 859
Biodiversity	38 938	35 500	1 382 299 000	19 469 000
Total:			**648 614 363**	**28 604 414**

	Provisioning services		Cultural services
	Regulating services		Supporting services

Examples of the ES maps

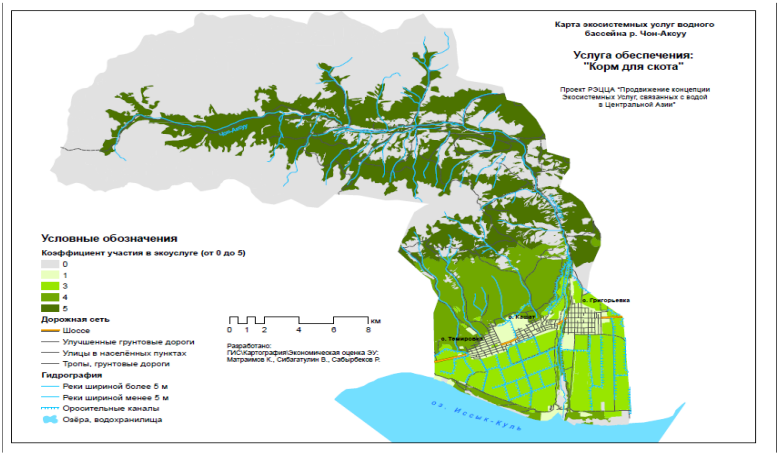


Figure 6.4. Map of the livestock feed ecosystem service in the Chon-Aksuu River Basin

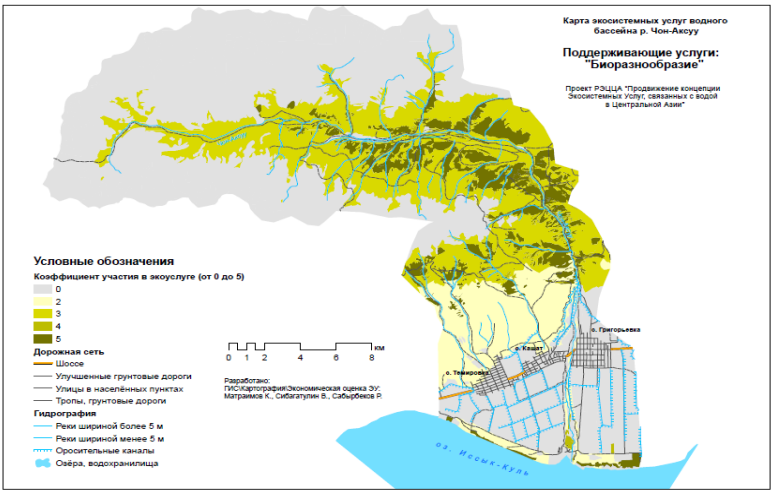


Figure 6.5 Map of the biodiversity ecosystem service in the Chon-Aksuu River Basin

The basin of the Zerger river

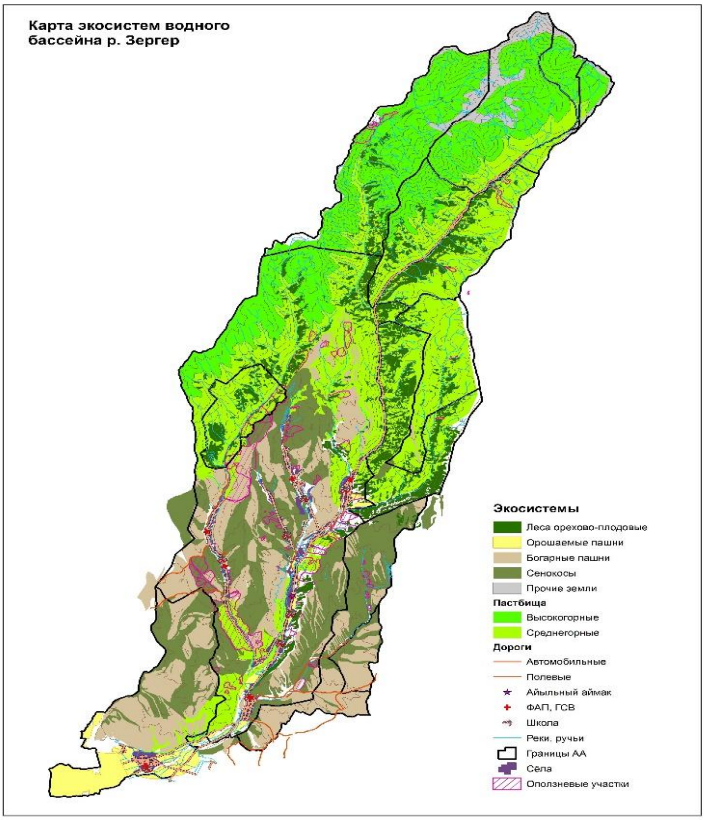


Figure.6.6. Ecosystem map of the Zerger River Basin.

The Zerger River Basin is located in the Uzgen district of the Osh oblast. The total area of the basin is 42,520 ha. It includes forest ecosystems (nut), agricultural ecosystems, water and pasture ecosystems, residential districts. The River Basin consists of the lands of Uzgen forestry and Zerger village district

Mapping of the ES in the River Basin was carried out after obtaining the economic indicators of ecosystems, which are given below.

Table 6.2. Ecosystem services value of the Zerger River Basin

Ecosystem services and products	Volume	Price per unit in KGS	Price in KGS	in USD
Honey	2 200	180	396 000	5 577
Wild non-wood fruits (apples, mushrooms, dogrose, hawthorn, nut)	6 560	151.5	993 550	13 992
Hay (+esparcet)	64 220	17.5	1,101,400	15,512
Pastures	5 096 376	20	101,927,520	1 435 599
Mid-mountain pastures	3487 120	20	69 742 400	982 287
Agricultural products (vegetables)	64 020		1 370 390	19 300
Firewood	7 852	400	3 140 800	44 237
Timber (poplar)	1 200	1000	1 200 000	16 901
Drinking water	11,417	20	2,740,080	38 593
Carbon conservation (pastures+ Forests)	92 950	1 349	125 389 307	1 766 047
Biodiversity	25 960	35 500	921 580 000	12 980000
Total:			**136 331 527**	**17 318 049**

	Provisioning services
	Regulating services
	Supporting services

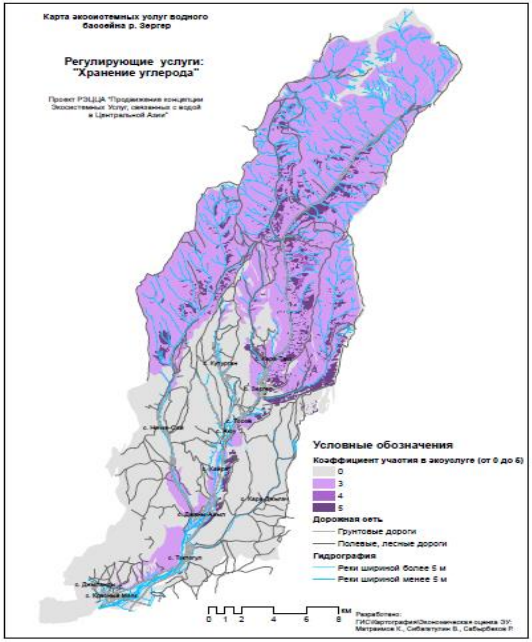


Figure 6.7. Map of the carbon sequestration ecosystem service

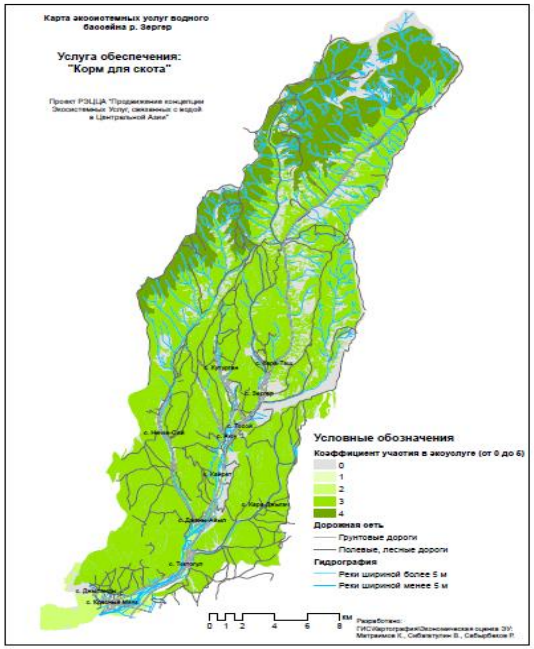


Figure 6.8. Map of the livestock feed ecosystem service

In 2017-2018 the “Implementation of payments for ES in the pilot territory” component of the GEF-FAO project “Sustainable Management of Mountain Forests and Land Resources of Kyrgyzstan under Climate Change” was implemented. The component was implemented by the CAREC Branch in Kyrgyzstan. The Tyup forestry and the Sary-Bulak village district of the Issyk-Kul region were identified as the pilot territory. The resulting maps of the ecosystems and their services are given below:

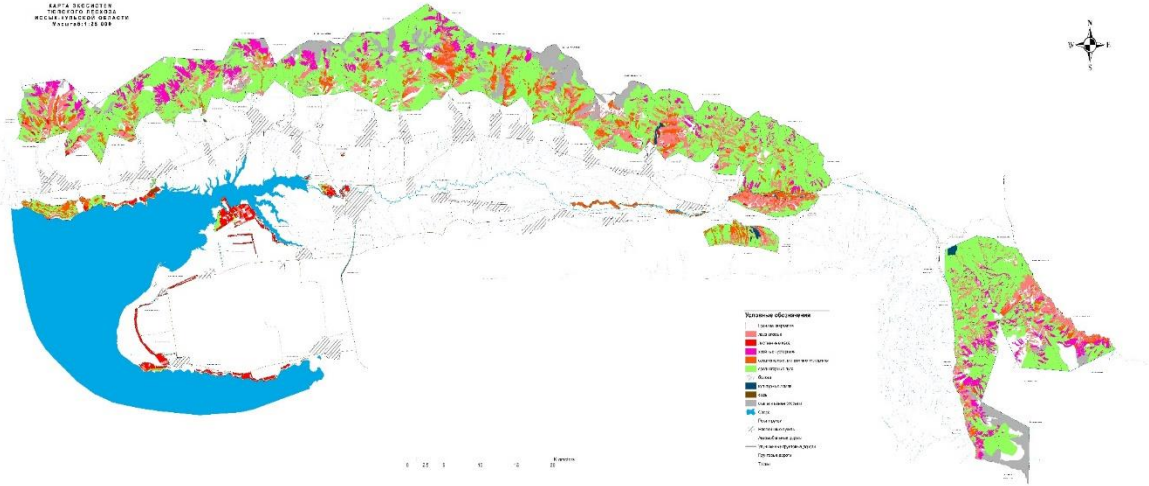


Figure 6.9. Ecosystem services map of the Tyup forestry and the Sary-Bulak village district

The economic assessment has focused on the use value, i.e. directly on those ecosystem services, the quality and quantity of which affect the daily level of the local population. All data was collected through a representative survey of the population, and during an interview with the specialists of the local authorities. The data was processed in the statistical applications SPSS and STATA.

Table 6.3. Economic assessment of ecosystem services

Provisioning services	**Volume**	**Price per unit, KGS**	**Value in KGS**	**Value in USD**
Meat	528 030	250	120 187 800	1 741 852
Kumis	429 058	40	17 162 320	248 729
Milk	4 835 484	12	58 025 808	840 954
Firewood	35 322.4	400	14 128 979	204 768
Construction wood	850	6 000	5 100 000	73 913
Honey	37 318	183	6 829 194	98 974
Non-wood fruits of the forest	10 041.3		3 571 159.4	51 755.9
			225 005 260	**3 260 946**

The UN methodology was used to calculate the volume of carbon dioxide (UN, 2005). Also, the InVEST program was applied for categorization and mapping, on the basis of the land use data provided by forestry. The carbon price was taken from the Central Asian land degradation study (ELD Initiative, 2016)

Table 6.4. Economic assessment of the carbon sequestration services

Carbon sequestration	Volume	Price per unit in KGS	Area, ha	Value in KGS	Value in USD
Forest plants	140.3	1 035	17 711	2 571 823.16	37 272 800
Non-connected forest crops	98.1	1 035	52	5 279 742	76 518
Nurseries	113.0	1 035	19.6	2 292 318	33 222
Thin forest	94.2	1 035	1 007	98 179 479	1 422 891
Burned areas	97.0	1 035	43.9	4 407 341	63 875
Cutting	96.0	1 035	9.6	953 856	13 824
Glades and wasteland	95.0	1 035	1,597	157 025 025	2 275 725
Non-irrigated arable land	82.0	1 035	27.1	2 299 977	33 333
Haymaking	83.0	1 035	185.8	15 961 149	231 321
Pastures	79.8	1 035	35 818.9	2 958 390 408	42 875 223
Gardens, vineyards	79.0	1 035	29.6	2 420 244	35 076
Manors	27.0	1 035	25.6	715 392	10 368
Swamps	172.0	1 035	157.5	28 038 150	406 350
Other lands (rocks, stone spills)	10.0	1 035	8 415.3	87 098 355	1 262 295
		1 035	65 169.9	**5 937 443 017**	**86 049 899**

To calculate the value of biodiversity, a world-wide calculation method was used depending on the type of forest and location (country of the site of growing). For the conditions of Kyrgyzstan, the cost of 1 hectare of the biodiversity conservation area is accepted at 500 USD.

Table 6.5. Economic assessment of the biodiversity services

	Forestry Area	Price per hectare	Value of BD of the forestry, KGS	Value of BD of the forestry, KGS
The value of biodiversity	65 225	34 500	2 250 265 950	32 612 550

Based on the land use and the forest management maps, a map of the ecosystems of the Tyup forestry enterprise was prepared, and the materials on the ecosystems of Kyrgyzstan were used to identify the existing forestry ecosystems (The 4th National Report on the Conservation of Biodiversity of the Kyrgyz Republic, 2008). The boundaries of the forestry ecosystems are prepared on the land maps using the names and characteristics of the republic's ecosystems.

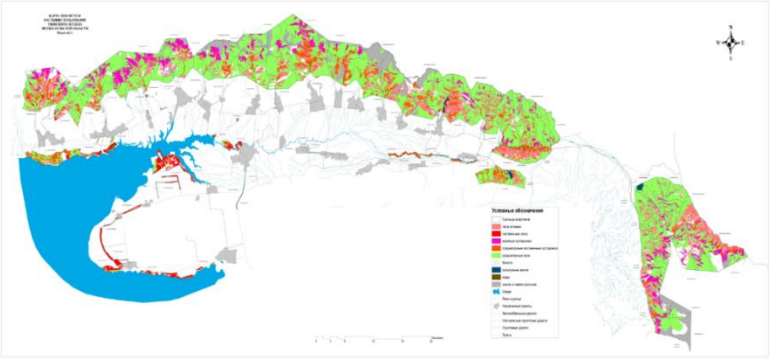


Figure 6.10. Map of the carbon sequestration ecosystem services of the Tyup forestry

Examples of mapping of other ecosystems and ES are given in Appendix 3.

6.3. Monitoring and a system of indicators in the national statistics

Development of the national strategies and development plans for the country, taking into account the Sustainable Development Goals and the green growth concept, implies transition to the new principles of modeling and planning of the economy development, including not only the economic, but also the social and environmental indicators. Not economic achievements are so much considered the indicators of the green economy development, but rather the conservation and rational use of natural resources. As a result, assessment and monitoring systems of the state of ecosystems and their services are of particular importance.

The economic activity of humans can lead to the degradation of ecosystems, and to the deterioration in the quality and quantity of services generated by ecosystems. The accounting and monitoring of ES conducted on the ongoing basis provide an opportunity to analyze to what extent economic activity can reduce the ecosystem's ability to produce ecosystem services.

Currently, the researching, practical accounting and monitoring of the ES at the government level are being conducted in many countries. Great Britain, the United States of America, the European Union countries, Russia and China take an inventory and assessment of their ecosystems and the services they provide, and mapping them at the national level, indicating the growing need to include the indicators of natural capital in the country development statistics.

In 2014, OECD developed and published a methodology for measuring the green growth indicators that include the key features such as the environmental and resource efficiency; the economic and natural assets; the environmental quality of life, and economic opportunities and political instruments.

In addition to the above indicators, there are indicators that reflect the socio-economic context and the growth characteristics. Some of these indicators are given in Table 6.6.

Table 6.6. Groups of indicators and the covered issues

№	Groups of indicators	Covered issues
1	The environmental and resource efficiency of the economy	• Carbon and energy efficiency • Resource efficiency: materials, nutrients, water • Multi-factor productivity
2	Natural assets base	• Renewable reserves: water, forests, fish resources • Non-renewable reserves: subsoil assets • Biodiversity and ecosystems
3	Environmental aspects of the quality of life	• Environmental conditions and risks • Ecosystem services and environmental benefits
4	Economic opportunities and political tools	• Technology and innovation • Ecological goods and services • International financial flows • Prices and transfers • Skills and training • Normative acts and management approaches
Socio-economic context and growth characteristics		Economic growth and economic structure Productivity and trading Labor markets, education and income Socio-demographic trends

Source: OECD (2011), Towards Green Growth: Monitoring Progress: OECD Indicators

A system of indicators combines the main characteristics of green growth with the basic accounting principles and the pressure-state-response model, used in the environmental reporting and assessments are based on the economic functions such as production and consumption, and describes the interaction between the economy, the natural asset base and policy instruments.

The main goal of this system of indicators is to structure and analyze the sources of green growth, and to identify the indicators important to the decision-makers and society.

In order to advance the systems of the green growth indicators, some countries, the UN, OECD and other international organizations are working together to create a statistical database, and introduce environmental accounts in accordance with the System of Environmental-Economic Accounting (SEEA) – the international statistical standard, which represents a multi-purpose conceptual framework for accounting the interconnection between the economy and the environment (System Environment-Economic Accounting, 2012).

One of the areas of work in the development of SEEA has been focused on the accounting of environment in terms of its ecosystems, and its results are presented in the SEEA Experimental Ecosystem Accounts, which provide a coherent and holistic synthesis of the modern knowledge in the ecosystem measurement and the approach to the assessment of such measurements, and provide the basis to advance research in the field of ecosystem accounting of various countries, using the terms and concepts that make it easier to compare statistics, and share the best practices.

The SEEA experimental ecosystem accounts describe the measurement of ecosystems in physical terms, and quantification of the ecosystems to the extent at which it is consistent with the principles of the market value assessment. ES accounting involves accounting

of both tangible and intangible benefits of the environmental assets.

OECD keeps records and monitors the green growth indicators in 46 countries, including member countries of OECD and G20.

According to the 2017 OECD Green Growth Indicators report, the leaders are Luxembourg, Iceland, Denmark, Norway and the Netherlands. Monitoring of the indicators was carried out according to a set of indicators, such as productivity of the raw materials processing, CO2 productivity, the innovations and taxation related to the environment, etc. The worst results turned out to be in Canada, Mexico, Greece, the Republic of South Africa and China.

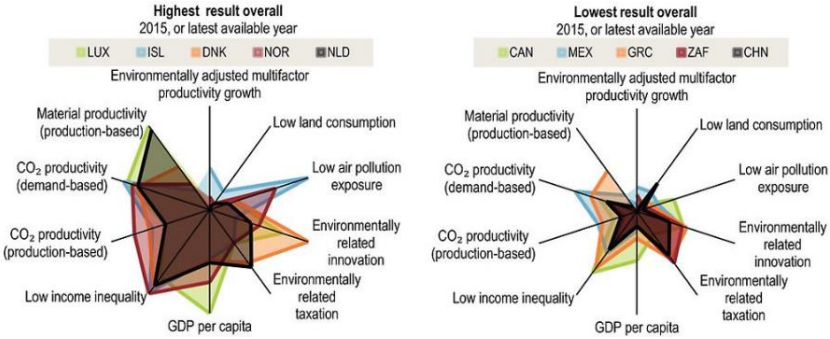


Figure 6.11. Monitoring of the green growth indicators

Source: OECD Green Growth Studies, Green Growth Indicators, 2017

In addition to the statistical methods, other methods of the research and monitoring of ecosystems with the use of the remote sensing satellites are being developed.

6.4. National experience in building the system of indicators in the national statistics

Since 2015, the National Statistical Committee of the Kyrgyz Republic has been implementing SEEA. NSC is developing the forest accounts (part of SEEA) based on the economic valuation of the forest ecosystem services. The forest accounts will allow

demonstrating a real contribution of the forestry to the country's GDP.

Also, in 2016, the "Using Czech Experience: Piloting SEEA-EEA in the Kyrgyz Republic" project on the Experimental Ecosystem Accounts using the example of the Kyzyl-Unkur Forestry (Jalal-Abad Oblast) was implemented. This work was carried out thanks to the expert support of the Czech consultants from the Research Institute for Global Change of the Czech Academy of Sciences (Czech Globe). The project was funded by the Czech Trust Fund and jointly with the UNDP-UNEP Poverty and Environment Initiative in the Kyrgyz Republic. This 6-month project was fulfilled in close collaboration with the National Statistical Committee (NSC) and the State Agency for Environmental Protection and Forestry.

According to the project outcomes, the SEEA implementation in the Kyrgyz Republic will support achievement of the sustainable development goals and the related international processes, increase the "visibility" of ES for the national economy and development, conduct regular measurements of the ecosystem degradation, and assess the production and consumption of the ES and economic units.

6.5. Software for assessment of ecosystem services

For the effective management and decision-making in the politics and economics, considering environmental issues, it is necessary to promptly receive information on ES, human well-being and economic activity.

In order to obtain and analyze the ES data, the complex models and software that would allow modeling and predicting the data at different levels, are being developed. Year by year, the models and

programs for evaluating ES are getting more sophisticated and advanced, including the mathematical apparatus, database analysis, neural networks, satellite data, etc.

Currently, there are both the local models adapted for a certain locality or for solving certain ES management tasks, as well as the global ones that evaluate ES at the global and international levels.

Scientists, decision makers and stakeholders are looking for the best combination between the simple and complex ES modeling approaches. The more complex and realistic the model, the more input data is required and the longer it takes to calculate and analyze ES. Although simple models may be less accurate, but they let to quickly provide the data, this may be important for making decisions or adjusting actions for the sustainable development.

The optimal may be the development such ES model, which would be available to everyone to analyze the data on the necessary parameters, for example, to calculate the impact of the changes in the land use or water use in a given territory on the quantity and quality of ES of the local population.

Many research teams work on this task and develop software for working with the ES databases.

A list of the most commonly used software in the research and assessment of ES:

- Integrated Valuation of Ecosystem Services and Trade-offs (INVEST)
- Artificial Intelligence for Ecosystem Services (ARIES)
- Multiscale Integrated Earth Systems model (MIMES)
- Multi-Criteria Decision Analysis (MCDA)
- Multi-criteria GIS toolbox (POLYSCAPES)
- Local Economic Development and Environment (LEDE)

VII. Conclusions

Reviewing practical application of the concept of ES in the world, and the experience of the pilot projects implemented in the Kyrgyz Republic, revealed barriers and opportunities for the development of PES in the Kyrgyz Republic. The review also revealed the need and importance of further development and implementation of the ES concept in the country's development strategy.

In order to implement the government policy on sustainable development, the incorporation of the ES concept into the strategic documents has begun in the country, implying further development of the roadmap, an action plan and mainstreaming the ES assessment in the regulatory framework.

The following work has been completed in Kyrgyzstan in this area:

1. The green economy concept in the Kyrgyz Republic titled "Kyrgyzstan is a country of green economy" has been developed and approved by the resolution of Parliament of the Kyrgyz Republic dated June 28, 2018 No. 2532-VI. In order to switch to green economy, it is proposed to develop "green" directions in 10 sectors. The sixth and the seventh sectors are almost entirely devoted to ecosystems.

2. The principles of ES are integrated into the Concept for Forestry Development of the Kyrgyz Republic until 2040, approved by the Decree of the Government of the Kyrgyz Republic dated May 27, 2019 No. 231. The Concept stipulates that forest resources are natural capital, considered as the combination of forest resources and ecosystem services, and the cases of economic assessment of forest ES have been identified as well.

3. Priorities for the conservation of biodiversity of the Kyrgyz Republic until 2030 determine the strategy, program, principles

and main directions of the Kyrgyz Republic in the biodiversity conservation. The goal of the priorities is about Kyrgyzstan becoming the country steadily developing in the harmony with nature, in which, by 2030, biodiversity is appreciated at its true value, conserved, restored and wisely used, supporting and sharing the benefits of ecosystem services, contributing to the achievement of the sustainable development goals.

To achieve the objectives of the above strategic documents, it is recommended to implement Action Plans approved by the government of the Kyrgyz republic, which include a set of the phased actions for short, medium and long terms.

However, the analysis of the regulatory documents and project materials related to the ES concept in the Kyrgyz Republic revealed the need for further work in a number of areas.

The main proposed directions for the implementation of the ES concept in Kyrgyzstan are stipulated in the strategic documents promoting the goals of green economy and include the following recommendations:

- Adoption of the unified ecosystems classification system in the Kyrgyz Republic, identification of the relevant ecosystems standards for subsequent monitoring of their condition;
- Introduction of the term ecological system and its related concepts in the relevant laws and regulations on the environmental protection and related fields;
- Incorporation of the ecosystem approach in the sectoral development plans, in the territorial management plans; accounting the value of ecosystems and biodiversity in the industrial and municipal planning, the use of grazing and other agricultural lands; consideration of the seasonal migration

zones, quiet zones and ecological corridors in the management plans of the grazing lands and in the construction of the line infrastructure;

- Development of a program for the restoration of the especially valuable ecosystems to conserve globally significant biodiversity;
- Implementation of the biodiversity offsets system by the economic entities causing inevitable damage to biodiversity; supporting the local initiatives to participate in the biodiversity compensation schemes;
- Assessment of the value of the plant genetic raw materials for development of the pharmacological, food, and cosmetic industries; support for patenting of the particularly valuable best practices;
- Implementation of assessment and mapping of ES at the national level;
- Organization of trainings and educational programs on raising awareness and capacity building on ES and PES

An action plan of the Green Economy Concept stipulates the development and approval of the Methodology for an economic assessment of ES in the IV quarter of 2022 through the Decree of the Government of the Kyrgyz Republic.

The authors of the book consider it necessary to further carry out the following work:

Regulatory framework:

- Inclusion of the ES concept and the ES assessment in the strategic development documents of the country.
- Implementation of the official concepts and principles of ES in the Environmental Code, the Forest Code, and recognition of the advantages of ES for human society; this concept

should include the direct and indirect benefits of ecosystems to human society.

Formation and development of ES concept

in the Kyrgyz Republic:

- Conducting a general assessment of the condition and importance of ES for the sustainable development of the country;
- Establishing the system of an economic assessment of ecosystem services;
- Development of the system of monitoring and assessment of ecosystem services;

Raising awareness and implementation of the ES concept:

- Establish a unified information center on the ES of Kyrgyzstan to share information and experience.
- Review the developed methods of economic assessment of ES for Central Asian countries (within the framework of CAREC, GIZ, ICARDA etc.) and adapt them to the conditions of Kyrgyzstan
- Develop a manual for PES implementation, coordinate it with stakeholders and approve for further application;
- A standard PES agreement shall be developed so that it can be easily used by the district forestry, associations of the users of natural resources, local authorities, and other relevant stakeholders.

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IX. Appendix

1. **International experience of PES implementation**
2. **The value of ES in pilot areas**
3. **Examples of ecosystem maps and ecosystem services in Kyrgyzstan**

Appendix 1: International experience of PES implementation

Country	Project title	Description	Category	Type of PES
Albania	World Bank loan, the area of future forest land 6 thousand hectares since 2010	Afforestation of the areas for carbon sequestration	Forest resources	Banking / Compensation Schemes
Georgia	CDM project, 2007	Through a carbon sequestration project, work has been done to restore soil for growing hazel-wood.	Forest resources	Banking / Compensation Schemes
Moldova	CDM project - Bio-Carbon Fund of the World Bank (20-year lending period 2002–2022) - 20 thousand hectares	The fund acquires emission reductions by transferring funds to prevent soil erosion, restoration, biodiversity conservation in the forest area of Moldova. In the first 11 years, USD 18.7 million were paid. According to this project, USD 21.7 million will be received. The project involves 265 communities. Unproductive agricultural lands will be forested.	Forest resources	Banking / Compensation Schemes
Netherlands, Latvia		Paid paths and sites for observing animals and birds	Forest resources	Public schemes

USA	(watershed of the Catskill River)	Increased payments for the use of water to ensure water quality.	Water resources	Public schemes
	(2002 METSO program in the southern part of the country); since 2008, the entire area of the country has been covered.	Compensation payment to the private owners for refusal of economic activity.	Land use	Public schemes
Switzerland	(Basel –Statd canton, catchment basin of the Langen-Erlen river)	Forests are a natural water purifier. Residents pay increased fees for forest management (planting and care for forest species that will maximize water quality).	Forest resources	Public schemes
Sweden	(2010 Komet program), 9 percent of the forest land covered	Based on the agreement (for a period from one to 50 years), the owners receive fixed payments to limit their economic activity to protect those forests that have the maximum value.	Forest resources	Public schemes

Denmark	Copenhagen Energy Corporation – Forest Owners – Private Farmers	The corporation collects higher tariffs from its customers and transfers part of the funds to forest owners and farmers to increase the volume of water. The goal is to transform agricultural lands into forests; replace conifers to the hardwood for increasing the groundwater level; reduce the fertilizer application on agricultural land.	Forest resources	Public-private schemes
Germany	BIONADE Corporation, non-alcoholic beverage production, contracts (term - more than 20 years)	The corporation covers the expenses of NGOs to replace coniferous species with hardwood to ensure an increase in groundwater for the production of the beverage (in 10-12 years, the volume of water is growing by 800 thousand liters / ha).	Forest resources	Private schemes
Portugal	Coca-Cola, based on the Agreement	Forest owners receive a fee for maintaining forests (abandonment of activities) to ensure the quality of water in the Tagua reservoir).	Forest resources	Private schemes
France	Nestle Waters Vittel brand of bottled water	The company has signed contracts (for 30 years) with 26 farmers in the river basin to ensure water quality, with the condition to reduce fertilizer, by repaying farmers losses.	Water resources	Private schemes
Switzerland	Hennitz company, bottling of mineral water	Buying-out agricultural land in order to turn them into protective forests to ensure water purity (reduction of nitrates in the mineral water).	Forest resources	Private schemes
Argentina	GTZ	The German Development Agency (GTZ) is investing in a project to protect 120,000 ha of virgin forests in Argentina in the country's	Forest resources	Public-private schemes

		protected areas. It is estimated that these forests can absorb about 12.6 million tons of carbon.		
Bulgaria, Romania, Moldova and Ukraine	WWF, GEF	The World Wildlife Fund has launched the PDF A phase of the GEF project to implement PES mechanisms in the basin and delta of Danube river. If the project receives funding from the Global Environment Facility, it will be the first initiative of its kind implemented in the countries of the Central and Eastern Europe (Bulgaria, Romania, Moldova and Ukraine are involved in the project). The aim of the project is to identify potential suppliers and consumers of the ES in the region, negotiate with them and launch the model PES model mechanisms adapted to the conditions of this region.	Water resources	Public-private schemes
Bolivia	Nature Conservancy NGO and the country's government	In Bolivia, at the initiative of the international Nature Bolivia NGO and the government of the country, the largest carbon project in the world is being implemented. The main stakeholder is the Noel Camp Mercado National Park. For forest conservation measures, this park will receive USD 9.6 million for 15 years. It is estimated that during this time the park's forests will absorb about 26 million tons of carbon.	Forest resources	Public-private schemes
Brazil	Environmental Fund	The public water supply company in Sao Paulo, Brazil, transfers 1 percent of its revenue to the environmental fund, which is spent on the reforestation activities in the upstream of the Corumbatai region.	Water resources	Private schemes

Guatemala	WWF in partnership with CARE and the International Institute for Environment and Development (IIED)	In Guatemala, the project focuses on the protection of the unique coral reefs of international importance and tropical rainforests as part of the Sierra de las Minas Biosphere Reserve. The implemented mechanism is based on the above-described water PES services provided by the reserve. The studies of the "willingness to pay" for water quality have shown that the most interested and able to pay users are large enterprises that use water in the production process (Coca-Cola bottle factory, the pulp and paper factory and the liquor producer. All these companies expressed their willingness to participate in the project. Currently, a financial mechanism is being developed to collect and redistribute payments.	Water resources	Public-private schemes
Dominican	Project PROCARYN	In the Dominican Republic, the PROCARYN project has been launched to use payments to conserve ES and water resources of the country. The technical and financial support for the project is provided by the German Development Agency. Currently, the funds from the National Electricity Corporation have been attracted to finance the environmental measures. The Corporation volunteered to allocate the funds for the anti-erosion measures in the North Yak River Basin. In the future, the project plans to shift from the German financing to self-sufficiency through getting the irrigation companies and enterprises producing drinking water to participate in this activity.	Water resources	Public-private schemes

Indonesia	WWF in partnership with CARE and the International Institute for Environment and Development (IIED)	In Indonesia, this project finances the conservation of forests, including in the territory of the Betung Kerihun National Park. In addition to the project's own funds, the funds come from the state utilities, regional and municipal bodies and industrial enterprises.	Forest resources	Public-private schemes
Colombia		In Colombia, hydropower plants are required to transfer 3 percent of the income from the electricity sales to the regional and municipal government agencies responsible for the conservation of water resources in the respective regions.	Water resources	Public-private schemes
Costa Rica		The communal service of Heredia, Costa Rica, has introduced an additional tariff for paying for the quality of water in the city's water pipelines (USD 0.05/m p3p of the consumed water). The funds received in this way go to the upstream Braulio Carrillo National Park and to the private landowners for their efforts to conserve and restore the forests through which the main water flows supplying Heredia pass. The average income is USD 70/ha/year. In this scheme, the classical consumer pays principle is used. Thus, the national park has a stable source of additional financial revenues, regardless of the size of budget allocations.	Water resources	Public-private schemes

Costa Rica	PES Program of the Costa Rica Government Environmental Services Payments Program The National Forest Financing Fund (FONAFIFO)	The most famous example of the PES project relying on the strong government support is PES Program of the Costa Rican Government (Environmental Services Payments Program). By the decision of the authorities, a financial mechanism has been created to compensate forest owners for conducting the environmental protection measures on their lands. This mechanism is notable for a very well-developed legal basis - the Costa Rica Forest Code has a definition of ES and a list of activities that shall be paid. Payments are distributed through a specially created environmental trust fund - the National Forest Financing Fund (FONAFIFO). Active participants of the project include the National protected areas service, the National Forest Service, the National Association of Agronomists, the regional cooperative organizations, and the environmental NGOs. Notably, the national service on protected areas is responsible for identifying the investment priorities in accordance with the needs of the protected areas system. The National Forest Financing Fund has developed and implemented a sophisticated procedure for monitoring the program effectiveness. Besides the government funds and foreign grants, payments come from private companies willing to pay for the ecosystem services, primarily for clean water. The government of Costa Rica is currently preparing a decree imposing single fines for water pollution. These payments will also be used to finance the environmental activities.	Forest resources \ Water resources	Public-private schemes

Costa Rica	Cerveceria	A similar example exists in Costa Rica, where the beer company Cerveceria pays compensation to the farmers who live close to the sources of water used for production of beer. Cerveceria is not the only user of clean water in the region, but it voluntarily committed to pay expenses of the farmers - thus the company hopes to create their positive image in the region.	Water resources	Private schemes
Mexico	Bioclimatic Fund	Bioclimatic Fund has been created in Mexico, which accumulates and redistributes funds received from the foreign buyers of the "emission reduction units" between 300 owners of the coffee plantations. The latter undertake to allocate 20 percent of their land for afforestation, and carry out appropriate activities (such schemes are very popular in Europe termed "agro-environmental payments").	Forest resources	Private schemes

Mexico	National PES program	In Mexico, the PES program is implemented at the national level on the initiative and with active support of the government. Under this program, payments are collected from the water users in the form of an additional tax and redistribution of funds between service providers through auctions. All forest owners are allowed to participate in the auction, while preference is given to the landowners and land users whose plots are located in the protected areas, in the environmental priority areas, in the areas with an increased risk of floods and in the places where native people live. Payments to the most "environmentally responsible" forest owners shall be made in the form of regular payments until 2008. It is expected that the service providers should implement sustainable forest management practices on their land by this time and for this money. Compliance with the terms of the contract by the participants is strictly monitored by the authorized state bodies. The program is very popular among the population of the priority areas – year by year more enterprises participate in the auctions.	Water resources	Public-private schemes

El Salvador, Nicaragua and Honduras	Sustainable Agriculture Development Program	Sustainable Agriculture Development Program in the foothills of Central America (El Salvador, Nicaragua and Honduras), funded by the Swiss Development Agency, launched 10 PES model projects in these 3 countries. The municipal authorities are the purchasers of the services. Among the activities funded under the projects are: liquidation of the consequences of the forest fires, forests thinning, the coffee production waste composting, which decomposition cause clogging ponds, etc. Service providers are farmers and their associations.	Sustainable land use	Public-private schemes
USA	Watershed Agricultural Council	One of the most well-known examples of the use of water charges is the payments by the New York City Municipality to the farmers whose land is located upstream of the Hudson River, the foundation of the city's water supply system. In the early 1990s, the water quality in the water pipelines of a multi-million city has deteriorated significantly. In response to this, the US Agency for Nature Protection required that the New York authorities build a filtration plant (the cost of construction was estimated at USD 4-6 billion). In an effort to reduce the cost of improving the water quality, the municipal authorities launched the PES program: they informed farmers about financing the activities aimed at improving the quality of water in the river and its tributaries flowing through their possession. These included: reducing the fertilizer consumption, planting forests, creating private protected areas, and expanding the area of the protected areas in the area. About USD 1-1.5 billion	Water resources	Public-private schemes

		were spent for 10 years. The funds for payments to the farmers and protected areas came from the municipal payments of citizens (the average payment has increased by 9 percent, nonetheless people were willing to pay for the water quality) - the Watershed Agricultural Council, a special organization was set up. It conducted a large-scale awareness campaign in the media, raised funds from the population, invested in stocks, bonds, and created a special trust fund which was replenished through the profit from these transactions - this profit also went to the payments for farmers. As a result, over 10 years, the water quality in the city has improved significantly, there was no need to build a filtration unit, the authorities saved money, and protected area and farmers received significant support.		
USA	Reserves conservation program	In the United States of America, the national program on the conservation of reserves concludes 10-15 year contracts with farmers for allotting part of their land to create a private protected area, thereby ensuring conservation of the biodiversity in the present and future.	Biodiversity	Public schemes

USA	"Biodiversity quota" market	In 1982, United States of America adopted amendments to the Law on the Conservation of Rare and Endangered Species. According to these amendments, in the case of "accidental" extermination of species listed as rare and endangered, the perpetrator must compensate for this damage by creating a protected area on their lands, taking measures to protect certain species and/or landscapes. On this basis, a whole market of the biodiversity quotas has formed in the country: the protected areas and other environmental organizations are actively trading biodiversity loans. Specialized "environmental banks" have even appeared.	Biodiversity	Public schemes
France	Perrier-Vittel company	Perrier-Vittel, a French company, a bottled water producer, pays compensation to farmers who own land upstream from the water production site to so that they use the sustainable agricultural practices. The more "ecological" farming is carried out by farmers, the better the quality of the water produced by the company. Each farmer receives an average of USD 230 per a hectare of land. Payments are made for 7 years - during this time the farmer must shift to the more sustainable agricultural practice.	Water resources	Private schemes
Ecuador	The Ecuadorian National Water Fund	The Ecuadorian National Water Fund (Fondo Nacional del Aqua) collects fees from water users – the residents of Kyoto, and the hydroelectric power plant located near the city, and directs them to finance the environmental activities upstream of the river supplying the capital with water.	Water resources	Public-private schemes

Ecuador	"Condor" Biosphere Reserve	Another example, also in Ecuador, is the city of Pimampiro, supplied with water from rivers flowing from the Ecuadorian Andes and located on the territory of the Condor Biosphere Reserve. After a significant deterioration of the drinking water quality, the city authorities initiated a project to collect additional payments from the city residents in favor of the land users of the upper Andes. For this, the land users (20 families were involved in the model project) had to switch to more environmentally sustainable methods of farming. A substantial part of the payments went to the biosphere reserve for the implementation of its environmental programs. The total payments for water made by the residents of the city, in the end, grew by 20 percent - in total, about USD 500 was collected per month. The funds for launching this mechanism (including creation of an environmental fund for the accumulation of payments), amounting to USD 15 000 were provided by a local NGO.	Water resources	Public-private schemes
Ecuador	A model project on the use of PES to finance preservation water quality in the Rio Arenilas River Basin	In the province of El Oro, Ecuador, a model project is being implemented to use PES to finance preservation of the water quality in the Rio Arenilas River Basin. The Takhuin HPP dam is a consumer of the service, the productivity of which has significantly decreased because of the increase of the sediment content in the river water, and the clogging in its hydro-technical facilities. The studies have shown that the reason for the increase in the concentration of the solid sediment is the increased erosion caused by intensive deforestation in the upper reaches of the river. Accordingly, the funds received under the PES mechanism are spent on the reforestation	Water resources	Public-private schemes

		activities. It is estimated that the average price of these activities is USD 32.7 per year. Collection and redistribution of payments is carried out by the regional and local authorities; Legal framework for PES is the Ecuador Water Code.		
Kazakhstan	UNDP	The study of the development of the project areas in the context of ES. Ile-Balkhash (Almaty region) Aral-Syrdarya (Kyzylorda region)		

Appendix 2: The value of ES in the pilot areas

Zerger River Basin, Kyrgyzstan

Ecosystem services and products	Volume	Unit price in KGS	Price in KGS	in USD
Honey	2 200	180	396 000	5 577
Wild apples	300	10	3 000	42
Mushrooms	535	400	214 000	3 014
Hay	36 600	15	549 000	7 732
Sea buckthorn	15	200	3 000	42
Dogrose	660	55	36 300	511
Hawthorn	150	15	2 250	32
Nut	4 900	150	735 000	10 352
Pastures	5 096 376	20	101 927 520	1 435 599
Mid-mountain pastures	3 487 120	20	69 742 400	982 287
Esparcet	27 620	20	552 400	7 780
Potatoes	15 270	7	106 890	1 505
Wheat	27 550	15	413 250	5 820
Sunflower seed	6 500	35	227 500	3 204
Corn	7 450	15	111 750	1 574
Rice	3 550	130	461 500	6 500
Fruit	2 500	15	37 500	528
Vegetables	1 200	10	12 000	169
Firewood	7 852	400	3 140 800	44 237

Timber	1 200	1000	1 200 000	16 901
Drinking water	11 417	20	2 740 080	38 593
Soil - Carbon	2 950	1349	3 979 307	56 047
Pasture - Carbon	90 000	1349	121 410 000	1 710 000
Biodiversity	25960	35500	921 580 000	12 980 000
Total:			**136 331 527**	**17 318 049**

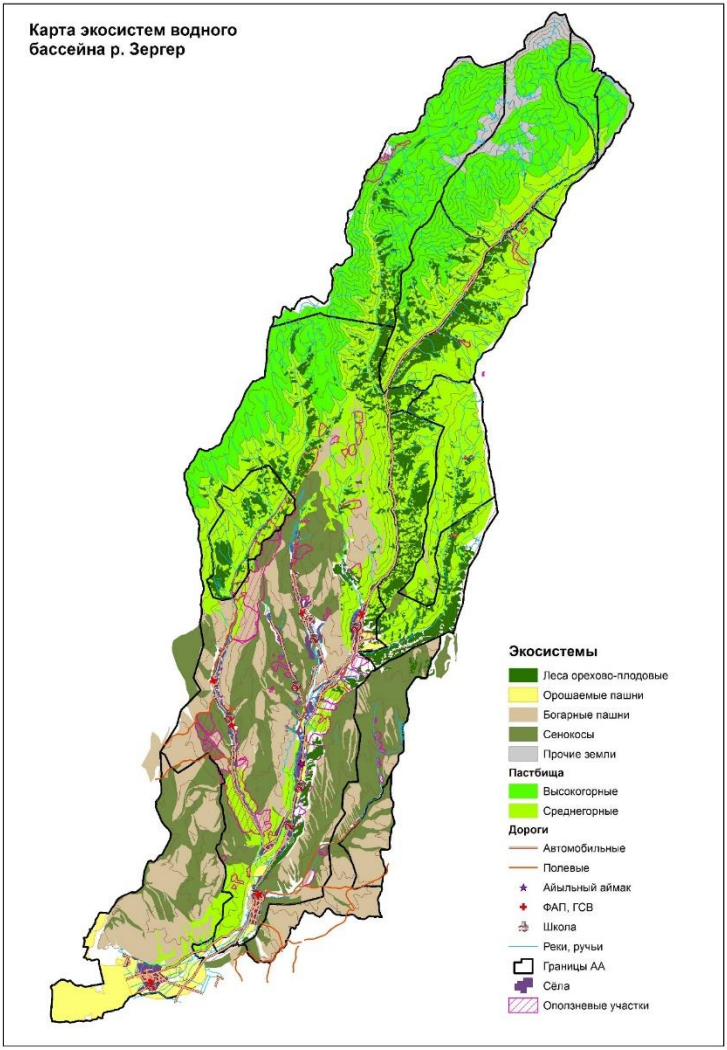
Chon-Aksuu River Basin, Kyrgyzstan

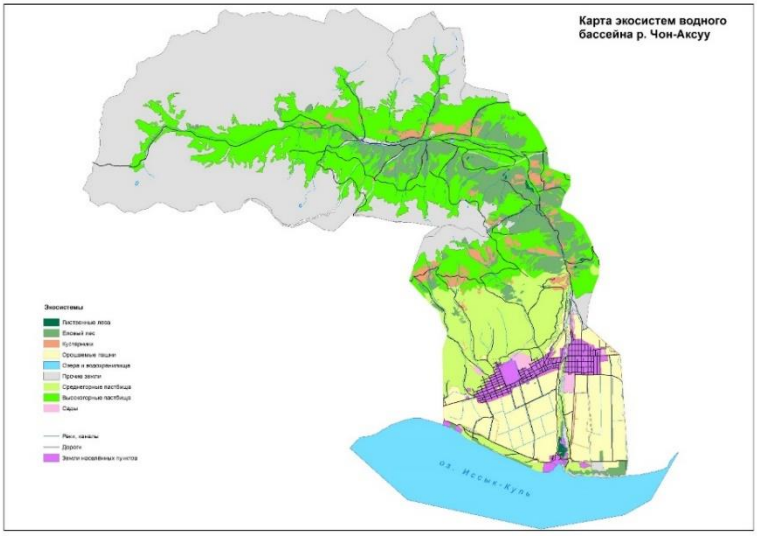
Ecosystem services and products	Volume	Unit price in KGS	Price in KGS	in USD
Harvest Barley	4 375	8	35 000	493
Harvest - Tomato	62 606	7	438 242	6 172
Harvest Wheat	41 788	15	626 820	8 828
Harvest - Fruits	28 820	17	489 940	6 901
Harvest raspberry	3 550	200	710 000	10 000
Harvest vegetables	10 700	17	181 900	2 562
Haying (esparcet)	98 540	200	19 708 000	277 577
Pastures (mid-mountain)	2040620	20	40 812 390	574 822
Pastures (high-mountain)	12997990	20	259 959 800	3 661 406
Mushroom picking	12 840	450	5 778 000	81 380

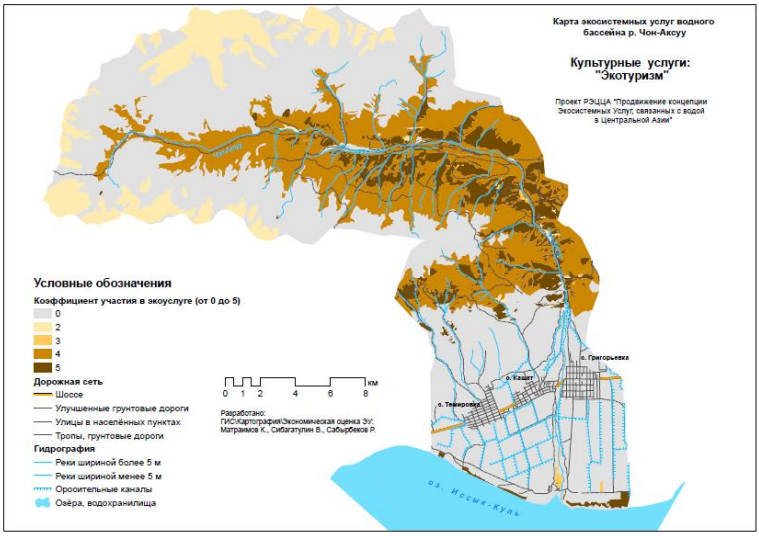
Firewood for heating	14 015	400	5 606 000	78 958
Drinking water supply	14 015	20	3 363 600	47 375
Carbon Grazing	15 215	1 349	20 524 671	289 080
Carbon Forest	140 000	1 349	188 860 000	2 660 000
Eco-tourism	22 560	4 500	101 520 000	1 429 859
Biodiversity	38 938	35 500	1 382 299 000	19 469 000
Total:			**648 614 363**	**28 604 414**

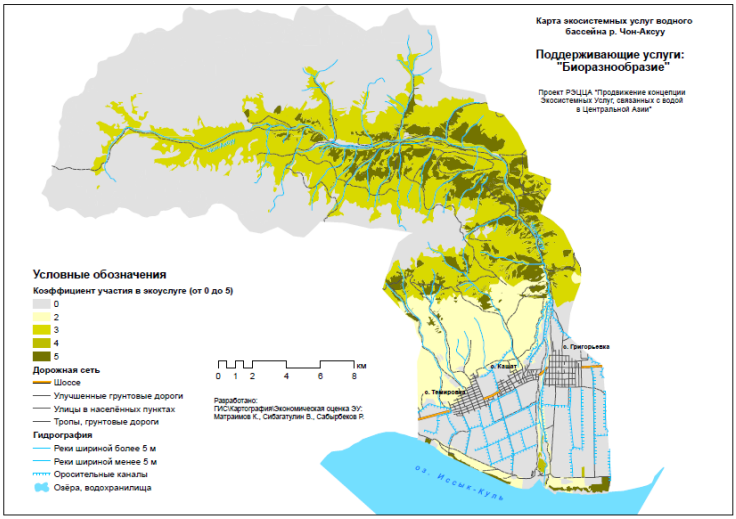
	Provisioning services
	Regulating services
	Cultural services
	Supporting services

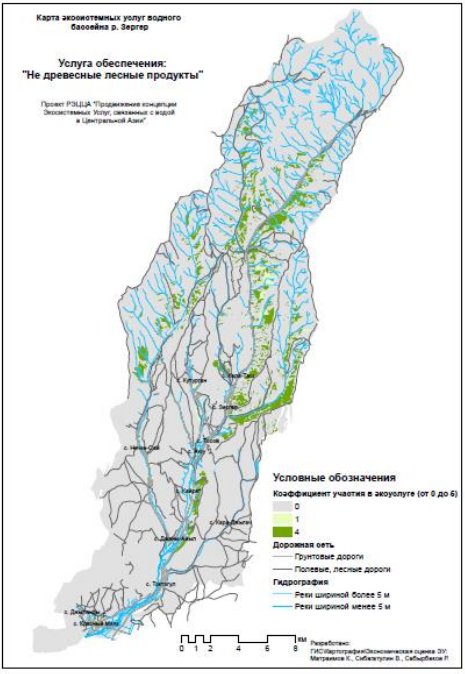
Appendix 3: Examples of the ecosystem maps and ES in Kyrgyzstan

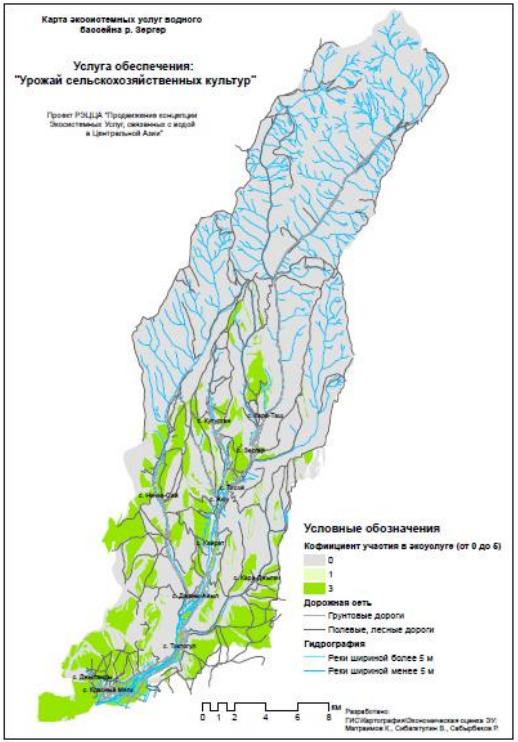



Карта экосистем водного бассейна р. Чон-Аксуу
Экосистемы
оз. Иссык-Куль


Карта экосистемных услуг водного бассейна р. Чон-Аксуу
Культурные услуги: "Экотуризм"
Проект РЭЦЦА "Продвижение концепции Экосистемных Услуг, связанных с водой в Центральной Азии"
Условные обозначения
Коэффициент участия в экоуслуге (от 0 до 5)
0
2
3
4
5
Дорожная сеть
Шоссе
Улучшенные грунтовые дороги
Улицы в населённых пунктах
Тропы, грунтовые дороги
Гидрография
Реки шириной более 5 м
Реки шириной менее 5 м
Оросительные каналы
Озёра, водохранилища
0 1 2 4 6 8 км
Разработано:
ГИС\Картография\Экономическая оценка ЭУ:
Матраимов К., Сибагатулин В., Сабырбеков Р.
п. Григорьевка
с. Кашат
с. Темировка
оз. Иссык-Куль


Карта экосистемных услуг водного бассейна р. Чон-Аксуу
Поддерживающие услуги:
"Биоразнообразие"
Проект РЭЦЦА "Продвижение концепции Экосистемных Услуг, связанных с водой в Центральной Азии"
Условные обозначения
Коэффициент участия в экоуслуге (от 0 до 5)
0
2
3
4
5
Дорожная сеть
Шоссе
Улучшенные грунтовые дороги
Улицы в населённых пунктах
Тропы, грунтовые дороги
Гидрография
Реки шириной более 5 м
Реки шириной менее 5 м
Оросительные каналы
Озёра, водохранилища
0 1 2 4 6 8 км
Разработано:
ГИС/Картография/Экономическая оценка ЭУ:
Матраимов К., Сибагатулин В., Сабырбеков Р.
с. Григорьевка
с. Кашат
с. Тамчеркан
оз. Иссык-Куль


Карта экосистемных услуг водного бассейна р. Зергер
Услуга обеспечения:
"Не древесные лесные продукты"
Проект РЭЦЦА "Продвижение концепции Экосистемных Услуг, связанных с водой в Центральной Азии"
Условные обозначения
Коэффициент участия в экоуслуге (от 0 до 6)
0
1
4
Дорожная сеть
Грунтовые дороги
Полевые, лесные дороги
Гидрография
Реки шириной более 5 м
Реки шириной менее 5 м
0 1 2 4 6 8 км
Разработано:
ГИС/Картография/Экономическая оценка ЭУ:
Матраимов К., Сибагатулин В., Сабырбеков Р.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Услуга обеспечения:
"Урожай сельскохозяйственных культур"
Проект РЭЦЦА "Продвижение концепции Экосистемных Услуг, связанных с водой в Центральной Азии"
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Гидрография
Реки шириной более 5 м
Реки шириной менее 5 м
0 1 2 4 6 8 км
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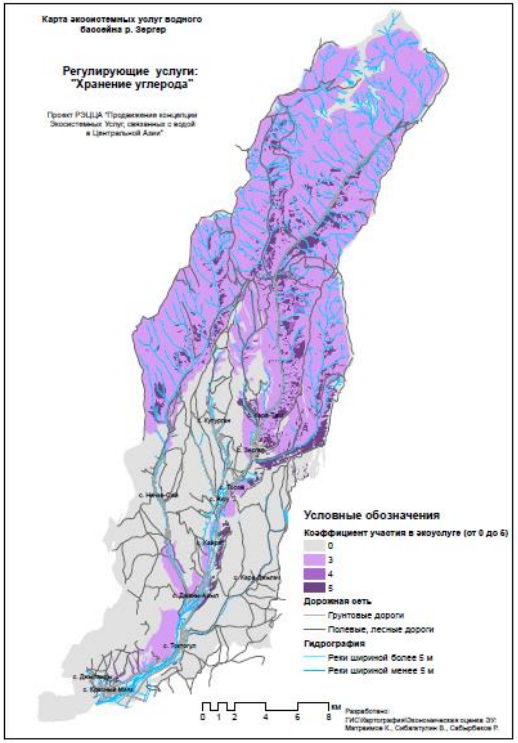
Карта экосистемных услуг водного бассейна р. Зергер
Регулирующие услуги:
"Хранение углерода"
Проект РЭЦЦА "Продвижение концепции Экосистемных Услуг, связанных с водой в Центральной Азии"
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