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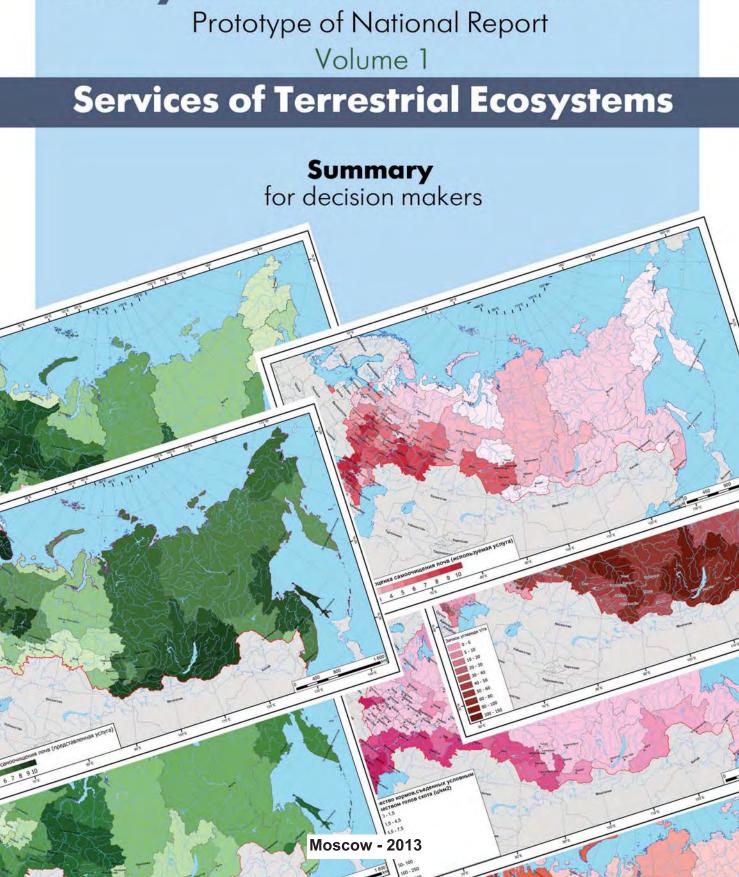
The Prototype of the National Report (Vol. 1) includes on-line supplement with quantitative ES evaluation spreadsheets and high-resolution maps (www.biodiversity.ru/teeb-russia.html (available from August 1, 2016).

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Conservation Center (Moscow)

Ecosystem Services of Russia



TEEB-RUSSIA





Leibniz Institute of Ecological Urban and **Regional Development** The Russian-German project "TEEB-Russia. Ecosystem Services Evaluation in Russia: First Steps" was initiated in 2013 by the Biodiversity Conservation Center (Moscow) in cooperation with the Leibniz Institute of Ecological Urban and Regional Development (Dresden) in accordance with the decision (of 23 May 2012) of the

Russian-German standing working group "Protection of nature and biodiversity". The financial support is provided by the German Federal Agency for Nature Conservation (BfN). The project is also supported by the Ministry of Natural Resources and Ecology of the Russian Federation.

The goal of the project is the creation of the Prototype of the National Report on Ecosystem Services of Russia, which demonstrates approaches to country-scale ecosystem services (ES) evaluation as well as the urgency to start forming a national system of ES monitoring and evaluation and the integration of ES value into economy and decision-making process.

In the first phase of the project (2013-2015) the Volume 1 of the Prototype Report considering terrestrial ecosystem services was created. It addressed the following main objectives:

- the ES classification adapted to Russian conditions was elaborated;
- the possible approaches to the ES estimation on the federal and interregional levels were demonstrated;
- the most important ES of the Russian regions were evaluated quantitatively in natural sciences indicators or estimated in points;
- the existing publicly available data on ecosystems, their components and their use were analysed, the list of necessary additional data to ES assessing on the national and interregional levels was compiled.

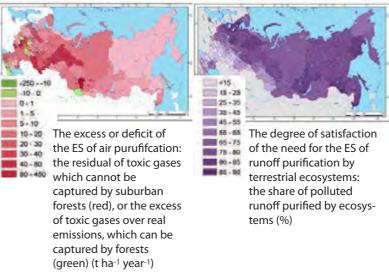
Economic ES valuation, the analysis of the importance of biodiversity for ES maintenance, as well as the development of specific recommendations on monitoring and management of ES of Russia are scheduled for the following stages of the project.

Given the limited resources of the project, the national report prototype can not claim a final comprehensive ES assessment. The document pursues methodological goals and shows possible approaches to the ES estimation on the national level and their importance for the socio-economic development and population welfare of Russia.

All the ES estimates presented in the Prototype of the National Report are only illustrations of the possible assessment approaches and should be significantly refined for use in decision making.

THE MAIN FINDINGS

- Terrestrial cosystem services are critical for the well-being of population and economy of Russia. The provided by ecosystems amount of the most important ES is comparable to the amount of basic needs of population and economy of the russian regions in regulation of the environment, natural bioproduction, conditions for recreation.



A number of the most important regulating services already are not sufficient to meet the needs of people and economy

- Uneven distribution of supplied, demanded and
 Currently ES are missing in the field of state consumed ES makes some regions ES donors, and others – ES benefeciaries. These relations must be considered when national and interregional planning and development of ES markets.
- ES monitoring is absent in Russia. Monitoring of natural ecosystems (except for forests) and the components of biodiversity which are the physical and functional basis of ES is incomplete and does not correspond to the modern level of technology. Bio-resources accounting systems are permanently reformed and do not provide comprehensive information. The degree of official data reliability is low, especially on IUU harvesting and forest fires. Many of the data are not available in the public domain.
- Immediate start forming of a national system of ES monitoring and evaluation is necessary, as well as mechanisms of integrating ES values in decision making. If this is not done the environmental safety and sustainable development of Russia will be threatened, global advantages of ecological donor country will be lost.

 A number of the most important life-supporting services are fully used or they already are not sufficient to meet the needs of people and economy. This is true for ecosystem regulation of runoff, ensuring water quality by terrestrial ecosystems, purification of water in aquatic ecosystems, absorption of air pollutants by suburban forests.



10-20

20 - 50

30-40

a0 - 100

The excess or deficit of the ES of water purification in aquatic ecosystems: the unpurified residual of polluted water (red), or the excess of pollutants, which can be neutralised in aquatic ecosystems (green) (m³ ha⁻¹ year⁻¹)

regulation. ES are not adequately assessed and does not take into account when making decisions. **Provisioning ES** partially (the main biological resources) is subject to government regulation, but in the post-Soviet time, it was significantly weakened and the share of illegal unreported and unregulated (IUU) harvesting of all types of bioresources has grown substantially.

Regulating ES are practically not taken into account and are not regulated by the government, except for some forest ES (partly water and soil protection and "carbon" services). The lack of regilating ES accounting in decision making leads to damage that may exceed several times supposed profit.

Information ES are completely absent in the governmental and legal regulation.

Recreational ES are understood very limited - just as the possibility of get profit from recreation in nature. Particularly, this has a negative impact on the strategy of development of russian nature reserves (zapovedniks). The traditional priority task of preservation and study of nature was replaced by the task of the tourism development which inevitably leads to violations of natural systems and the loss of information about their structure and functions.

ES CLASSIFICATION

ES classification. The Prototype Report employed a classification of ES combining the approaches of the Millennium Ecosystem Assessment, CICES and National Strategy of Biodiversity Conservation in Russia (2001). It includes four major ES groups: 1) productive (provisioning) - production of biomass which is removed from ecosystems by people (in contrast to CICES, "production" of water is not included);

2) environment-forming (regulating) - establishment and maintenance of the environmental conditions conducive to human life and economic development;

3) information (cultural) – all kinds of information which is contained in natural ecosystems and can be used by people.

4) recreational - establishment and maintenance of natural conditions for different types of recreation; recreational ES are integrative, as they are coupled to all of the groups above to various extents.

This ES classification is proposed to use in the national system of ES monitoring and assessment.

DATA SOURCES

Data sources. ES were assessed by open public data bases of the Russian Federal State Statistics Service (FSSSR), published cartographical materials and statistical compilations.

The Prototype Report has primarily a methodological orientation. Analysis of the accuracy of used data and their adjustment is not a task of the Prototype Report. The accuracy of the ES estimates corresponds to the accuracy of the source data. In the future ES valuation should be clarified on the basis of more detailed and adjusted original data.

METHODS OF ES ASSESSMENT

Units of assessment. The subjects of the Russian Federation - Oblasts, Krais, Republics etc. (the top-level administrative units; hereinafter the regions) were used as assessment units. The entire socio-economic data as well as some environmental indicators were obtained from the public FSSSR databases and the databases of other federal agencies, which produce data for the subjects of the Russian Federation. There were multiple sources of physical, geographical and biological data used for ES evaluation, which was available at various scales from the level of medium-resolution satellite imagery to the level of natural domains. To make our assessment uniform, we assumed the values scaled down or up to the level of the administrative units using GIS methods.

PRELIMINARY REQUIREMENTS FOR THE NATIONAL SYSTEM OF MONITORING, **EVALUATION AND MANAGEMENT OF ECOSYSTEM SERVICES**

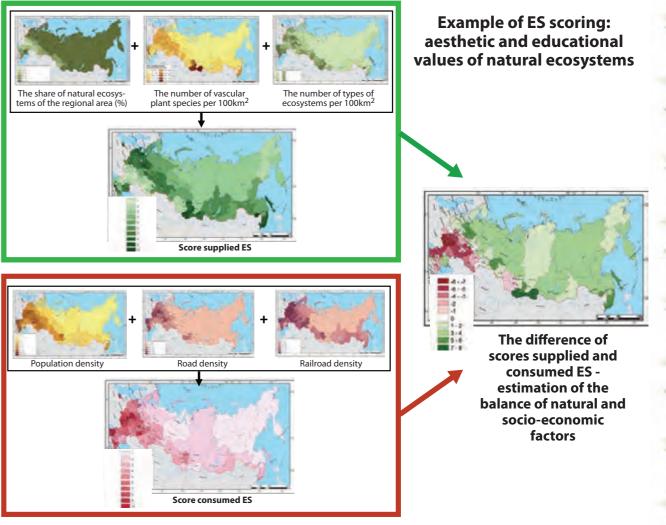
The system of monitoring, evaluation and management of ES should take into account the state of natural ecosystems and biodiversity, as they are structural and functional basis of ES. These issues will be considered in the Volume 2 of the Prototype Report and the full requirements for the system of monitoring, evaluation and management of ES will be set after that. In the Volume 1 of the Prototype Report only the general preliminary requirements were formulated.

• Considering the current state and possible changes of biodiversity at different hierarchical levels (intra-population, intraspecific, species and ecosystem diversity) as a basis of ecosystem functions and services, because biodiversity is a critical factor in efficiency and stability of ecosystem functioning.

• Valuation of species and populations, including traditionally considered as commercial resources, taking into account their importance for the sustainability of ecosystems and the ES performance.

• Accounting the total value of all major groups of ES, and first of all environment-forming (regulating) ES; priority of environment-forming (regulating) ES in possible conflicts between aims of use of different ES.

- Estimation of ES in three indicators: supplied, demanded and consumed ES.
- Considering spatial scales of ecosystem functions and services.
- Comparing spatial distribution of ES and indicators of socio-economic development of regions in the choice of the assessment methods and management goals.
- Use of best available techniques and technologies.



Methods of ES assessment. Depending on the data availability and methodological clarity the following methods were used.

1. Direct quantitative evaluation when statistical data are available on supplied, demanded and consumed ES.

2. Indirect quantitative evaluation based on combination of other quantitative data on regional ecosystems and economy.

3. Score in points if there is no data to evaluate ES itself and if it is possible to estimate only factors affecting it. Scores of supplied ES show the relative intensity of natural factors that determine the performance of ES (eq, the share of natural ecosystems of the area of the region). Scores of demanded and consumed ES show the relative intensity of social and economic factors that determine the need for ES and their use (eq, population density and transport accessibility of the territory).

4. Formulation of the task of ES assessment, if methodological approaches aren't ready for the above methods or failed to get data.

ECOSYSTEM SERVICES

Provisioning (Productive)	
Production of timber and firewoods	
Production of non-wood plant resources	
Production of fodder by natural pastures and hayfields	
Production of fresh-water seafood	
Production of game resources	
Production of honey from natural meadows	

Regulating (Environment-forming)

Regulation of climate and atmosphere
Biogeochemical regulation of climate (carbon, GHG)
Biogeophysical regulation of climate
Purification of air by vegetation
Regulation of hydrosphere

Regulation of water run-off Providing of water quality by terrestrial ecosystems Self-cleaning of water in aquatic ecosystems

Forming and protection of soils

Protection from water and wind erosion Prevention of landslides

Biological cleaning of soils, removal of pollutants

Regulation of cryogenic processes

Forming of bioproductivity of soils

Regulation of biological processes which are important for economy and safety

Regulation of agriculture and forest pests	
Regulation of pollinators	
Regulation of species which have medical importance	

Cultural (Informational)

Genetic resources of native species and populations
Information about structure/functioning of natural systems
Aesthetic and cognitive value of natural systems.
Ethical, spiritual, religious significance of natural systems

Recreational Formation of natural conditions for the following types of recreation:

Daily and weekend recreation

Wellness recreation at resorts

Educational and active tourism in nature

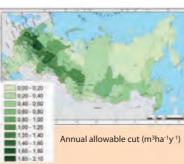
Estimation methods Indirect quantitative 'ect antitativ

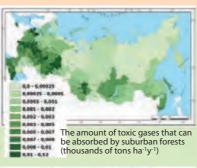
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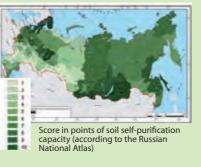
ore points Formulation of task

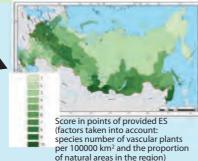
SUPPLIED ES









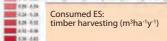


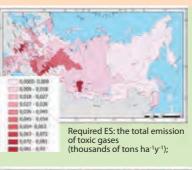


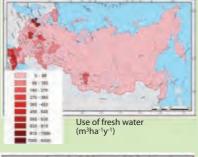
EXAMPLES OF ASSESSMENT

CONSUMED or DEMANDED ES

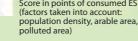
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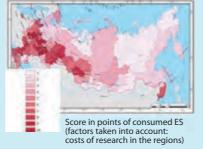


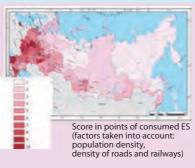




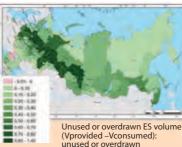




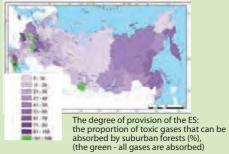




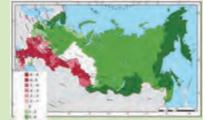
Degree of use or satisfaction of needs for ES



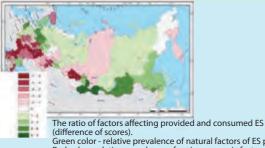
annual allowable cut (m³ha⁻¹y⁻¹)



Unused or overdrawn ES volume (Vprovided –Vconsumed):



(difference of scores). Green color - relative prevalence of natural factors of ES providing.









Unused rest of ecosystem water runoff (m³ha⁻¹y⁻¹)

The ratio of factors affecting provided and consumed ES

Red color - relative prevalence of socio-economic factors of ES use

Natural genetic resources

(difference of scores). Green color - relative prevalence of natural factors of ES providing. Red color - relative prevalence of socio-economic factors of ES use

Wood production

Air purification by suburban forests

Ecosystem regulation of runoff

Self-purification of soils

Natural

conditions for

tourism

in nature



Supplied, demanded and consumed ES

The extreme diversity of natural and socio-economic conditions in Russia required specific approaches to the assessment of ES which could potentially be supplied by ecosystems, ES necessary for people and ES actually used by people. The supplied ES are generally correlated with the area of ecosystems. The demanded and consumed ES and the value of the ES for human wellbeing are linked to population density, economic development and transport accessibility of the regions. The

The share of natural ecosystems of the region area (%)



Supplied ES were defined as ES produced by ecosystems regardless of the presence or absence of people. Supplied ES correspond to the capacity of ecosystems to perform useful for people functions and meet their needs. Supplied ES are determined by natural factors: the state of ecosystems and biodiversity, the intensity and stability of ecosystem functioning, degree of ecosystem disturbance. This indicator should be evaluated taking into account the sustainable use of ecosystems and their components, ie. it is equal to the ES volume which may be used by people without disturbance of ecosystem structure and functioning (eg, volume of withdrawal of bioresources, which does not disturb the structure, reproduction and ecosystem functions of exploited populations).

most common pattern is an inverse relationship between the area of natural ecosystems and the density of ES consumers, because human economic activity in most cases, is associated with the destruction or disruption of natural ecosystems.

The comparison of distribution of potential ES and potential consumers of ES can be made by estimating of ES in three indicators: supplied, demanded and consumed ES.

Population density



Demanded ES were defined as ES which correspond to the ES yield necessary to fulfill the needs of the population and economy of a region.

Consumed ES were defined as the ES yield which is materially or immaterially being used by the population, or which people derive benefits from.

Ratios and differences of supplied, demanded and consumed ES show the degree of use of ES and satisfaction of needs for ES which is important information for the assessment of the environmental situation in the regions and interregional comparisons. These indicators are relative indices in the case of ratios and are measured in the same units as ES volumes in the case of differences.

Ratios and differences of ES volumes and their application in ES assessment

Ratios and differences of ES volumes	Application in ES asssessment	Examples from the Prototype Report
V _{consumed} / V _{supplied} V _{consumed} / V _{supplied} ×100%	The level of ES use	The share of harvested game animals, mushrooms or berries in the total biomass or abundance The share of fodder eaten by livestock The share of actually purified water volume in purification abilities of terrestrial ecosystems* The share of regional carbon stock in managed forests
$V_{supplied} - V_{consumed}$	Unused (if positive) or overdrawn (if negative) ES volume	The unused residual of the annual allowable cut (the difference between annual allowable cut and logged timber) The supplied ecosystem runoff unused by people
V _{supplied} / V _{demanded} V _{supplied} / V _{demanded} ×100%	The potential satisfaction of the needs for ES	The share of toxic gases which can be assimilated (or trapped) by suburban forests*
$V_{demanded} - V_{supplied}$	Excess (if positive) or deficit (if negative) of ES	The excess volume of toxic gases over the ecosystem's capacity to trap pollutants* The residual volume of polluted runoff which cannot be neutralized by water ecosystems or water ecosystems' untapped opportunities for wastewater treatment
V _{consumed} / V _{demanded} V _{consumed} / V _{demanded} ×100%	The actual satisfaction of the needs for ES	The share of purified runoff in polluted runoff* The share of toxic gases absorbed by suburban forests*
V _{demanded} – V _{consumed}	Volume of unmet need for ES	The residual of polluted runoff unpurified by terrestrial ecosystems (the difference between polluted and purified runoff)*

Indicators and measures for estimation of supplied, demanded and consumed ES

Category of	Supplied ES	Demanded ES	Consumed ES	Measure
ES Provisioning ES	 The total biomass, abundance or productivity of a bio-resource (e.g. abundance of hunting animals, total biomass of mushrooms and berries, productivity of natural pastures). More accurately – the part of a bio-resource yield that could be extracted from the ecosystem without undermining the population (e.g. annual allowable cut) 	Yield of a bio-resource necessary for sustainable socio-economic development of a region	Yield of a bio-resource extracted from natural ecosystems (e.g. logging volume, fish take, mushroom and berry harvest, the mass of fodder eaten by cattle in natural pastures)	Mass Number
Regulation ES	 Volume/area for which ecosystems control the considered parameters (e.g. the total area protected from erosion) Volume of matter involved in the considered function (e.g. runoff provided by ecosystems, amount of pollutants which could potentially be neutralized by ecosystems, the amount of carbon stored in all ecosystems) Overall factors affecting the environmental regulation (area and productivity of ecosystems, the capacity for self-cleaning, etc.) 	 Volume/area where it is necessary to regulate environmental parameters for sustainable socio- economic development of a region (e.g. volume of ecosystem runoff regulation needed for the population and the economy) Volume of matter which needs to be involved in the considered function to maintain acceptable environmental conditions (e.g. amount of pollutants which must be neutralized by ecosystems) The sum of factors that determine the necessary volume of environment regulation 	 Volume/area directly important for people where ecosystems regulate environmental parameters (e.g. the area of agricultural land protected from erosion, the area of agricultural land with natural pollinators) Amount of matter directly important for people which is involved in the ES (e.g. the amount of water used by people, the volume of runoff purified by ecosystems, the amount of pollutants neutralized by ecosystems, the amount of carbon stored in managed ecosystems) The sum of factors that determine actual benefits (or prevented damage) from environment regulation (population, regional GDP, level of pollution, agricultural area, etc.) 	Volume Area Mass
Cultural ES	Overall factors affecting the information which is naturally preserved by ecosystems (number of species, diversity of ecosystems and landscapes, etc.)	The sum of factors that determine the volume of information which people need to get from nature	The sum of factors that determine the actual volume of information which people get from nature (population, transport accessibility, the number of scientific expeditions, etc.)	Score in points
RecreationalThe sum of natural factorsESthat determine recreationalpotential (recreationalcapacity of ecosystems,pleasant climate,picturesque sights,capabilities of swimming,bird-watching, fishing, etc.)		The sum of socio- economic factors that determine the necessary recreational potential	Overall socio-economic factors affecting the actual recreational load (transport accessibility, tourist infrastructure, etc.)	Score in points

COMPARISON OF THE REGIONS

Scoring supplied and consumed ES gives the possibility to compare the regions of Russia by the ratio of natural factors that determine supplied ES, and socio-economic factors that determine the need for the services and their use

The matrix on this spread shows the difference of scores supplied and consumed ES. Positive values (green) indicate a predominance of natural factors that provide ES, negative (red) - the predominance of socio-economic factors that determine ES use. Zeros and values close to it (white and light colors) indicate the relative balance of natural and socio-economic factors. Values moving away from zero (bright colors), show an imbalance of factors.

Natural factors that determine supplied provi-sioning ES, notably prevalent in the Ural and Siberian federal districts, as well as in some regions of the North-Western, Volga and Far Eastern federal districts (ie, non-wood products in Komi Rep., Perm region and Sakha Rep.). Socio-economic factors determining the consumed provisioning ES predominate in all districts, except for the Ural, Siberian and Far East. The most intense they are in the South and the North-Caucasian federal districts (use of natural pastures), in some regions of the North-West, Central and Volga federal districts (use of wood products).

Natural factors that determine supplied environment-forming (regulating) ES predominate in the North-West, Siberian and Far Eastern federal districts. Most strongly it appears to ES associated with the runoff regulation and purification of water and soil. On the contrary, the factors ensuring air purification, predominate in the regions with great area of suburban forests (Central, North-Caucasian federal districts and some regions of the North-Western, Volga and Southern federal districts). ES of carbon cycle regulating are provided primarily by wetland ecosystems in Western Siberia (Ural and Siberian federal districts), as well as chernozem (black earth) ecosystems in the southern regions of the Central Federal District. The consumed "carbon" ES, which are calculated as carbon accounts in managed forests, are represented in all districts, except for the South and the North-Caucasian districts, where are few managed forests. The result is a significant imbalance: in the forest regions of North-West, Central, Volga and Siberian districts factors of ES use are predominate, while the main natural factors of supplied ES are presented in nonforest districts with peat and black soils. Socio-economic factors determining the cousumed ES of runoff regulation and purification of water and soils predominate in the Central, Volga, Southern and North Caucasus federal districts.

Natural factors that determine supplied infor-mation ES are associated primarily with biodiversity indicators. They are strongest in the North-West, North-Caucasian, Siberian and Far Eastern districts. Factors determining consumed information ES use are the most intense in the regions with high population density and welldeveloped transport network (Central, Volga, Southern districts).

Natural factors that determine supplied recreational ES relatively prevalent in the North-Western, Volga, Urals, Siberian and Far Eastern districts, while socioeconomic factors determining ES use predominate in only a few regions (Kaliningrad, Moscow, Samara, Krasnodar regions).

In general, the comparison of the regions shows the expected pattern: natural factors that provide ES, relatively prevalent in the North-West, Siberian and Far Eastern districts, socio-economic factors determining the use of ES prevalent in the Central, Volga, Southern and North-Caucasian districts. Distribution of provisioning and recreational ES is the most balanced (except for few regions).



		rodu ovis				
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	Production of timber	Non-wood plant production	Production of natural fodder	Production of game resources	Carbon storage	Regulation of CO ₂ flows
North West Federal District						
Arhangelsk region Vologda Region	4	1	0	0	5	2
Leningrad region Kaliningrad region	4	0	0	1 0	-5	5
Murmansk region	.1	2	0	0	2	1
Nenets AO Novgorod region	0	0 4 3	1	2	â	2
Pskov region The Republic of Karelia	1	3	0	0	23	4
Komi Republic	0	6	0	0	-6	3
Central Federal District Belgorod region	4	1	0	5	1.	2
Bryansk region Vladimir region	5	33	0	1	3	3
Voronezh region	22	4	0	33.	6 -5	1 3
Kaluga region	-2	1	0	1	4	-1
Kostroma region Kursk region	0	2	0	1	6	0
Lipetsk region	2	0	0	1	5 4 7 m m m m	6
Moscow region Oryol Region	2	_3 0	0	32	3	6
Ryazan Oblast Smolensk region	-3	3	0	2 4	3	3
Tambov Region	2	-1	0	1	5	4
Tver region Tula region	3	-1 2	0	4 3	2	2 2
Yaroslavl region Volga Federal District	2	2	Û	-1	5	2
Kirov region	34	2	0 0	0	5 4	1
Nizhny Novgorod Region Orenburg region	-1	0	1	112	4 2	0
Penza region Perm Krai	20	1	0	20	2	1.
Republic of Bashkortostan Mari El Republic	1	2	-1 0	1	4	1
The Republic of Mordovia	-2	-1	0	11173	0	2
Republic of Tatarstan Samara Region	0	0	1	-1 -2	1	3.2
Saratov region Udmurt Republic	-1	1	0	02	4	-3
Ulyanovsk region	-1	1	0	1	2	-2
Chuvash Republic South Federal District	.1	.1	Ű	2	.1	2
Astrakhan region Volgograd region	0	0	-5	L O	0	2
Krasnodar Krai	-1	0	0	3	1	4
Republic of Adygea Republic of Kalmykia	0	0	4	2 0	0	4
Rostov region Northern Caucasus FD	-1	1	2	3	1	4
Republic of Ingushetia Kabardino-Balkar Republic	0	0	1	1 2	1 2	4 2
Karachay-Cherkess Republic 📃	0	0		.5	0	5
Republic of Dagestan Republic of North Ossetia	.1 0	1	1	0	2	.4
Stavropol region Chechen Republic	-1	1	37	0	3	4
Ural Federal District						
Kurgan region	4	1	5	0	2	37
Tyumen region Khanty-Mansi AO	2	0	1	1 0	4	0
Chelyabinsk region Yamalo-Nenets AO	1	03	3	6	1 2	4
Siberia Federal District						
Altai Krai Transbaikal Krai	1	0	1	2	5	3
Irkutsk region Kemerovo region	4	0	0	1	4	4
Krasnoyarsk Krai	4	4	0	0	2	1
Novosibirsk region Omsk region	1	2	4	2	1	3
Altai Republic Republic of Buryatia	0	1 2	0	3	43	0
Tyva Republic Republic of Khakassia	1	. 5	0	2	0	4
Tomsk region	02	0	0	20	7-	1
Far East Federal District	0	.1	0	1	4	1
Jewish Autonomous Region	-1	0	0	3	-1	4
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Sakhalin region	0	4	0	0	3	-4
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