Final booklet

About activities of Belarus Forestry Development Project

funded by GEF Grant funds

Content

PROJECT ACTIVITY: Identification and creation of a collection of forest woody plants resistant to climate stress, rare and economically valuable wood species on the premises of the National Forest Selection-Seed Production Center (1.3.3)

Implementation period: October 2017- February 2020

Goal of the activity:

The objective of the assignment is to identify, select and create a collection of forest woody plants resistant to climate stress, rare and economically valuable species that will ensure:

a) storage of economically valuable genetic material of tree species for its further use in breeding and development of new species;

b) preservation of the most productive and adapted genotypes in the conditions of changing climate and invasive diseases caused by climate change;

c) management of rare and endangered species.

Activity is implemented by: State Scientific Organization «Institute of Forest of the National Academy of Sciences of Belarus»

Target audience: specialists of forest enterprises and forestry units; students of High Schools studying forestry; staff of research organizations and educational institutions; civic society; partners from the Eastern European countries

Key results achieved:

In the result of work on identification, selection and reproduction of forms of forest plants resistant to climate stress, and rare and economically valuable tree species, an *ex situ* collection was created with the total area of 3.05 ha. The collection was established on the basis of the National Forest Selection-Seed Production Center, Dvinskaya and Korenevskaya Experimental Facilities of the National Academy of Sciences of Belarus. 1214 seedlings and saplings of more than 35 coniferous and deciduous wood species and their varieties were planted. The collection is represented by:

– climatic stress resistant origin of Scots pine and European spruce, selected as part of provenance trials, and perspective introduced species (*Tilia caucasica* and *Tilia dasystyla*);

– clones of Scots pine with high resin productivity;

– forms of European ash resistant to phytopathogens, and Scots pine genotypes resistant to infectious lodging;

– rare species listed in the Red Book of the Republic of Belarus (Silver fir, Dwarf birch);

- clones of eight natural monuments of national and local significance (English oak, Silver fir, Siberian larch);

– fast-growing and high productive clones and forms of Scots pine, Norway spruce, European larch, Douglas-fir, English oak, European beech, Small-leaved linden, Norway maple, Silver birch (including Black-barked birch and Silver birch 'dalecarlica'), poplars (including Aspen, Simon poplar, White poplar, Petrowskiana poplar, Black poplar, Canadian poplar);

– clones of lyre-shaped, bush and standard forms of Karelian birch, as well as clones with highly veiny timber;

– seeds of coniferous introduced trees (Weymouth pine, Siberian cedar pine and Korean cedar pine, Japanese white pine, Korean fir, Nordmann fir);

– food species (Walnut, Manchurian walnut, Butternut, H**eart-shaped walnut**, Black mulberry);
– 14 varieties of decorative forms of Scots pine, Silver maple, etc.

The created *ex situ* collection is aimed at the preservation of biological and genetic diversity of tree species, increasing the productivity and biological sustainability of forests.



Photo 1. Sampling of vegetation material in the national parks

Brief description of the main results:

On a global scale the creation of such collection will promote increase in efficiency of forestry and sustainable forest management.

The following scientific and technical products were developed in the course of the task, the use of which allowed achieving the main goal of the activity and creation of the *ex situ* collection:

– analytical note about international and local experience of creation of collections of forest plants resistant to climate change, efficiency of means and methods of conservation of forest genetic resources;

– integrated system of criteria and norms for selection of populations, ecotypes and forms of forest tree species with due regard to their value, specifics and need of conservation;

– data obtained during the revision of dendroflora in Belarus aimed at finding new, unique and ornamental forms as well as rare and endangered species, subspecies and some populations of forest tree species;

– database upon genetic and breeding assessments of climatypes of coniferous trees on provenance trials and monitoring of the state of marginal and/or peripheral populations of woody species of Belarus;

– list of genetic (form) variety of priority tree species which are selected in forest ecosystems in Belarus including those in reserves, national parks, forests which are of scientific and/or historical value and nature sanctuaries;

– registers of forms of selection and collection fund of forest tree species, which are fast-growing and high productive, resistant to phytopathogens, and ensure high production of resin;

– updated database of the selected populations, climatypes, species, forms and genotypes existing in natural conditions (*in situ*);

– register of endangered species, subspecies, forms and some populations whose conservation under natural conditions is not effective and application of biotechnologies is desirable.

In general, the *ex situ* collection and its doublets are highly practically oriented products ensuring production of biologically sustainable and economically valuable planting materials. They are also of high scientific importance as they ensure production of initial material for experimental selection and genetic works.

Photo 2. Collection fund *In vitro* of fast-growing and highly productive forms of forest tree species

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https://bellesexport.by/ru/vidy-deyatelnosti/proekt-razvitiya-lesnogo-sektora-respubliki-belarus.html

PROJECT ACTIVITY: Development of computerized accounting of planting materials for development of forest seed and forest nursery bases of forest enterprises (1.3.4)

Implementation period: July 2019 – July 2021

Goal of the activity:
The main objective of the assignment is to develop: (i) new software package "Nursery management" allowing to control production of planting materials in the forest nurseries, to track flow of the material at all the stages, and to calculate cost of production of planting materials; and (ii) new software "Seed management of forest stands" allowing to control and track production of forest seeds, treatment with the forest seeds at all the stages, usage of the collected seeds, exploitation of available seed stands and actual cost of works on seed management.

Activity is implemented by: Republican Unitary Enterprise "Belgosles"

Target audience: specialists of forest enterprises and forestry units involved in seed management and nursery management activities.

Key results achieved:

Until recently, accounting of all the works in the field of nursery and on the forest seed bases were done manually. As the result of this, prognoses of production of planting materials and forest seeds for reforestation were not fully correct. This problem was actual especially last years as the area of lands for reforestation and afforestation and those where the forest was already planted significantly increased. Thus, to ensure efficiency of accounting works and to minimize errors in reporting documentation needed for further decision-making and prompt analysis of the situation, the above-mentioned processes were computerized. Two new software, "Nursery management" and "Seed management of forest stands", were developed.

Due to the new software, all the documents on nursery management are filled in electronically, and all the aggregated documents and reports are generated electronically with further transformation in Word format and printing on paper. All the final documents conform to the requirements of normative and technical documents of the Ministry of Forestry of the Republic of Belarus.

Databases for the above-mentioned software were also developed within the contract. The applications use PostgreSQL и MS SQLServer systems of database management with the possibility of further simple integration with the cartographic application QGIS.

Brief description of the main results:

The software "Nursery management" and "Seed management of forest stands" are used for:
Tracking of planting material production in forest nurseries and further use of the materials at all the stages;
Calculation of the cost of planting material production;
Keeping and control over documentation on seed management;
Generating of aggregated documents and reports.

With the use of the new software, accounting of the following material and financial costs ensured: production, exploitation and harvesting of forest seed raw material and seeds of forest stands; production and usage of the planting material; calculation of demand in seed and plating material for further effective use of the existing objects.

Experimental works were done at 6 forest enterprises (Glubokskij experimental forest enterprise, Shchuchinskij forest enterprise, Krupskij forest enterprise, Mogilevskij forest enterprise, Rechitskij experimental forest enterprise, Ivatsevichskij forest enterprise).

Upon completion of the development and testing, 110 specialists of the forest enterprises responsible for seed and nursery management were trained through videoconference via zoom platform.

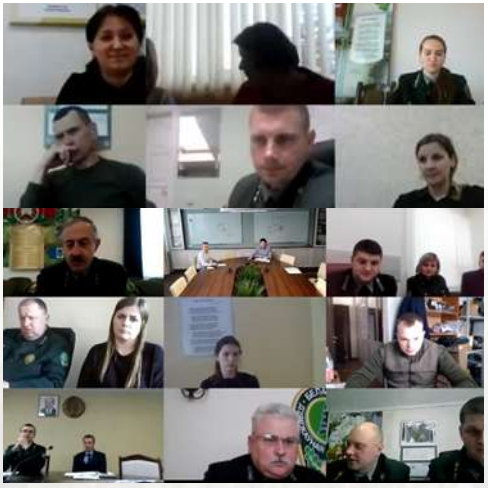

Photo 3. Participants of training on usage of new software

Figure 1. User manual of new software products

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PROJECT ACTIVITY: Updating the firefighting zoning of the Republic of Belarus (2.1)

Implementation period: May **2**016 - May 2017

Goal of the activity:
This activity aims to improve the system of monitoring activities of forest fires and firefighting arrangement of the forest fund, taking into account the updated map of the firefighting zoning. The map is updated on the basis of classes of natural fire risk of forests, forest coverage and population density, level of forest inflammability, distribution of territory of forest fund by radioactive contamination zones.

Activity is implemented by: State Scientific Enterprise «Institute of Forest of the National Academy of Sciences of Belarus»

Target audience: specialists of forest enterprises and forestry units of the Ministry of Forestry and other organizations working in the field of forestry; students of High Schools studying forestry.

Key results achieved:

Complex index of fire risk of the forest fund was defined for all legal entities working in the field of forestry. The index is based on the class of natural fire risk of forests, forest coverage of the region, level of forest inflammability, density of population of the region, distribution of forest fund of the region by radioactive contamination zones. Scheme of dividing of territory of the country into 3 forest fire zones is prepared with due regard to: (i) anthropogenic burden; (ii) length of the borders of forest fund with settlements and their remoteness from the forests; and (iii) degree of radioactive contamination and regime of silviculture. 46 legal entities working in the field of forestry are attributed to the I forest fire zone (44% of the total amount of legal entities), 39 entities (34.2%) are attributed to the II zone, and 29 entities (25.4%)- to the III zone.

In the result, actual map of the firefighting zoning of the Republic of Belarus was prepared. It was found out that during the last decade the highest amount of fires have been noted in Gomel and Brest regions, and the minimum amount- in Minsk and Vitebsk regions. Natural fire risk of the forests of the country is high; average class of natural fire risk is 2,7 out of 5 points scale of assessment of forest types and forest sites of I.S.Melehov. For the conditions of the Republic of Belarus, this scale is modified by I.A.Rihter. Pursuant to the scale, the stands of all forest types, forest lands not covered with the forests, and non-forest lands on the territory of the forest fund are divided into 5 classes of natural fire risk, including: I class is very high fire risk, II class is high fire risk, III class is medium fire risk, IV class is low fire risk, and V class is low fire risk. The division is made based on the potential possibility of fires, time of the fires and type of the fires.

Proposals on actualization of forest fire zoning are included into Amendment No.1 to the Technical Code of Common Practice on firefighting arrangement of forests of the Republic of Belarus that was approved by the Resolution of the Ministry of Forestry of the Republic of Belarus and put into operation from 1 July 2017.

Brief description of the main results:
Key factors used for definition of complex index of fire risk of forests were identified based on the analysis of dynamics of forest fire cases and area for the last decades, fire causes, duration of fire

dangerous season. These key factors are class of natural fire risk of forests, forest coverage of the region, level of forest inflammability, density of the population of the region, distribution of forest fund of the region by radioactive contamination zones.

Based on the data of the forest fire record books, database of fires in the forest fund of the Republic of Belarus for 2001-2015 was developed. The database includes information on forest fires with connection to concrete site: forest enterprise, forestry unit, compartment, sub-compartment, time of fire initiation, cause of fire, and area.

To ensure actualization of forest fire zoning, complex index of fire risk of forests is defined for 98 state forest enterprises of the Ministry of Forestry, and 20 other legal entities working in the field of forestry.

In accordance with requirements of the current legislation, differentiated system of firefighting arrangement of forests includes: creation of system of fire preventive barriers in the form of gaps and screens, and protective mineralized stripes; development of network of roads and reservoirs to ensure prompt transportation of firefighting troops and elimination of the fires. The following should be undertaken to increase fire resistance of the forests: adjustment of composition of coniferous stands in the process of intermediate fellings through preservation of some share of deciduous species; timely intermediate fellings; removal of wood residues from felling sites and cleaning of forests outside felling sites; creation of fire-resistant edges of forest.

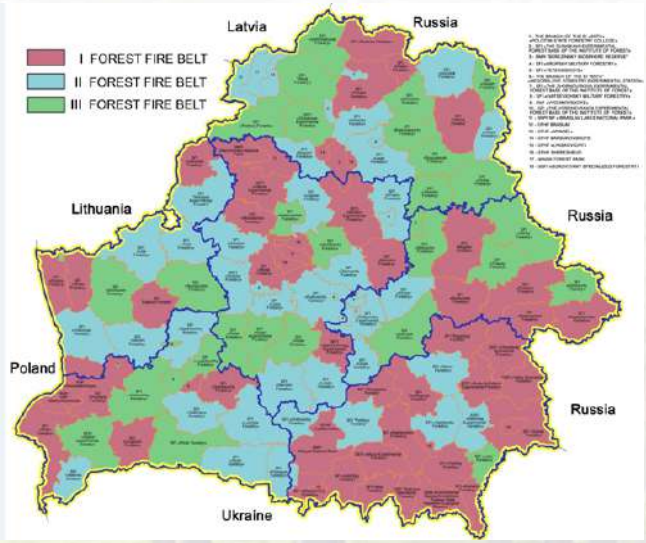

Figure 2. The updated map of forest firefighting zoning of the territory of the Republic of Belarus

Photo 4. 20-meters fire-prevention gap in plantations of the I class of natural fire danger

Photo 5. The mineralized protective strip in plantations of the I-III classes of natural fire danger

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PROJECT ACTIVITY: Creation of the animated commercial in order to strengthen the measures on forest fires prevention and its broadcasting on TV, internet, in cinemas, subway stations and the bus station «Centralny» (2.2.2)

Implementation period: May 2018- May 2020

Goal of the activity:

The main objective of the assignment was to produce animated commercial, and its public broadcasting TV channels, in Internet, in subway, cinemas, schools, to ensure: an informed and careful behavior of the people on the territory of the forest fund; compliance with the fore safety rules in the forests; alerting the state forest protection service in case of forest fires and assistance in fire extinguishing.

Activity is implemented by: Unitary enterprise "Hepta Group»

Target audience: citizens visiting forests; civic society; children and youth; public environmentalists; environmentalists.

Key results achieved:

Produced animated commercial was demonstrated in the republican, regional and district TV channels, in Minsk subway, in Internet, in cinemas, and bus station "Centralny" (Minsk city) during the high fire danger season (April- June 2019, and May 2020). About 2 million people had an opportunity to watch the commercial.

Production of the commercial video is aimed at resolving the following tasks:

- forest fire protection, timely detection and extinguishing of forest fires;
- propaganda of careful attitude towards forest as one of the main natural resources of the country;
- drawing of people's attention to the necessity to comply with the rules of behavior in the forests.

To ensure broadcasting of commercial as social video on republican, regional and district TV channels, agreement of the Intersectoral board on advertising of the Ministry of Antimonopoly Regulation of the Republic of Belarus was received.

Brief description of the main results:

Idea of forest conservation is not innovative itself, however taking into account the big ecological role that the forest play, forest fire protection is becoming really a very important issue. If each of us will follow the required rules of forest fires prevention in Belarus, damage to the forests in the result of fire disaster can be minimized.

In order to minimize forest fire cases caused by the people it is necessary to teach people, inform them on the responsibility that they do bear, and to change people's view of the problem.

Broadcasting animated video for the general public, we can change behavioral insights of people and to draw their attention to the problem of forest fire protection.

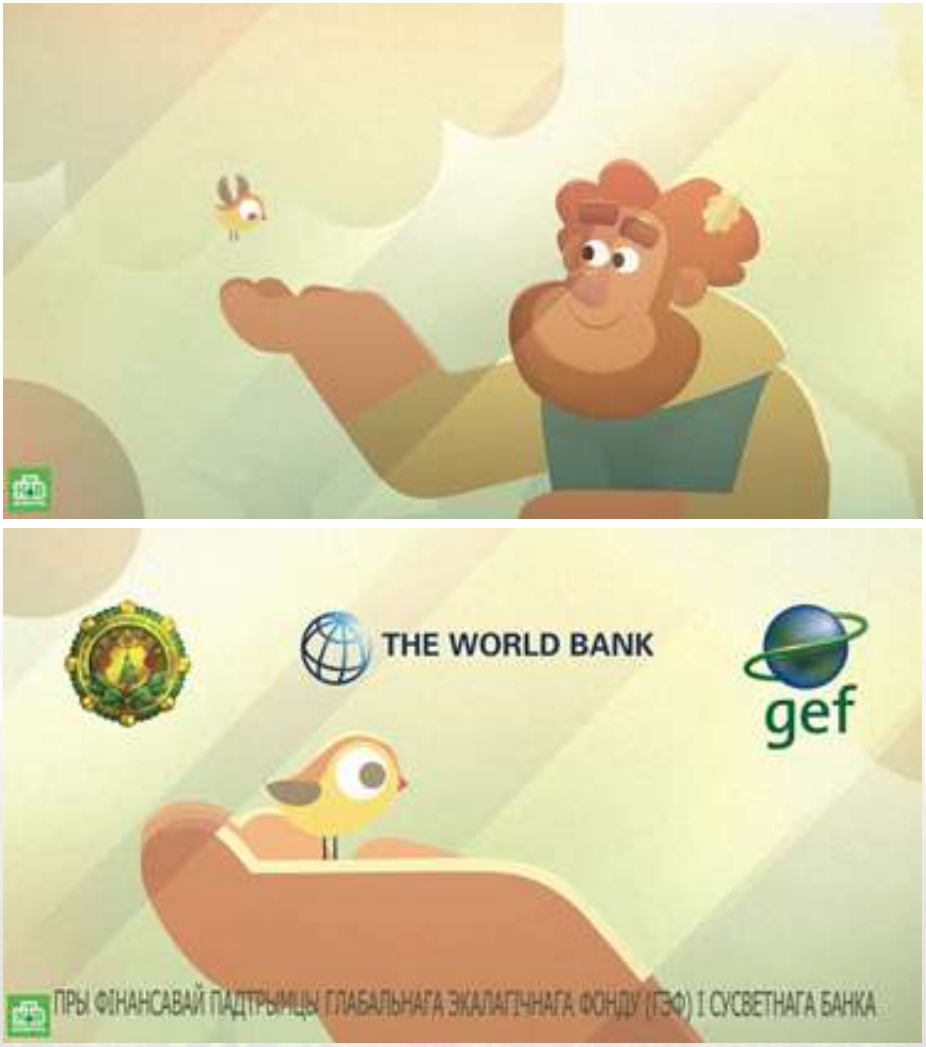

Figure 3. Demonstration of video at the TV channel

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PROJECT ACTIVITY: A targeted inventory of depleted peatlands and those peatlands that are no longer used for agricultural purposes and that pose a high risk of fires (2.3)

Implementation period: September 2018 – November 2019

Goal of the activity:

Objective of the assignment is to undertake an inventory of the peatlands dried for agricultural purposes that were depleted, are no longer used for agricultural purposes and were transferred to the forest enterprises for further use.

Activity is implemented by: State Scientific Entity "Institute of Forest of the National Academy of Sciences of Belarus"

Target audience: specialists of the Ministry of Forestry of the Republic of Belarus; workers of forest enterprises and forestry units having peatlands on their territory; students of High Schools studying corresponding disciplines; other entities working with usage and restoration of peatlands.

Key results achieved:

Inventory of dried peatlands and those inefficiently used in agriculture and for industry purposes, which were transferred to the forest fund, was done.

Area of peatlands transferred to the forest fund after their industrial exploitation and agricultural use was updated. In total, 6679,2 hectares of peatlands were transferred to the forest fund, including 1381,5 hectares of peatlands used in agriculture, and 5297,7 hectares of peatlands after industrial extraction of peat.

Information on 36 sites of peatlands with the area of 10 and more hectares that are not used any more in agriculture or after industrial peat extraction, which have been transferred to 24 forest enterprises starting form 2008, was added to the database "Belarusian Peatlands".

Using functionalities of the mentioned database, allocation of concrete peatland that has been transferred can be seen on the map of Belarus.

Upon results of the study, proposals on minimization of fire risks and improvement of forestry management efficiency were prepared for each concrete peatland.

Brief description of the main results:

The following data was added into the database "Belarusian Peatlands" (peatlands.by) on 24 forest enterprises:

location of the site (forestry unit, forest compartment);
Administrative supervision of the site;
Year of the site transfer;
Average class of fire risk of the site;
availability of hydro-technical devices on the site;
general description of the conditions of the site and its utilization;
technical conditions of meliorative systems and hydro-technical devices at the site;
data on whether meliorative systems and separately located hydro-technical devices are duly registered at the balance of forest enterprise;
assessment of necessity of accounting of meliorative systems and hydro-technical devices as assets belonging to the forest enterprise;
area of peatland transferred (in hectares);
depth of the peat left (in meters);

ground water level (in meters);
Recommendations on usage of the site.

The findings of the study show that mainly low productive lands were transferred to the forest fund, e.g. Depleted peatlands after industrial use and dried peatlands inefficiency used in agriculture. Re-wetting processes are observed on these lands, and the sites are hardly accessible and difficult for effective silviculture.

Analysis of fire preventive measures for each peatland was made. Schemes of organization of territory to minimize risk of fires for each peatland were developed.

42 sites for water taking and 5 firefighting reservoirs should be established on the peatlands transferred to the forest enterprises to ensure minimization of risk of fires. It was defined that the best way to prevent fires of the dried peatlands is to rise water level till the surface level and above. This can be done on the majority of the sites through repair of the pipes of water regulating devices.

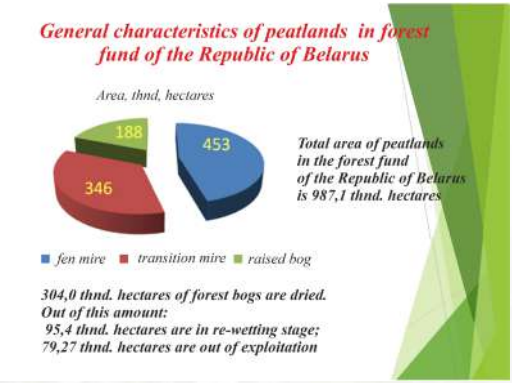

Figure 4. General characteristics of peatlands in forest fund

Photo 6. Peatland transferred to Lidskij forest enterprise, which can be used for traditional silviculture

Figure 7. Peatland transferred to Stolbtsovskij forest enterprise and recommended for re-wetting

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PROJECT ACTIVITY: Improvement of the national forest policy with account of requirements set forth in international agreements, of sustainable forest management and use requirements, and principles of biodiversity conservation and mitigation of consequences of climate change (3.1.1.1)

Implementation period: September 2019 - July 2020

Goal of the activity:

Overall objective of the assignment is improvement of legislation and forestry policy with due regard to the Sustainable Development Goals (hereinafter- SDGs). The specific goals of the assignment are: (i) development of criteria to assess progress of implementation of the SDG 15, and specifically for indicators related to the forestry sector; (ii) preparation of proposals on achievement of indicators of other Sustainable Development Goals that are directly or indirectly connected to the forestry sector; (iii) development of indicators for achievement of 6 global goals on the forests and 26 related tasks of the United Nations Strategic Plan for Forests 2017-2030; and assistance with the reporting on the input of Belarusian forests in achievement of these goals; (iv) development of draft State program for 2021- 2025 "Belarusian Forest" with regard to the indicators of SDGs; and (v) elaboration of at least 10 project proposals aiming at achievement of SDGs by the forestry sector for financing by international organizations.

Activity is implemented by: Belarusian State Technological University

Target audience: specialists of forest enterprises and forestry units of the Ministry of Forestry and other organizations working in the field of forestry; students of High Schools; civic society organizations.

Key results achieved:

– Review of the existing national indicators of SDG 15 and other SDGs related to forestry is done; proposals to supplement or to amend national indicators are prepared; analysis of indicators for achievement of 6 global goals on the forests and 26 related tasks of the United Nations Strategic Plan for Forests 2017-2030 is carried out (hereinafter "The UN Strategic Plan");

– State program "Belarusian Forest" for 2021- 2025 is developed and approved by the Government (Decree of the Council of Ministers of the Republic of Belarus dated 28.01.2021 No.52). The program is based on the analysis of implementation and target indicators of the previous similar State program. Proposals on revision of the Forestry Development Strategic Plan for 2015-2030 are prepared;

- analysis of international organizations providing technical grant assistance to implement pilot projects with the purpose of achievement of SDGs and UN Strategic Plan is done; project proposals aiming at achievement of SDGs and UN Strategic Plan by the forestry sector for financing by international organizations are elaborated.

Brief description of the main results:

The goal of the State program "Belarusian Forest" for 2021-2025 if to improve efficiency of use and reproduction of forest resources on the basis of ecologically and socially oriented forest management, forest use, and hunting management.

The tasks of the State program are as follows:

Improvement of accounting of forest resources ensuring increased efficiency of forest

management on the basis of non-exhaustible forest use;

Development of forest reproduction and management system aimed at conserving biological diversity and increase of sustainability against climate change consequences;

Sustainable forest use to ensure protection and strengthening of ecological and social forest functions;

Development of market of services in the field of silviculture and forest harvesting works;

Full use of wood resources within the annual approved allowable cut;

Ensuring deeper processing of wood resources and increase of share of products with high added value;

Development of road and transport network in forest, and increase of accessibility of forest resources to meet requirements of production in raw materials and to ensure ecosystem services;

Sustainable hunting management based on optimization of number of hunting animals and creation of conditions to meet demands of people in hunting, hunting products and recreation related to hunting to maximum extent.

Implementation of the State program will facilitate achievement of the Sustainable Development 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" at national level, which was announced at the General Assembly of the United Nations Organization.

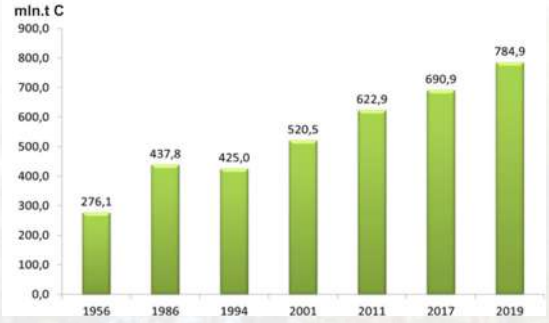

Figure 5. Dynamics of the total amount of carbon in phytomass of the stands

The following results will be achieved till 2025:

Forest coverage of the territory of the Republic is 40,3%;

Timber harvesting is increased till 3,2 cubic meters per 1 hectare;

Average growing stock is increased till 230 cubic meters per 1 hectare;

Not less than 500 km of new forest roads are built;

Population of elk is 93% in comparison with the optimum number, population of red deer is 34%, and number of roe deer is 71%.

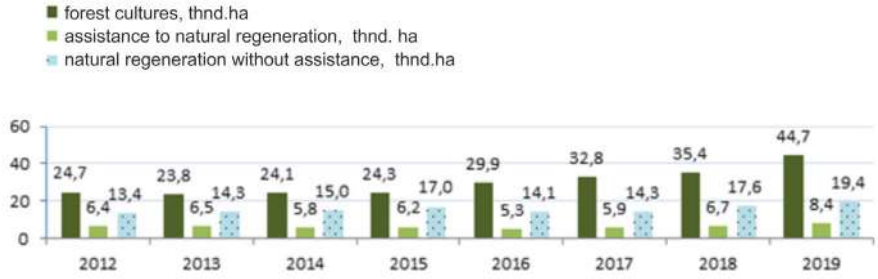

Figure 6. Reforestation area, thnd.ha

Years	1944–1945	1946–1950	1951–1958	1959–1970	1971–1980	1981–1990	1991–2000	Sub-total for 1944–2000	2001–2005	2006–2010	2011–2015	2016–2019	Sub-total for 2001–2019	Total
Area of forest cultures created, thnd. ha	3,4	198,4	372,7	582,9	371,6	273,8	221,7	2 024,50	190,2	189,3	115,5	143,9	638,9	2 663,40

Figure 7. Area of forest cultures created

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PROJECT ACTIVITY: Improvement of the national legislation and the regulatory technical framework of the forestry sector with account of principles of sustainable forest management and use, practice of implementation thereof, and international experience (3.1.1.2)

Sub-task: Improvement of the forest management planning system in the Republic of Belarus

Implementation period: January 2016 - December 2017

Goal of the activity:
To improve the system of forest management planning in the Republic of Belarus based on international experience; to prepare proposals for development of competitive environment for services on elaboration of forest management plans (including collection of field data) to ensure improvement of economic effectiveness and quality of forest management planning activities.

Activity is implemented by: Individual consultant I.A. Kusiankou

Target audience: specialists in the field of forest inventory; staff of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; workers of research organizations and educational institutions; civic society; partners from other countries of Eastern Europe.

Key results achieved:

Integral part of any process of improvement of legislation is permanent study and monitoring over new technologies of forest inventory and management, usage of digital methods of collection and processing of data in the developed countries and introduction of these technologies in the process of forest management in Belarus, endorsement of technologies that were tested in practice by legislation.

Analysis and evaluation of effectiveness of the current system of forest management planning in the Republic of Belarus were done in order to identify challenges of the current forest management system, including analysis of forest legislation of Belarus in the field of forest management and planning, and questioning of forest enterprises, Unitary Enterprise "Belgosles" (responsible for forest management and inventory), Ministry of Forestry and other stakeholders. Appropriate results and conclusions were elaborated and presented.

Proposals in the following fields were developed: (i) improvement of forest management system in the Republic of Belarus; (ii) introduction of new and updating of the currently used technologies of forest management in Belarus with due regard to the international experience; (iii) usage of modern measuring forest inventory instruments in the course of forest management. All the proposals are based on the peculiarities of forestry organization in the Republic of Belarus and economic effectiveness of their use.

International experience of different countries on organization and implementation of forest management, in particular concrete leading countries in the field of forest management such as Finland, Sweden Czech Republic, and Poland, was made on the basis of internet sources and resulted in formulation of the proposals mentioned above. Analysis of the main achievements in the forest management (technologies, methods, techniques) was also done.

Additionally, the following was analyzed on the basis of the internet data: technologies of collection of field data (selective method and field measurement of the areas) available in the world

and used in the developed countries; usage of different available sources of data (satellite images, digital aerial photographic images, LIDAR, digital surface models, GIS systems and databases, etc.); systems of data storage and processing; software.

Analysis of positive and negative aspects of functioning of market for forest management and planning services was completed. Analysis was made for the countries, where the peculiarities of such markets are clearly visible, e.g. countries, where access to the market does not have any legislative and regulative barriers; countries, where such barriers exist, but there is competitiveness; and countries, where only one state owned organization has the right and is responsible for forest management and planning as per the national legislation. Recommendations in this field were developed for Belarus based on the analysis.

Study of legislative, economic, and administrative possibilities to build-up service industry in the field of forest management and planning in Belarus was made. In particularly, overview of Belarusian legislation and general legislation of Eurasian Economic Union (Belarus, Russia, Kazakhstan, Armenia, Kyrgyzstan) was prepared.

Analysis of advantages and disadvantages of functioning of competitive environment in the field of forest management and planning in Belarus was made. Assessment of general impact at the quality of forest management and increase of economic efficiency was also accomplished. Recommendations on possibilities of development of competitiveness, ways of its development taking into account specifics of forest management in Belarus were prepared.

Draft roadmap for transition to competitive and effective market of services in the field of forest management and planning was elaborated and includes possible optimum time, methods and process of transition. Responsible specialists for each stage of the transition were proposed.

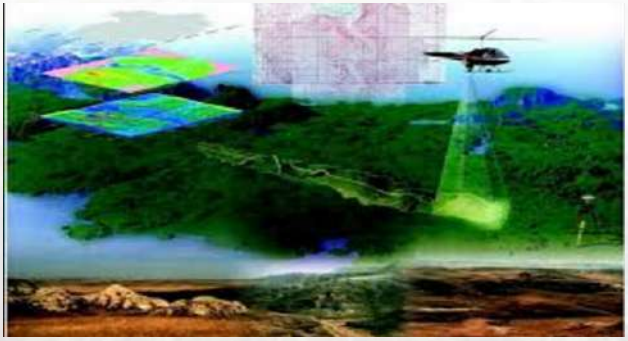

Figure 8. Air laser scanning of the earth surface LIDAR

Brief description of the main results:

Results of the work can be used by the Ministry of Forestry, Unitary Enterprise "Belgosles", other institutions as basic materials for improvement of organization of forest management system.

In case of development of market services in the forest management system, the following should be clearly regulated by legislative documents:

Requirements to entities that will be engaged in forest management in relation to their technical and technological equipment, staff;

Unified technologies of forest management and methods of forest inventory for all the market players;

Unified approaches to organization of forest management, including organization of competitions, tenders, etc.;

Transfer of forest management data and its integration in one common center;

Control over implementation of forest management works, acceptance, approval and put into action of forest management materials;

Survey over implementation of the developed forest management plan during the revision period.

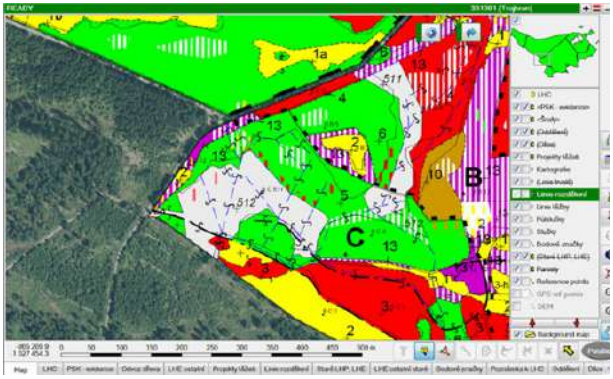

Figure 9. Mapping using software Field-Map

Figure 10. View of the forest stands and felling site from the camera of the remotely piloted aerial vehicle

In the result of the study of international experience on organization and implementation of forest management it was found out that two-levels organizational model of forest management is used in many country, and similar in the Republic of Belarus:

1. National forest inventory;
2. Forest planning (classic forest management).

Accelerated introduction of technologies that will result in positive economic effect in short term is the most desirable way for our country. These technologies include automatic decoding of pictures, expansion of use of the remotely piloted aerial vehicles, renewal of software similar to the software that was considered and recommended such as Field-Map, ArcGIS.

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https://bellesexport.by/ru/vidy-deyatelnosti/proekt-razvitiya-lesnogo-sektora-respubliki-belarus.html

PROJECT ACTIVITY: Improvement of the national legislation and the regulatory technical framework of the forestry sector with account of principles of sustainable forest management and use, practice of implementation thereof, and international experience (3.1.1.2)

Sub- task: Improving the system of forest monitoring in the Republic of Belarus

Implementation period: March 2016 – April 2017

Goal of the activity:
to improve the system of monitoring in the Republic of Belarus based on international experience;
to improve the quality of monitoring over the forest conditions;
to introduce new technologies, which proved to be efficient in the developed countries, to ensure prompt implementation (if deemed to be necessary) intensive silviculture methods and other actions that will minimize negative impact at the forests in the result of the climate change and economic activities.

Activity is implemented by: Republican Unitary Enterprise "Belgosles"

Target audience: specialists of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; staff of research organizations and educational institutions; civic society; partners from other countries of Eastern Europe.

Key results achieved:

To ensure improvement of the forest monitoring system of the Republic of Belarus the works were done under the following directions:
Analysis of dynamics of the main qualitative and quantitative indicators of the conditions of the forest fund of the Republic of Belarus for the last 10 years;
Analysis of monitoring over conditions and transformation of the forest fund of the country due to the impact of the changing of climatic conditions and economic activities for the last 10 years;
Study of the problematic issues of the current forest monitoring system with involvement of all the stakeholders. Collection of the material and its analysis;
Study of the best international experience in organization and implementation of the forest monitoring (by the example of the leading countries in the field of forest management such as Finland, Sweden, Czech Republic, Russian Federation, Republic of Poland);
Preparation of proposals on improvement of forest monitoring system in the Republic of Belarus to ensure minimization of negative impact of the changing climatic conditions and economic activities at the forests;
Development of proposals on improvement of normative, legal and technical framework regulating forest monitoring system. Proposals have been integrated into Regulation on organization of forest monitoring and usage of monitoring data, which was approved by the Resolution of the Government as of 04.11.2016 No. 907.

Brief description of the main results:

Since 1989, Unitary Enterprise "Belgosles", which is in the structure of the Ministry of Forestry, is responsible for forest monitoring in our country. Forest monitoring is an integral part of the

National Environmental Monitoring System of the Republic of Belarus functioning in line with the Regulations on National Environmental Monitoring System of the Republic of Belarus.

Forest monitoring is done under the following directions:

General conditions of the forest, including under the impact of atmospheric air pollution (*monitoring over forest conditions*);

Conditions of the forest under the impact of harmful insects and diseases (*forest pathological monitoring*);

Conditions of the forest under the impact of meliorative activities (*ecological and meliorative monitoring of the meliorated forest lands).*

In the last decade mainly, positive changes are noted in the forest fund of the country, including increase of the area of forest lands and forest coverage. However, forest distribution on the territory of the country is uneven.

Coniferous forest stands prevail in the Republic of Belarus (59,6% of forest land); soft-leaved stands cover 36,4% of forest land; and hard-leaved forest stands cover 4,0% of forest land.

The most intense climate changes on the territory of Belarus are noted since the end of 1980 years. In the last decades average air temperature increased climatic norm by 1,1°C.

Since 1980 years amount of precipitations on the territory of Belarus is slightly reduced. At the same time, unevenness of precipitations during the year and during different years increased in the stated warming period. Decrease of amount of precipitations and their unevenness, especially in combination with increase of air temperature, leads to increase of droughts. Consequently, droughts are observed in this period twice as much as during previous years.

One of the most severe droughts for all the history of meteorological observations was registered on the territory of the Republic of Belarus in 2015. Due to hot and dry weather, the year 2015 happened to be the most fire dangerous.

Changes of climatic conditions result in direct or indirect impact at forest conditions through change of the level of ground waters, forest pests dissemination, and intensification of forest diseases. Drying of forests is considered to be one of the most visible consequences of climate change. In the last decade, in average 8.8 thousand hectares of forests died annually due to the impact of different natural and climatic factors.

Figure 11. Monitoring points over the forest conditions and prevailing forest species at the sites

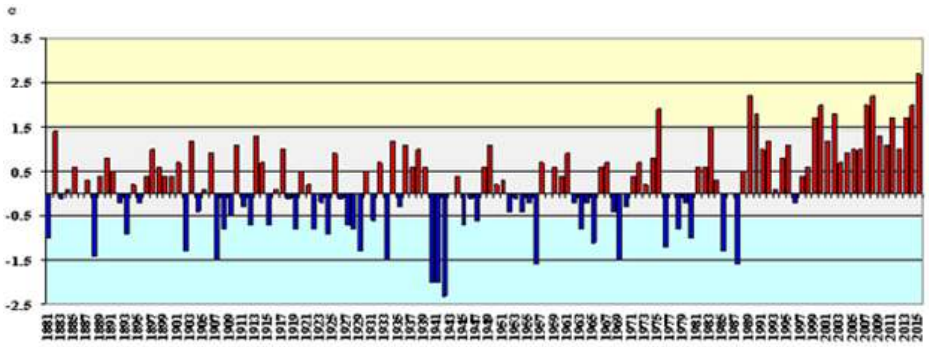

Figure 12. Deviation of average annual air temperature in comparison with the seasonal norm (+5.8°C) on the territory of the Republic of Belarus

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PROJECT ACTIVITY: Implementation of specialized forest surveying that takes into account the requirements on climate change adaptation, biodiversity conservation, and expansion of the forest use sphere (3.1.3.1)

Implementation period: July 2018 - April 2020

Goal of the activity:

Objectives of the assignment were: (i) development and introduction of new approaches on assessment of climatic changes influencing the structure and conditions of forests in the course of forest management with the purpose to create sustainable and productive forests with conservation of biodiversity; (ii) testing of new technology of forest assessment through interpretation of stereoscopic photos; (iii) testing of use of the remotely piloted aerial vehicles in the process of forest inventory, and development of technology of processing of data received from the remotely piloted aerial vehicles in order: (a) to make changes to the forest management plans with due regard to the climate change adaptation; (b) to organize operative monitoring in case of emergency situations; (c) to conduct forest pathological study of the forest stands, etc.; (iv) study of possibility of introduction of new method of forest management that is stratification of forest by sites of the similar characteristics, for which similar silvicultural operations are defined.

Activity is implemented by: Unitary Enterprise "Belgosles"

Target audience: specialists in the field of forest inventory; staff of forest enterprises and forestry units of the Ministry of Forestry responsible for implementation of forestry management plans; students of High Schools studying forestry management and planning; staff of research organizations and educational institutions.

Key results achieved:

Climatic changes and sanitary and remedial operations carried out on the territory of two pilot forest enterprises (Puhovichskij forest enterprise and Starobinskij forest enterprise) in the last 10 years (revision period of forest management plan) were analyzed as there are severely damaged forest stands on the territory of these enterprises.

Actions on adaptation of forest stands to climate change and biodiversity conservation for further inclusion into the forest management plans of two pilot forest enterprises were developed.

Proposals on taking of the sites under protection were prepared. Technological instructions with the results of the research of forest sites on the territory of two pilot forest enterprises on their conformity to the criteria of nature protection territories were developed.

5 permanent sample plots in the most vulnerable forest types to monitor consequences of the climate change in the forest ecosystems were set up.

Methods of processing of data received from special digital camera ADS 100 (Airborne Digital Sensor) were studied, which allowing definition of the main characteristics of the stands without visiting forests in the process of forest inventory using technology of interpretation of stereoscopic photos, and with the help of software Photomod. Field trainings for the purpose of forest assessment and decoding were held on the territory of two pilot forest enterprises (Smolevichskij forest enterprise and Volozhinskij forest enterprise). Data received using technology of interpretation of stereoscopic photos with the data received during field study of the same forest sites with the help of ocular method was compared. Final technology of analytical and measurement decoding for receiving of the main characteristics of the stands in the process of forest inventory was completed.

Technology of use and processing of data received with the help of remotely piloted aerial vehicles for prompt detection of the areas of died and drying forests stands in the result of disasters was studied. Sites of the damaged and depressed forest stands were photographed on the territory of Lyubanskij and Starobinskij forest enterprises with the help of the most commonly used in Belarusian conditions types of the remotely piloted aerial vehicles.

Method of forest management that is stratification of forest by sites of the similar characteristics, for which similar silvicultural operations are defined, was analyzed, including its advantages in comparison with traditional methods. Permanent forest sites of the similar characteristics were allocated on the territory of Gravzhisjskoye forestry of Smorgonskij experimental forest enterprise. Methodology of organization of forest sites of the similar characteristics within forest management method envisaging stratification of forest by sites of the similar characteristics was prepared.

Brief description of the main results:

Forestry adaptation to climate change is targeted first of all at optimization of species composition of the stands in the process of reforestation and afforestation and during intermediate cuts when forest stands of concrete species composition are formed.

Specialized forest management methods were worked out on the basis of two pilot forest enterprises, Puhovichskij and Starobinskij forest enterprises.

Currently, materials of aerial photography made with the digital camera ADS 100 (Airborne Digital Sensor) make technical basis for forest inventory works. With more profound usage these materials can be used for definition of the main characteristics of the forest stands without visiting the forest. In the result of this assignment, technological instructions for engineers responsible for forest assessment on technology of interpretation of stereoscopic photos in the process of forest inventory works were developed. Instructions include consequence of actions (stages) while assessment of standing volume and characteristics of the trees of sub-compartment using the method of analytical and measurement decoding.

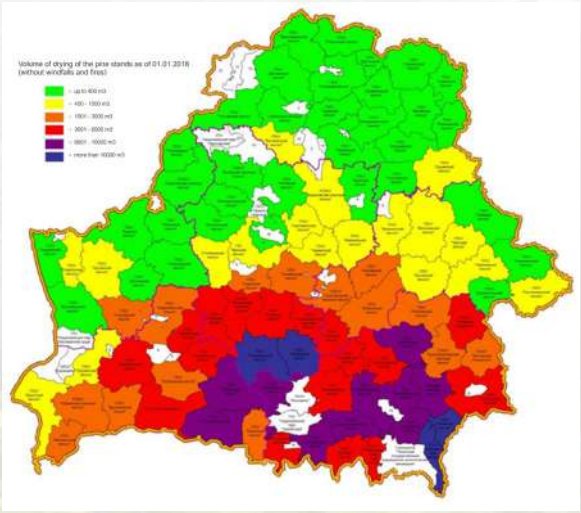

Figure 13. Volume of drying of pine stands in year 2017, м^3/1000 ha as per data of the Unitary Enterprise "Belgosles"

Technical characteristics of two types of remotely piloted aerial vehicles (aircraft and helicopter) were studied with the purpose to define areas of died and damaged forest stands. Piloting was done to ensure monitoring over forest conditions and aerial photography in two pilot forest enterprises with the help of the mentioned vehicles. Technology of usage of the program complexes on definition of the borders and areas of the damaged sites was developed.

Application of forest management method that is stratification of forest by sites of the similar characteristics, for which similar silvicultural operations are defined, within the current organization and production conditions of forestry operations in the Republic of Belarus was considered. Amendments to the legislative documents, which can ensure organization and implementation of the forest management method using stratification of forest by sites of the similar characteristics, were drafted.

Trainings on methods and approaches of special forest management were held using results of the assignment to ensure their practical usage.

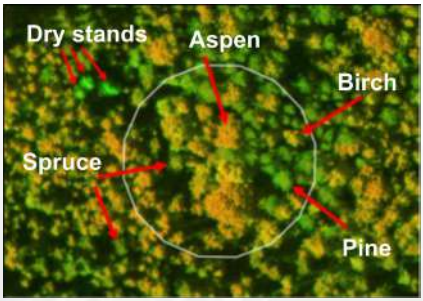

Figure 14. Example of decoding of species composition of forest stands at the digital aerial photo

Figure 15. Montage of the pictures of areal object by putting blocks on each other. Pictures of the object were made with the help of software installed at the remotely piloted aerial vehicle

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PROJECT ACTIVITY: Undertake assessment and monitoring of soil nutrient levels, soil carbon and biodiversity in main felling sites were felling waste in addition to timber has been harvested according to the criteria on developed by the Round Table on Ensuring Sustainable production and Use of Biomass . This will be done on a number of pilot sites with annual monitoring and writing up of results over the lifetime of the project (3.1.3.3)

Implementation period: August 2018 - December 2019

Goal of the activity:

The objective of the assignment is analysis, obtaining of reliable data and preparation of proposals on conservation of biodiversity and minimization of carbon dioxide emissions in the process of implementation of different types of commercial cuts with due regard to the balance of social, ecological and economic aspects of forest utilization.

Activity is implemented by: Belarusian State Technological University

Target audience: specialists of the governmental bodies; staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; civic society; partners from other countries of Eastern Europe.

Key results achieved:

International experience of Canada, Finland, Sweden, Germany and Russia on treatment of felling wastes after commercial feelings was studied.

16 pilot sites of commercial cuttings (clear and non-clear) in the stands of two main forest species (pine and spruce) and by the main forest types were laid out. Timber harvesting is done using felling wastes and without using felling wastes on the established sites. Analysis of carbon flows, biodiversity conservation level, nutrients content in the soil, in forest litter and phyto mass is done on the pilot sites.

Methodology of assessment of carbon sequestration by the felling wastes in the process of commercial cuts (clear, non-clear) was prepared. Recommendations and complex of actions on biodiversity protection, optimum content of nutrients and minimization of carbon dioxide emissions at the sites after clear and non-clear commercial cuts, and on treatment with felling wastes upon results of monitoring, with due regard to the balance of social, ecological and consumption interests of forest use were also developed.

Proposals on actualization of the legislation on treatment with felling wastes were developed.

Brief description of the main results:

Mitigation of negative consequences of commercial forest cuts in relation to the reduction of carbon dioxide emissions and biodiversity conservation is based on the selection of ecologically friendly methods of forest fellings and reforestation, removal and non-removal of felling wastes, technologies of harvesting works.

Considerable part of nutrients are taken by the forest stands from the deeper layers of the soil. Consumption is also partly replenished through annual tree wastes, which form forest litter.

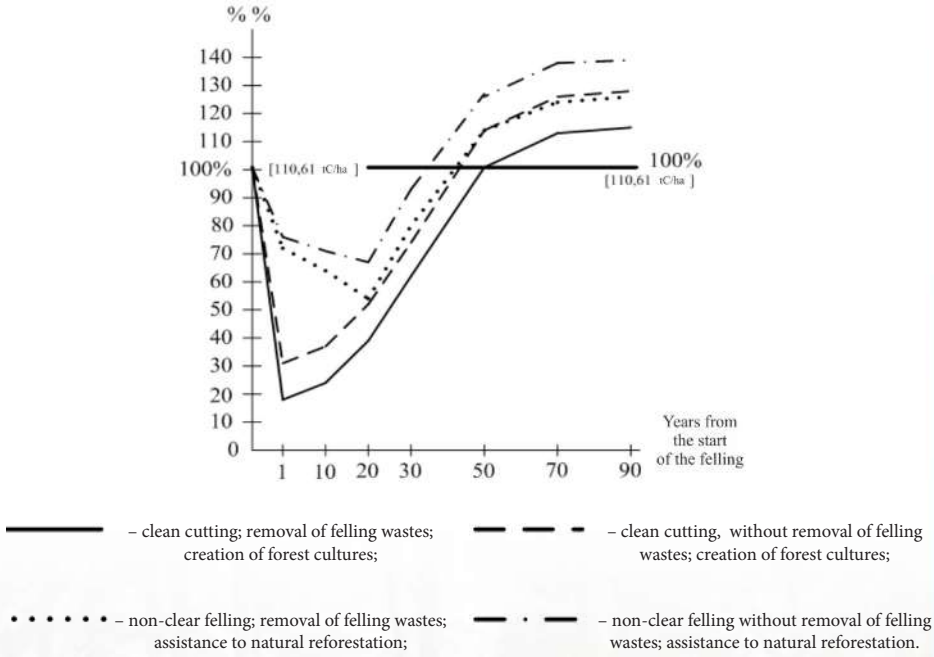

Figure 16. Dynamics of carbon content during the felling cycle (phyto mass plus forest litter) during different methods of fellings, reforestation, and with and without removal of felling wastes

In the result of observations, it was found out that removal of felling wastes reduce elements of soil nutrition by not more than 10%, does not have considerable impact at soil productivity and at the satisfaction of nutrient demand of the young forest that is regenerated.

However, taking into account regular loss of nutrients in the process of intermediate and sanitary cuts, it is advisable to limit removal of forest felling wastes in the stands growing on the poor soils. This is also favorable for protection of forest biodiversity and sequestration of part of carbon in phyto mass and soil. At the same time, risk of forest fires increases as well as risk of spots of spreading of forest pests and diseases.

Important stable trend of forest ecosystem of sequestration of organic carbon in the soil, and in lesser extent in forest litter, was discovered. This is typical for normally growing forests as well as for drying stands.

Usage of felling wastes for heat purposes is economically justified in case if customer is situated up to 100 km from the sites. It should be noted that such utilization of felling wastes results in: reduction of emissions of hazardous substances into the air; decrease of risk of forest fires and spots of forest pests; increase of level of employment of population due to involvement of the people as manpower at the enterprises of energy sector.

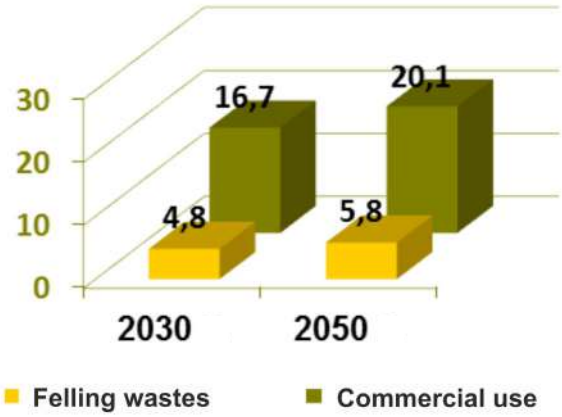

Figure 18. Volume of felling wastes by groups, mln.m^3/%

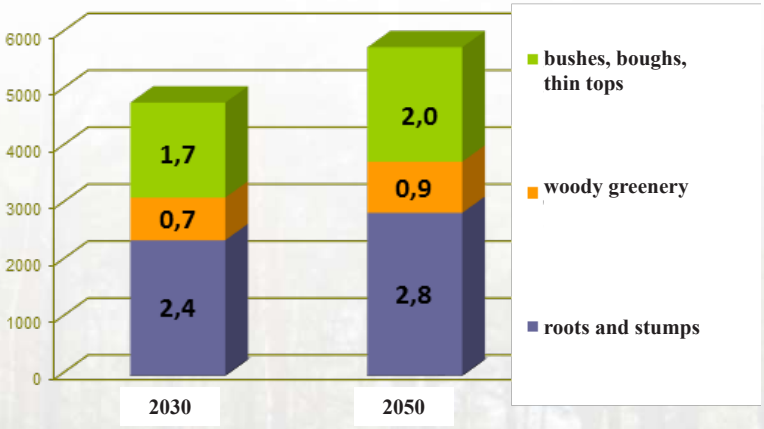

Figure 18. Volume of felling wastes by groups, mln.m^3/%

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PROJECT ACTIVITY: Consultancy Services to Develop Strategies and Actions Plans for the Adaptation of the Belarusian Forestry Sector to Climate Change and to Implement the Principles of "Green Economy" (3.1.4)

Implementation period: October 2017 - March 2019

Goal of the activity:

The objective of this assignment was updating and development of strategies and action plans on adaptation of Belarusian forestry to the climate change, increase of greenhouse gases absorption, and introduction of "green economy" principles.

Activity is implemented by: Belarusian State Technological University

Target audience: specialists of the governmental bodies; staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; civic society; partners from other countries of Eastern Europe.

Key results achieved:

Proposals on amendments to the legislation of the Republic of Belarus to ensure introduction of "green economy" principles into the forestry were prepared, and the following documents were elaborated:

- Updated Strategy of Forestry Adaptation to the Climate Change up to 2050, and National Action Plan on Forestry Adaptation to the Climate Change up to 2030. The documents were prepared on the basis of the analysis of current practice of forestry operations in the Republic of Belarus;
- National Action Plan on Increase of Greenhouse Gases Absorption by Absorbents (forests, swamps) up to 2030;
- National Action Plan on Introduction of "Green Economy" Principles into the Forestry of the Republic of Belarus up to 2030;
-Long-term Forestry Development Strategy of the Republic of Belarus with Low Level of Greenhouse Gases Emissions up to 2050.

All the above-mentioned documents were approved by the Scientific and Technical Council of the Ministry of Forestry as of 28.06.2019 No. 4.

Brief description of the main results:

In the current climatic changes forestry is seen as one of the most vulnerable sectors of economy.

Ministry of Forestry is responsible for implementation of the state policy in the field of forestry organization, including forestry adaptation to the climate changes. Legislation on use, protection, conservation and reproduction of forests is based on the Constitution of the Republic of Belarus, and includes Forest Code of the Republic of Belarus, Decrees of the President of the Republic of Belarus, and other legal documents regulating relations in the field of forest use, protection, conservation and reproduction. Organization of forestry on the principles of rational and inexhaustible forest use, including improvement of forest stability against current climate changes are reflected in the State Program "Belarusian Forest" for years 2016-2020 and in the "Strategic Development Plan of Forestry Sector from 2015 until 2030".

Within the frames of the assignment, analysis of the best international experience on development and implementation of actions on increase of greenhouse gases absorption by the absorbents (forest, swamps) of Germany, Turkey, Poland, France, Japan, Norway, USA, Spain, Sweden, Finland, Russia, and Canada was made.

Analysis of age structure of the forests and its influence at the absorption of carbon dioxide was done using methodological approaches that are based on the commonly used rules and mechanisms of productivity of forest stands, and on the "Methodology of Assessment of the Aggregated and Annual Carbon Depositing by the Forests of the Republic of Belarus" approved by the Ministry of Forestry. Materials of the state forest cadaster of the Republic of Belarus and actual data from the forest databank "Forest Fund" were used for the analysis. Study of the level of greenhouse gases absorption by forests and swamps demonstrates that annual depositing of the carbon for forest ecosystems is, as a rule, several times more than depositing of carbon by the swamps.

The key approach in the process of development of framework documents is the point that volume of carbon of annually harvested timber should not exceed volume of annual absorption of carbon by the stands of forest fund.

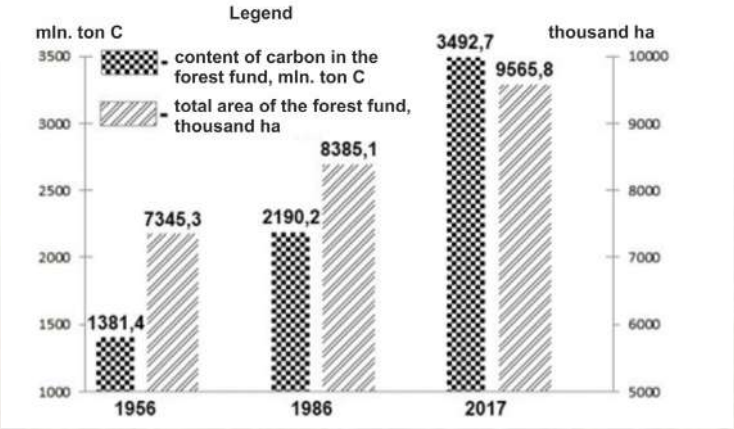

Figure 19. Dynamics of carbon and area of forest fund of the Republic of Belarus

Scenarios and prognoses of forestry development in climate change conditions were evaluated. Proposals on introduction and expansion of use of modern technologies of reforestation, afforestation, and forest fellings facilitating improvement of quality and sustainability of forests were prepared.

In the conditions of "green economy", forestry sector ensures maximum input into improvement of level of people's well-being through production of timber and non-timber products and services and creation of possibilities for income. At the same time, potential of forests as source of ecosystems services is being supported and developed on sustained basis with due regard to the climate change.

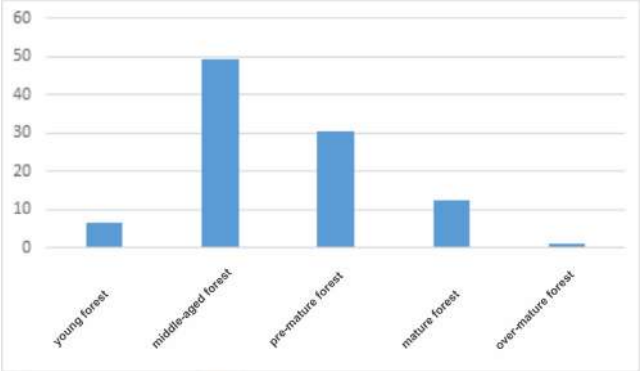

Figure 20. Carbon stock in pine stands by age groups, %

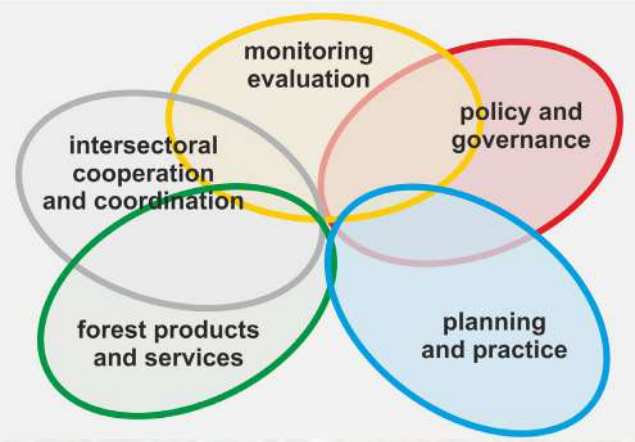

Figure 21. Complex attitude to sustainable forest management

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PROJECT ACTIVITY: Improvement and testing of a technology for the reconstruction of low-value plantations for the purpose of increasing the share of broadleaved species (3.1.5)

Implementation period: September 2018 - January 2020

Goal of the activity:

The goals of the assignment covered: analysis of the used previously practice of reconstruction of low-value forest stands (e.g. forests with low density, bushes, second growth stands, stands that are not properly developed in concrete conditions of growth) for the purpose of creation of valuable forest stands and increase of share of broadleaved forests; and development of proposals on improvement of the current normative and legislative basis on reconstruction of low-value stands.

Activity is implemented by: State Scientific Entity "Institute of Forest of the National Academy of Sciences of Belarus"

Target audience: staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; civic society; partners from other countries of Eastern Europe.

Key results achieved:

Methodical document on reconstruction of low-value forest stands to increase the share of broadleaved forests was developed. The document includes schemes of mixing of forest stands for creation of clear and partial forest cultures of broadleaved species in the process of reconstruction of low-value forest stands based on the zonal and typological basis. Practical recommendations on technologies and regime of intermediate cuts in the stands established in the process of reconstruction of low-value stands by corridor method were also prepared. The key aspect of the recommendations is to do intermediate cuts in the stands in several stages.

Brief description of the main results:

Currently, broadleaved stands (oak-, ash-tree-, maple-, lime-tree forests), cover 316,6 thousand hectares in the forest fund of the country, which makes 3,8% of the forest fund. In the last 13 years (2006-2018) reconstruction of the low-value forest stands through creation of forest cultures of broadleaved species was done on the area of 3,66 thousand hectares in the forest fund of the Ministry of Forestry. Searching for effective methods of restoration of broadleaved forests is becoming especially actual for the forest sector.

Within the frame of the assignment, experience of forest restoration and reconstruction of the low-value forest stands in France, Azerbaijan, Poland, Russia and Ukraine was studied.

Analysis of requirements of legal documents of Belarus in the field of reconstruction of low-value forest stands was made. The following issues were also explored: more precise definition of criteria of attribution of the stands to the category of low-value forest stands and their justification; decision on and order of implementation of intermediate cuts in the forest stands created in the process of reconstruction.

Analysis of forest management materials of state forest enterprises in relation to restoration of broadleaved forests created in the process of reconstruction of low-value forest stands, and using method of creation of forest cultures, was made.

A) B)

Photo 8. Mixed forest cultures of English oak at the pilot site:
A) Cultures of the oak in the corridor after intermediate cut; B) felled out sector

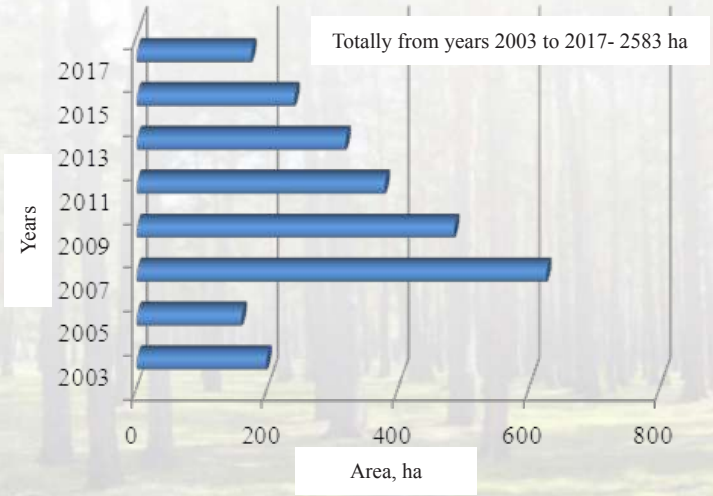

Figure 22. Creation of forest cultures of broadleaved species through reconstruction of low-value forest stands in the forest fund of the Ministry of Forestry (years 2003-2017)

Reconstruction of low-value forest stands through creation of forest cultures (clear of partial) is made by clumps and groups method, corridor method and via planning of cultures on the total area. Selection of the method of reconstruction of low value stands using method of creation of forest cultures depends mainly on the conditions, age, density and composition of the species to be reconstructed.

Technology of reconstruction fillings, formation of forest cultures, treatment and growing of the stands of the main broadleaved species (oak, ash-tree, maple) was piloted at 37 pilot sites on the territory of the forest enterprises of the Republic of Belarus and demonstrated its effectiveness.

6 trainings were held in each region of the Republic of Belarus (Brest, Vitebsk, Gomel, Grodno, Minsk, and Mogilev regions). Newly developed and improved technologies of reconstruction fellings and creation of forest cultures, treatment and growing of the stands of the main broadleaved species were demonstrated in the course of the trainings at the pilot sites. About 300 specialists of the forest enterprises took part in the trainings.

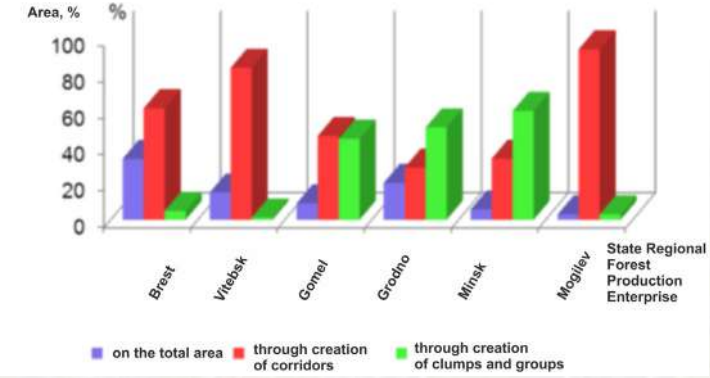

Figure 23. Methods of reconstruction of low-value stands through creation of forest cultures of broadleaved species

Link to the final report in Russian:

https://mlh.by/our-additional-activities/mezhdunarodnoe-sotrudnichestvo/sotrudnichestvo-so-vsemirnym-bankom/

Link to the final report in English:

https://bellesexport.by/ru/vidy-deyatelnosti/proekt-razvitiya-lesnogo-sektora-respubliki-belarus.html

PROJECT ACTIVITY: Improvement and testing of a technology for the reforestation of drying spruce felling sites for creating sustainable plantations (3.1.6)

Implementation period: October 2018 -January 2020

Goal of the activity:

The goal of the assignment was development of Methodical document on reforestation of the territories, on which fellings of the drying coniferous stands (spruce and pine forests) are done, through analysis of the practice of reforestation in other countries, current normative and legislative framework of the Republic of Belarus, methods of reforestation of the fellings of drying coniferous stands used currently by the forest enterprises of Belarus with due regard to different conditions of growth. Pilot sites should be laid out to test newly developed practices and methods of reforestation.

Activity is implemented by: State Scientific Entity "Institute of Forest of the National Academy of Sciences of Belarus"

Target audience: staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; civic society; partners from other countries of Eastern Europe

Key results achieved:

Methodical document "Recommendations on reforestation of felling sites of dried spruce and pine forest stands" was developed. Proposals for amendments to the current legislative framework with due regard to the results of piloting of reforestation technologies of felling sites of coniferous forests were also prepared.

Brief description of the main results:

During the last 20 years reduction of biological sustainability and drying of spruce stands are observed on the territory of Belarus. This trend has undulating nature.

In the years 2016-2018, new pathological phenomenon is registered in Belarus, which is large-scale drying of pine forests. One of the main reasons of drying of biologically weakened pine forests is mass dissemination of apical bark beetle *(Ips acuminatus*) and other forest pests that promptly react at declining of biological sustainability of forests.

Total area of dried coniferous forests in Belarus, which required clear sanitary cuts only in 2017, made 29,3 thousand hectares. Mass drying of coniferous stands on the large territories result in a number of unfavorable consequences, such as: damage to consistency and structure of forests; damage to regular silvicultural operations; violation of ecology of the regions; considerable losses of timber due to various biological injuries.

Effective protection of coniferous forests against the pests, and prompt localization and liquidation of pest infestation spots can be ensured in case of timely detection of the damaged stands. In its turn, detection of the damage forests is stipulated by the efficiency of forest pathological monitoring, the integral part of which is pheromone control. Currently, the most effective methods of management of forest pest spots are as follows: clear and selective sanitary

cuts; burning of felling wastes; cleaning the sites from the rubbish; prompt transportation of timber and its treatment with insecticides.

Practices and methods of reforestation of felling sites of drying coniferous stands (pine and spruce forests), and silvicultural, forest protective and prophylactic measures against drying of the forest stands were analyzed in Russia, Ukraine, Denmark, France, Poland, Latvia, Lithuania, Canada, and Germany.

Photo 9. Drying of pine stands in Gomelskij experimental forest enterprise caused by bark beetle

Analysis of drying of coniferous stands (spruce and pine forests) by sub-zones (regions) of Belarus in different conditions of growth taking into account peculiarities of water and physical characteristics of typical soils, and with assessment of weather conditions and hydrological regime in the last 5 years was done. The analysis was also done at the key points where measurements were made by hydro meteorological service of the country and other research institutes for the last decade.

Photo 10. 2- years mixed cultures of pine (6 pines 4 birches) created with planting material with closed root system (Gomelskij experimental forest enterprise, 2019)

Technologies of reforestation of felling sites of drying coniferous stands were tested through laying out of 25 pilot production sites on the territory of the forest enterprises of the Republic of Belarus and showed their effectiveness.

6 trainings were held in all the regions of the country (Brest, Vitebsk, Gomel, Grodno, Minsk, and Mogilev). Newly developed and improved technologies of reforestation of felling sites of dried pine and spruce stands in the forest fund of the Ministry of Forestry were demonstrated at the pilot sites in the course of the trainings. Around 300 specialists of the forest enterprises took part in the trainings.

Photo 11. 1-year mixed cultures of small-leaved linden (6 lindens 4 spruces) created at the felling site of the dried pine stands (Byhovskij forest enterprise, 2019)

Photo 12. Facilitation to natural regeneration of forest at the felling site of the dried pine stands (Luninetskij forest enterprise, 2019)

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PROJECT ACTIVITY: Monitoring research into changes in the forest fund in response to climate change, human impacts and forest activity and the development of recommendations for the preservation of plants of natural origin and biological diversity during reforestation, afforestation and forest use (3.1.7)

Implementation period: December 2016 - July 2019

Goal of the activity:
To establish the trends of modern dynamics of forest land and biological diversity of the forest ecosystem due to climate change. To suggest environmentally and economically effective measures to ensure current positive dynamics of wood stocks increment, and formation of stable natural forest with high level of biodiversity in the process of reforestation, forest growth and use taking into account ongoing increase of intensity of forest use and anthropogenic burden on the forest.

Activity is implemented by: State Scientific Entity «Institute of Experimental Botany named after V.F.Kuprevich of the National Academy of Sciences of Belarus»

Target audience: staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; civic society; partners from other countries of Eastern Europe

Key results achieved:

Forest management plans of Klichevskij, Glubokskij, Tolochinskij and Bogushevskij forest enterprises were amended upon results of field researches, and rare and key biotopes were identified.

Design of network of monitoring plots including 288 sites was developed. 214 sites out of 288 are established on the basis of forest monitoring plots. Dynamics of ecosystems due to climate change and intensive anthropogenic impact was assessed.

Software to collect and analyze monitoring data in forest ecosystems was developed. The software makes the process of data input automatic and ensures transformation of date into digital form.

Brief description of the main results:

Field researches on the territories of Klichevskij, Glubokskij, Tolochinskij and Bogushevskij forest enterprises were made. Sites of the forest fund to be specially protected in line with the new Forest Code were identified. The share of such sites is 0,9-2,8% of the forest fund of the forest enterprises. 256 passports and protective obligations for rare and typical biotopes, habitats of wild animals and location of wild plants included into the Red Book of the Republic of Belarus were prepared. Proposals on limitation of different types of fellings or prohibition of fellings on the territories of allocated biotopes and habitats and location of protected species of flora and fauna were developed.

Monitoring principles over consequences of climate change in forest ecosystems of Belarus were elaborated. Criteria and indicators to assess effectiveness of actions on forestry adaptation to the

climate change were prepared. Role and input of different factors into the dynamics and death of forest ecosystems were demonstrated.

Software for collection and analysis of monitoring data in forest ecosystems was developed. The software allows input, storage and processing of data of spatial, qualitative and quantitative characteristics of monitoring sites directly in forest ecosystems using tablets.

Changes of forest area of Belarus by forest formations, forest types, and origin were analyzed. Changes in spreading of the main forest species locating at the boundaries of natural habitats (common spruce, common hornbeam, gray alder) were assessed. Key factors of transformation of lands of the forest fund in post-war period (years 1944-2015) were identified.

After mass drainage of over- moistened lands in 60-80th. years of the last century , there are 289 thnd. hectares of drained forest lands in the forest fund of Belarus, and 1,5 mln.hectares of forests damaged by drainage networks. In the result of negative anthropogenic impact, degradation of forest lands and rewetting of forest stands are observed at the wet forest territories, and forest complexes are transformed into swamps. Recommendations for prevention of degradation of the lands of forest fund were developed and include: restoration of ground waters level; peculiarities of creation of forest cultures on the lands of open pits; actions on reduction of recreational burden on the forests.

System of actions for protection of natural origin and biological diversity in the process of reforestation, forest growth and use was developed. Advantage is given to the natural regeneration, increase of the share of non-clear commercial fellings, and preservation of some elements of biodiversity. Besides, some actions developed for protection of biological diversity were included into the normative documents regulating forestry management.

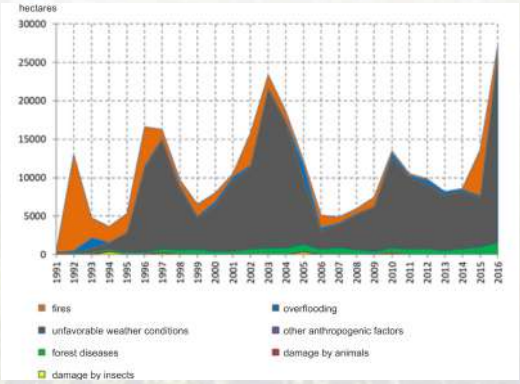

Figure 24. Dynamics of death of Belarusian forests in 1991-2016

Design of special monitoring over results of forestry activities on production of forests of high productivity and sustainability, and biological diversity in the process of development of forest management plans was elaborated. It was proposed to include new forms into the standard form of

explanatory note to the forest management plan, which include data on changes of area of specially protected nature territories; habitats of wild animals and location of wild plants included into the Red Book of the Republic of Belarus and transferred under protection of the forest enterprise.

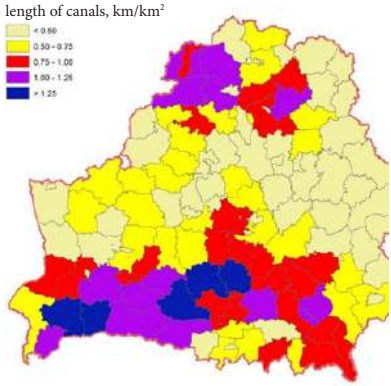

Figure 25. Length of canals of drainage network in the forest enterprises

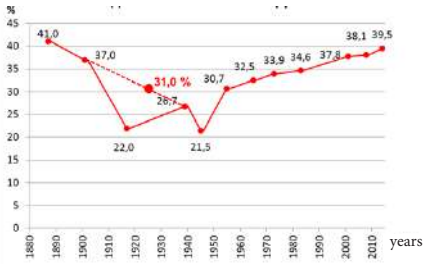

Figure 26. Dynamics of forest coverage of Belarus

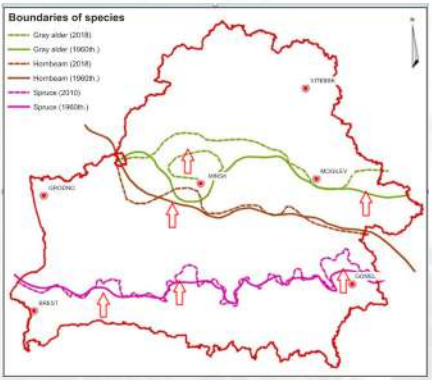

Figure 27. Changes of boundaries of spruce, hornbeam and gray alder forests on the territory of Belarus

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PROJECT ACTIVITY: Undertake monitoring and analysis of stands with and without project thinning and removal of felling waste interventions to assess Greenhouse Gas (GHG) emissions reductions (3.1.8)

Implementation period: September 2018 – January 2020

Goal of the activity:

Objective of the assignment was analysis of ecological, social and economic consequences of utilization of biomass of felling waste at the sites of intermediate fellings (thinnings and cut-through fellings). Analysis was carried out in order to identify necessity and scope of felling wastes to be removed after completion of thinnings and cut-through fellings to improve carbon sequestration capacity of the forests for the main tree species: pine, spruce, oak-tree, birch, black alder, aspen.

Activity is implemented by: Belarusian State Technological University

Target audience: staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; civic society; partners from other countries of Eastern Europe

Key results achieved:

International experience and practices of 14 countries in the field of treatment with felling wastes after intermediate cuts were studied and analyzed.

Analysis and monitoring over carbon sequestration capacity of pine, spruce, birch, aspen, black alder and oak forests were made under the following categories: forests, where intermediate cuts are not done; forests, here intermediate cuts (thinnings and cut-through fellings) are done, but without removal of felling wastes; forests, where intermediate cuts are done with further removal of felling wastes.

Methodology for assessment of carbon sequestration by felling wastes in the process of intermediate cuts by the main forest species was developed. Total storage of carbon by the whole phytomass of the stands is defined as sum of carbon storage by the concrete pool: timber of the trunk, branches and knots, needles (leaves), and roots.

Proposals with justification of social and ecological, and economic factors for removal/ non-removal of felling wastes in the process of thinnings and cut-through fellings were developed. The proposals were elaborated to ensure that absorption of carbon dioxide by the forest stands of Republic of Belarus in the forests of the main tree species is not reduced.

Brief description of the main results:

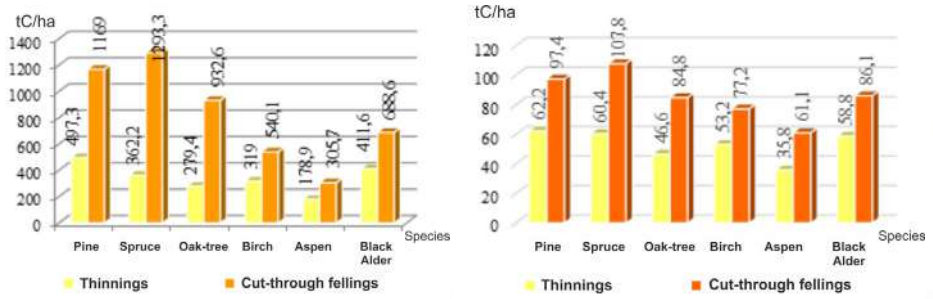
In the result of the study of international experience on treatment with felling wastes after intermediate cuts it was found out that in the majority of the countries chips and saw dust received from the felling wastes are used for production of the paper, cardboard, and cellulose and bark of the trees are burned at small thermoelectric power stations.

Increase of the share of usage of felling wastes for production of fuel and energy resources is justified mainly because of reduction of emission of greenhouse gases, which is ensured due to

substitution of the share of fossil fuel. Bioenergy of forests is considered as possible replacement to the fossil fuel.

Usually it is considered that biomass is CO_2-neutral energy carrier because carbon dioxide emitted in the process of burning of felling wastes is used again by the plants. Thus, burning of felling wastes is not considered as one of the sources of increase of emission of carbon dioxide into atmosphere.

Calculation and analysis of carbon sequestration capacity of the forest stands in the process of thinnings and cut-through fellings were done for 4 options: without fellings (basic option);



a) b)

Figure 28. Carbon sequestration by the forest stands of the main forest species at the age of thinnings and cut-through fellings: a) – for the whole age class corresponding to the age of thinnings and cut-through fellings, tC/ha; b) – in average for one year of the age of thinnings and cut-through fellings, tC/ha per annum.

with fellings and laying of felling wastes at the stripes with further compacting; with fellings and further chipping and spreading of felling wastes at the felling sites; with fellings and piling of felling wastes for further digestion; with fellings and further removal (burning) of fellings wastes.

Field and laboratory researches were done on the temporary trial plots to assess changes in the carbon stock in the felling wastes and to define speed of decomposition of felling wastes.

Optimal method of treatment with felling wastes will be ensured with such regime of organization of intermediate fellings and such volume of the left felling wastes, which result in: maximum accumulation of carbon by the forest ecosystem; due sanitary and forest pathological conditions of the forest stands; meeting of economic interests in relation to usage of marketable timber and felling wastes harvested in the process of intermediate cuts.

Usage of fellings wastes, as additional wood fuel or for ecological purposes, should be done with due regard to the analysis of such criteria as: soil productivity; content of nutrition elements in the felling wastes; demand of the stands in nutrition elements; type of forest growing conditions; area of felling site; distance from the transportation ways.

73 specialists took part in 2 roundtables, which were held to discuss results of the developed recommendations.

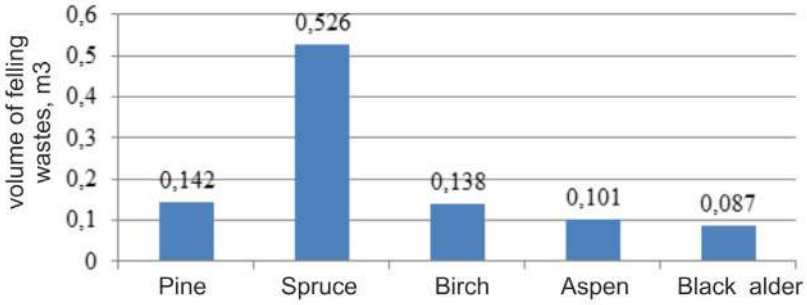


Figure 29. Volume of felling wastes (branches) per 1 m³ of timber in the process of cut-through fellings in the forest stands of the main tree species of Belarus

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PROJECT ACTIVITY: Development of the software for collection, processing, storage and provision of forest management information (3.2.1)

Implementation period: April 2020 - July 2021

Goal of the activity:
(I) development of the software (automated information system) for processing, storage and provision of forest management information "LesInfo";
(II) automation of the process of input and processing of forest management materials;
(III)integration of individual software products into a unified information complex through the unified information database on the forest resources of the Republic of Belarus.

Activity is implemented by: Private Enterprise "Softmax Systems Telemetrii"

Target audience: forest management specialists; staff of the Republican Unitary Enterprise "Belgosles"; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry.

Key results achieved:

Existing technologies of processing of forest management information, attributive data, cartographic information, normative and reference information used by the Republican Unitary Enterprise "Belgosles" were analyzed. Principles of creation of new software "LesInfo" were developed on the basis of the analysis.

Software "LesInfo" consists of the sub-systems of input, storage, and provision of forest management information, spatial analysis of data with possibility of demonstration of graphical pictures (public maps OSM, Google Maps and own maps), and creation of own information layers related to the forest fund.

Software "LesInfo" is new integrated technological platform, which uses modern systems of management of databases, IC accounting platform, mobile applications, cartographic services. Software "LesInfo" allowed:

substitution of the existing systems of automation of forest management information ("SOLI" and "FORMOD"), which worked on the old technological platform;

organization of electronic storage banks of data with multi-level access and automatic exchange of information with different external storage banks and various interfaces of users access;

organization of mobile working places of forest inventory specialists for implementation of field works;

automation of processes of input and processing of forest management data with usage of stationary computers and smart phones;

automation of spatial analysis of data and expansion of information cartographical services in the process of analyzing and visualization of the data;

automation of organization of group work with data, processes of planning and control over the works, accounting of resources and changes management.

Introduction of the software "LesInfo" ensures: (i) improvement of effectiveness of works and reduction of labor costs to carry out the works due to new principles of input of data by the forest inventory specialists because of combination of two devices for organization of the

work of specialists (Notebook and Smartphone); (ii) reduction of burden on the managers due to automation of the procedures of planning, distribution, operative monitoring and control; (iii) improvement of quality of information in the storage databanks, including reliability, accessibility and authenticity due to the proper organization of electronic storage databanks, automation of procedures of control of integrity of data.

Brief description of the main results:

Information systems for processing of forest management data (called "SOLI") used in Belarus and system of management of databank were developed more than 20 years ago for operation system MS DOS. The system consists of a lot of different applications and programs, does not have one common storage of data and does not support integration of these software products into one complex.

New software "LesInfo" allows processing of information in the process of development of forest management plans, supporting in actual conditions common information databanks on forest resources of Belarus, integration of information resources and technological processes of forest management, and makes processes of development of forest management plans automatic.

Album of output forms containing requirements to 150 standard forms of tables and reference reports, which are used for processing of forest management information, was developed. The data can be exported and stored in the formats MS Word, MS Excel and pdf.

There is also possibility to integrate reports by different levels of management (forestry unit, forest enterprise, administrative districts, regional production state forest enterprise, region, republic), and also at more minor levels (sub-compartments).

Mobile application "LesInfo" was developed. The application allows: distribution of works between the staff for long-term perspective, with visualization of the defined tasks in the calendar and directly on the map (by routes and territories); control over work of the staff in the field including demonstration of the actual route on the map in the process of tasks implementation; control over accumulative statistics of results and effectiveness of work by concrete person, calendar schedule of works, and calendar schedule of staff availability (vocational schedule, working shifts, etc.).

Effective collaboration means were developed in the process of implementation of this assignment, including organization of remote regime of work to prevent Covid-19 spreading.

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PROJECT ACTIVITY: Development of the software "Reforestation Management Information System" (3.2.1.1.)

Implementation period: August 2017- April 2020

Goal of the activity:

To develop a new multi-level information system to support decision-making in the process of planning of afforestation and reforestation: «Reforestation Management Information System" (hereinafter referred to as software «Reforestation") for the following forest management levels: forestry, forest enterprise, regional production forest enterprise, Ministry of Forestry of the Republic of Belarus.

Activity is implemented by: Republican Unitary Enterprise «Belgosles»

Target audience: workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; staff of research institutions and educational organizations.

Key Achieved Results:

New software (information management system) "Reforestation" was developed to ensure improvement of effectiveness of reforestation and afforestation, automation of planning process, and exclusion of errors in the process of integration of reporting documentation.

The software "Reforestation" has capacities allowing creation documents in electronic format in strict conformity with technological process of reforestation and afforestation, starting from the planning of reforestation on the concrete site and until transfer of the site into the category of forested lands.

The newly developed software ensures automatic generation of the summary and reporting documents based on the created initial documentation for artificial and natural reforestation. Summary and reporting documents are generated into the Excel and Word files, with the possibility of their further printing on the paper. The following information is available for entities working in the field of forestry management: information by sub-compartments and total information by years on the areas of reforestation, including by different species; information by types of forest culture; and information on the silvicultural works undertaken with the dynamics of survival rate of the forest cultures.

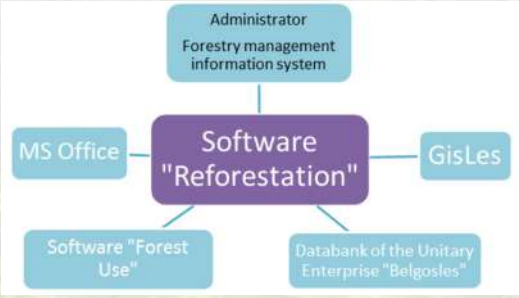

Figure 30. Interconnection of the software "Reforestation" with forestry information systems.

Software "Reforestation" interacts with the other forestry management information systems (software "Forest Use", 1C:Forestry) and thus increases the volume of the stored information.

The new software was installed in all 98 forest enterprises of the forestry sector. In 2020 one common database of the sites of forest fund, on which reforestation has been made since 2010, was established.

Brief description of the main results:

Software "Reforestation" allowed to: ensure rational planning of reforestation and afforestation; to fix in electronic format sites (felling sites, lands damaged by the fire, and other sites non covered by the forests in the forest fund) for obligatory reforestation in a period not exceeding 2-3 years after appearance of such sites; to control over all the silvicultural operations, including assessment of survival rate at the sites, where the trees were planted.

Due to the software "Reforestation", the following can be generated in electronic format and printed: registration books of the areas of reforestation and afforestation; certificates of inspection of a site of forest fund; field inventory cards and other reporting documents related to the forest cultures, including on facilitation to natural regeneration and on natural regeneration. User guide was developed. Usage of the software "Reforestation" was piloted in industrial conditions at the basis of three forest enterprises (Lepelskij forest enterprise, Shchuchinskij forest enterprise, and Osipovichskij experimental forest enterprise).

6 training workshops to work with newly developed software "Reforestation" were organized in Brest, Vitebsk, Gomel, Grodno, Mogilev and Minsk regions. 170 specialists took part in the trainings, including staff responsible for reforestation and afforestation from the forestry enterprises and regional production forest enterprises.

Photo 14. Training workshop in the State Enterprise "Shchuchinskij forest enterprise", 04 February 2020.

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PROJECT ACTIVITY: Development of the thematic area in the field of training, retraining and professional development of staff in the forest sector (3.3.1)

Implementation period: July 2020 - July 2021

Goal of the activity:

The overall goal of the assignment was improvement of the system of training, re-training and improvement of skills of the workers and specialists of forest sector through development of 11 new training and thematic plans, training programs and courses of lectures for each new topic based on the most recent findings in the field of forestry.

Activity is implemented by: individual consultant Yushkevich N.T.

Target audience: staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; civic society; partners from other countries of Eastern Europe

Key results achieved:

Currently, many efforts are put by the Ministry of Forestry of the Republic of Belarus to support opening of new professions and other training programs, and correction of training documentation of the educational process to ensure training of high qualified manpower for the forestry sector. Improvement of skills of the managers and specialists of organizations of forest sector is organized at the Republican Training Centre for Improvement of Skills of Forestry Manpower.

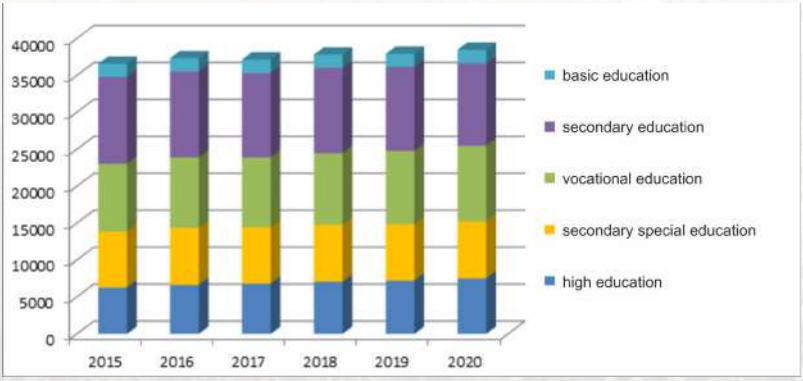

Figure 31. Education levels of the specialists of forest enterprises

Analysis of training and program documentation of the professions of high, specialized secondary, professional, and technical education shows that education of manpower for the organizations of forest sector is practically oriented. Most part of auditory lessons comprise practical, laboratory and seminar activities, and trainings and production practices. This leads to development of professional competencies and practical capacities in the respective fields of activities of the future specialists. Practical and laboratory classes are organized with the use of modern material and technical basis of the educational institutions. Technical equipping of the

institutions is upgraded on permanent basis with training stands, devices, models, new samples of modern equipment produced locally and abroad and used in the forest enterprises and other organizations of forest sector. Material and technical basis of the leading organizations of forest sector and resource centres are also used for practical trainings.

To ensure training of high-qualified specialists for the organizations of the forest sector, and improvement of educational process, 11 new educational programs and lectures were elaborated taking into account fast development and introduction of new technologies in the forest complex.

Since 2021, these programs are included into educational process at the Republican Training Centre for Improvement of Skills of Forestry Manpower.

Brief description of the main results:

Manpower potential of the organizations of forest sector of the Republic of Belarus was analyzed for the period 2015-2020 by the following criteria: age, professional education, periodicity of improvement of skills, labor turnover, and types of professional activity

The analysis revealed that organizations of forest sector has all required high qualified managers, specialists and workers in all the fields of the economic activities. The staff have necessary education pursuant to the requirements of the current labor legislation

Study of educational institutions of the Republic of Belarus and educational systems used abroad in the field of training, re-training and improvement of skills of specialists of the entities of

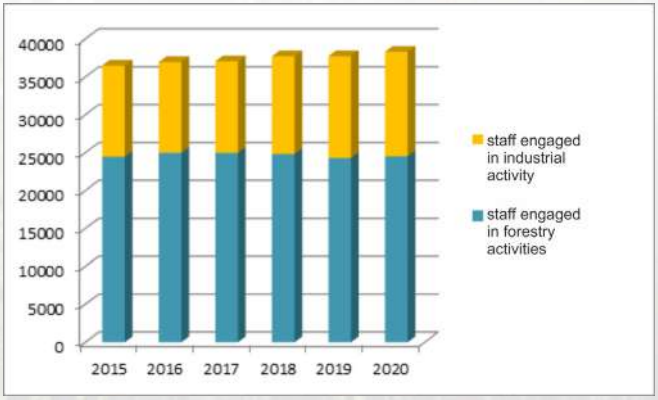

Figure 32. Staffing of the forest enterprises by directions of activities

forest sector was carried out.

To actualize training plans for improvement of skills of the specialists of forest sector new training programs and lectures were developed under the following directions:

Intensive methods of production of forest planting material.

Innovations in current forest management and planning.
Silvicultural operations in the conditions of nature and anthropogenic anomalies.
Innovations in timber harvesting production.
Improvement of effectiveness of forest nurseries and production of high-quality forests.
Forest adaptation to the climate change, including risk assessment in long-term perspective.
Stretching of chain of custody and certification.
Forest fire prevention in Belarus: new instruments and methods of communication with population.
Improvement of effectiveness of concrete managerial and field processes through application of technologies and IT solutions.
Promotion of sustainable tourism
Improvement of managerial potential, including development of strategy, leadership, and manpower management.

New training programs are targeted at the study of innovative findings developed also within the current Project in the field of effective introduction of the most recent technologies and equipment in the organizations of the forest sector.

New programs and findings cover the following topics: biodiversity issues in the process of forestry management; forest adaptation to the climate changes; carbon sequestrating role of the forest; silvicultural activities in the drying spruce and pine forest stands; reconstruction of low-value forest stands; green economy. Inclusion of the mentioned new directions and trends is required with due regard to the European and world approaches and practices, and to take in account all the ecosystem services provided by the forests to full extent.

Link to the final report in Russian:
https://mlh.by/our-additional-activities/mezhdunarodnoe-sotrudnichestvo/sotrudnichestvo-so-vsemirnym-bankom/

Link to the final report in English:
https://bellesexport.by/ru/vidy-deyatelnosti/proekt-razvitiya-lesnogo-sektora-respubliki-belarus.html

PROJECT ACTIVITY: Development of a system of support for decision-making concerning forest management in radioactive contamination areas, real time informing about the radioactive conditions in the territory of the forest fund (3.4)

Implementation period: May 2016 - March 2018

Goal of the activity:

The objective of the assignment was to optimize forest use on the territory of radioactively contaminated areas of the forest fund through: improvement of prompt informing on radioactive condition in the forest; use of the updated information on the levels of radionuclide content in the components of forest biogeocenosis and forest products; and development of forecasting of change in radiation conditions.

Activity implemented by: State Enterprise "Bellesozashchita"

Target audience: staff of research institutions; specialists of forest enterprises and forestry units of the Ministry of Forestry working with radionuclide contamination of the forest stands; partners from other countries of Eastern Europe

Key results achieved:

Decisions on organization of concrete activities in the forest are taken with due regard to the information on radioactive conditions. Results of radiation exploration of the lands of forest fund, felling sites, and forest products are contained in the databank of the information system "Radioactive forests contamination. RadFor" (hereinafter "software "RadFor") and its version for the forest enterprises "RadForView". While organization of forestry operations in the conditions of radioactive contamination, prompt exchange and transfer of information on the indicators of radioactive conditions should be ensured, including density of soil contamination with cesium-137; capacity of dose of gamma radiation; content of cesium-137 in the timber.

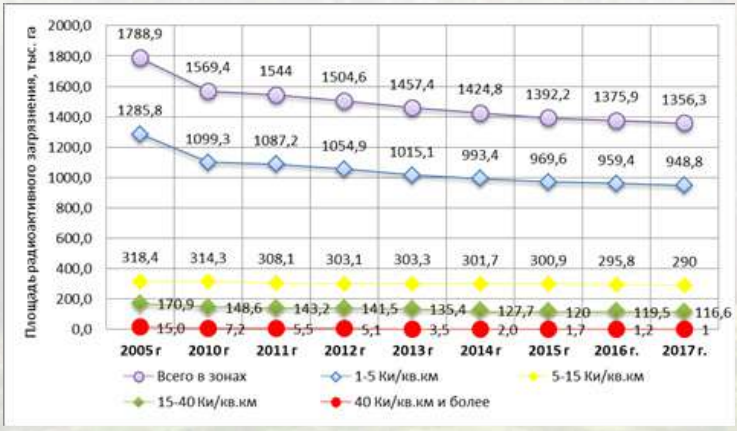

Рисунок 33. Изменение площади радиоактивного загрязнения лесного фонда Минлесхоза

This information is used in the process of forest felling operations to ensure that harvested timber meets the requirements of hygienic standards, and content of cesium-137 does not exceed allowable levels.

Requirements to the forestry management in the radioactive contaminated zones were revised. Amendments were developed and introduced into the normative documents related to the technology of forestry management in the radioactive contamination zones.

Works on optimizing of the software "RadFor" and "RadForView" in relation to the collection and transfer of information on indicators of radiation conditions of the forests were accomplished.

Additional functions of the software "RadFor" on submission of summary information on radioactive contamination of the territory of the forest enterprises with prognoses of changes in radiation conditions at the concrete defined date were developed.

Information on changes in radiation conditions during the 10-years period of implementation of forest management plans is necessary, first of all, for the most "contaminated" forest enterprises, which have timber with increased republican allowable level of content of radioactive elements. In Gomel region, these are Vetkovskij, Narovlyanskij, and Checherskij special forest enterprises, Elskij, Gomelskij, and Hoinikskij forest enterprises; and in Mogilev region, these are Krasnopolskij, Kostyukovichskij, and Cherikovskij forest enterprises.

Brief description of the main results:

In the result of the accident at Chernobyl nuclear power station in April 1986, one quarter of forests of the Republic of Belarus was contaminated by radionuclides. Currently, the area of forests contaminates with cesium-137 is 1356,3 thousand hectares or 16,1%.

Protective measures must be undertaken due to the considerable area and levels of radioactive contamination of the forests. These actions are targeted at meeting the norms of radiation safety: doses of radiation of the staff should not exceed 1 mSievert/annum; content of cesium-137 should not exceed republican allowable levels. To ensure these conditions are followed, the works are done within the allocated radioactive contaminated zones and with obligatory radiation control.

Amendments to the normative documents that have been developed will allow to have more precise indicators of radiation conditions in the forests in the cases if there are problems with harvesting of normatively "clean" forest products, and to reduce scope of radiation control if there are no such problems.

Technical code of common practice 240-2010 "Exploration of lands of forest fund" was amended in relation to definition of uniformity of radioactive contamination of forests in I zone (1-5 Ci/km^2), and requirements to the selection of forest sites for exploration for more detailed examination of radiation conditions. It was found that share of the forest sites, which have been transferred to the zone with less density of contamination, increased in comparison with previous years. The area of radioactive contamination is decreased in average by 2,0% annually in the result of radiation exploration of the lands of forest fund.

Amendments of the Technical code of common practice 239-2010 "Exploration of forest felling sites" cover the following: study of one specially selected forest felling site with the density of contamination of 2-5 Ci/km^2 in the forestry unit, on the territory of which content of cesium-137 in the timber does not exceed 200 Bq/kg; usage of the results of the study of this forest felling site for confirmation of radiation safety of all the batches of timber from other felling sites of the same forestry unit. The amendments can be applied in 32 out of 41 forest enterprises with the territories with contamination density of 2-5 Ci/km^2.

Amendments to the Rules for organization of forestry in radioactive contaminated zones (hereinafter "The Rules") were developed with due regard to the positive changes in the forest fund, and namely: area of radioactive contamination decreased from 2009 till 2016 by 12,4%; content of cesium-137 in the forest products reduced. Amendments to the mentioned Rules touch upon the following: zoning of territories; regulation of forestry operations and forest use; requirements to radiation exploration of forest harvesting volume; requirements to the submission of data evidencing radiation safety of the forest products to be sold; requirements to the informing.

Practical usage of the newly developed Rules for control of radioactive contamination ensures receiving of actual information on radiation conditions on the territory of the forest fund, and guarantees delivery of normatively "clean" forest products to the customer, which means products with content of radionuclide not exceeding republican allowable levels.

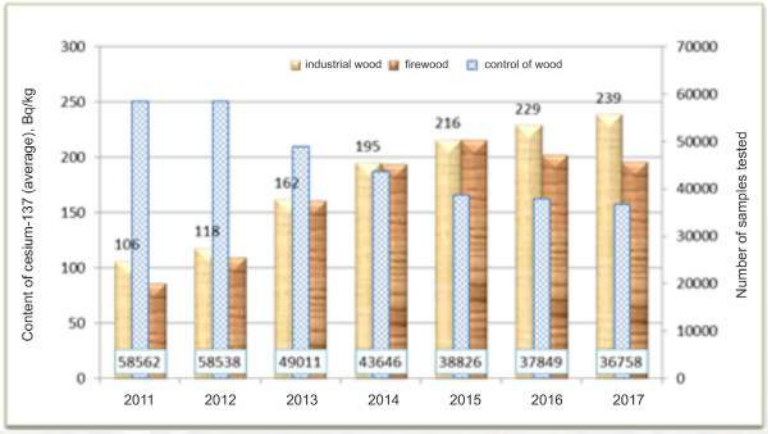

Figure 33. Change of the area of radioactive contamination of the forest fund of the Ministry of Forestry

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PROJECT ACTIVITY: Improvement of information flow about the radioactive conditions in the forests (3.4.1)

Implementation period: February 2020 - February 2021

Goal of the activity:

Objective of the assignment was to develop an information module on radioactive contamination of the forest fund. Development of such a module will simplify and facilitate the process of obtaining the information about the radiation situation in forests using cartographic materials. The module will allow visualization of the received information on the map in real-time mode and forecasting change of radiation situation in time. This will raise the awareness of the forestry enterprises' senior staff and support decision-making when planning and managing forest use at radioactively contaminated areas of the forest fund.

Activity is implemented by: State Enterprise "Bellesozashchita"

Target audience: staff of research institutions; specialists of forest enterprises and forestry units of the Ministry of Forestry working with radionuclide contamination of the forest stands; partners from other countries of Eastern Europe

Key results achieved:

Currently there is a possibility of step-by-step return to the normal conditions of forestry management due to the reduction of radioactive contamination levels and intensity of transition of ^{137}Cs into vegetation, and as consequence, reduction of ^{137}Cs content in the forest products. Majority of radionuclides, which have fallen out of the soil surfaces and have been included into reaction with the soil absorption complex, are in fixed form. This reduces availability of radionuclides in the nutrition chain "soil- vegetation", and does not allow ^{137}Cs to get more deeper into the soil.

Geoinformation service "RadForInfo" (software) was developed, which is directly connected with the indicators of radiation conditions of the forests within the existing information system (software) "RadFor". Usage of "RadForInfo" facilitates prompt decision-making on forest use (forest fellings) in radioactive contaminated zones, and first of all, with high density of soil contamination with ^{137}Cs (hereinafter- contamination density) from 15 until 40 Ci/ km^2 (III zone).

Geoinformation software "RadForInfo" consists of two functional parts:

Information part, which reflects data from the database "Radiation conditions", database "Forest products" and estimated values;

Cartographic part, which ensures: management of images; correction of layers of the map; graphic-based mapping of current and prognosis information on density of soil contamination with ^{137}Cs of the forest compartments of concrete forestry unit and information on ^{137}Cs content in the timber in the forest compartments of concrete forestry unit.

Function of "time scroll box" was developed. This function allows to generate map of forestry unit (forest enterprise) with coloring by radioactive contaminated zones with prognosis for the concrete year, and to generate maps "^{137}Cs content in timber" with prognosis of changes of ^{137}Cs content in the timber.

Consolidated interactive map of each forest enterprise with bridging to forest compartments and sub-compartments was created. Detailed information on radiation conditions can be seen while choosing objects at the map.

Brief description of the main results:

As of 01.01.2020, territories of 44 forest enterprises of the Ministry of Forestry are contaminated with radionuclide cesium-137 at the area of 1262,4 thnd. hectares or 14,77% of total area of the forest fund. In time, as radioactive contamination levels are reduced, it is possible to return step-by-step to the normal conditions of forestry management at the territories with high density of contamination- more than 15 Ci/km^2. To ensure this, preliminary assessment of radiation conditions is required and should be based on the previously obtained data.

The key criterion for decision-making is such indicator as "contamination density" in the forest compartment. This indicator is actualized on permanent basis and characterizes radiation

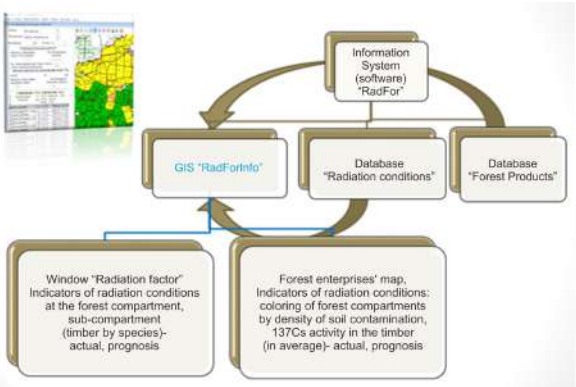

Figure 35. Geoinformation service "RadForInfo"

conditions: minimum, average and maximum surface contamination of soils by ^{137}Cs. In the process of exploration of forest compartment, samples of soil are taken with forest litter and plants from the surface soil layer for the depth up to 20 cm. Contamination density is concretized on the basis of prognosis of possible transfer of forest compartment from the zone with large contamination density to the zone with less contamination density. In the last three years, the prognoses are confirmed by 70-80%. Dose rate and ^{137}Cs content in the forest products are in direct proportion to this indicator.

Software "RadForInfo" was tested in production conditions in the forest enterprises. Pilot testing revealed that the software ensures interaction with information systems of the forest enterprises, and generating of full, reliable and actual information on radiation conditions in the forests with usage of cartographic materials.

To facilitate effective usage of the software "RadForInfo" in the forest enterprises training workshops were held for 40 specialists from the departments of radiation control of forest enterprises of Gomel and Mogilev regions. Installation disks with uploaded maps and cartographic service of "RadForInfo" of each forest enterprise were prepared. Presentation and visual training materials were developed and given to the forest enterprises.

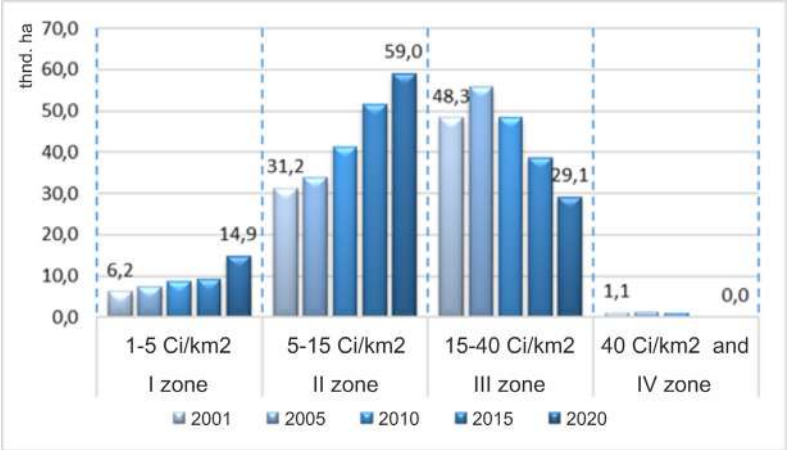

Figure 36. Change of the area of contamination zones of Vetkovskij special forest enterprises from 2001 until 2020

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PROJECT ACTIVITY: Development of methods and techniques for the preservation of biological and landscape diversity during the conduct of forest management activities and forest use (3.1.1.3)

Implementation period: April 2020 - July 2021

Goal of the activity:

Overall objective of the assignment was improvement of legislation and policy in the field of forestry to ensure conservation of biological and landscape diversity. In the result of this activity, the following tasks were performed: (i) electronic register of all the specially protected nature territories on the territory of the forest fund of the enterprises in the structure of the Ministry of Forestry was prepared; (ii) proposals on amendments to the normative and legislative documents regulating forestry activities and standards in the field of forestry were prepared in line with new legislation on specially protected nature territories and new normative and other framework documents in the forest sector.

Activity is implemented by: Belarusian State Technological University

Target audience: staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Schools studying forestry; civic society; partners from other countries of Eastern Europe

Key results achieved:

Sustainable forest management and forest use is impossible without conservation of biological diversity of forest ecosystems. In 2020, "Decade of biodiversity" of the United Nations Organization was completed as well as Strategic Plan for Biodiversity (2011-2020). Results on achievement of 5 strategic goals and 20 Aichi Biodiversity Targets were summarized.

In the result, it was confirmed that conservation of most part of biodiversity in the world is absolutely dependent on how the forests are used, because majority of the world biodiversity of the land is concentrated precisely in the forests.

Within the frames of the assignment, electronic register of all the specially protected nature territories (nature reserves, nature monuments) allocated in all 98 forest enterprises of the Ministry of Forestry of the Republic of Belarus was compiled. The register is integrated into geoinformation system on the basis of the existing geoportal of the Unitary Enterprise "Belgosles", which can be found following https://park.belgosles.by/map.html. From the technical point of view the register is databank containing descriptive attributive characteristics of the specially protected nature territories and cartographic images of the sites.

Exploration of the forest fund of Vetkovskij special forest enterprise and Narovlyanskij special forest enterprise were undertaken to identify rare and typical biotopes and nature landscapes; habitats of wild animals and location of species of wild plants included into the Red Book of the Republic of Belarus. Documents required for transfer of the protected animals and plants under protection (167 passports and protective obligations) pursuant to the legislation were prepared and handed over to the territorial bodies of the Ministry of Natural Resources and Environmental Protection.

International approaches and initiatives to secure conservation of biological diversity were analyzed, including Bonn Challenge and commitments made at the first Ministerial Roundtable on Forest Landscape Restoration and the Bonn Challenge in the Caucasus and Central Asia in Astana, Kazakhstan, etc. (20 international agreements and conventions related to Belarusian forestry, which were ratified by the Republic of Belarus). In general, requirements of international agreements and initiatives (directly related to the forestry, forest use or applicable for forestry) are reflected in Belarusian normative and legislative documents.

The following draft amendments to the state standards of the Republic of Belarus were developed to ensure harmonization with requirements in the field of biodiversity and provisions of the international agreements and conventions.

Draft state standard STB 1708 "Sustainable forest management and forest use. Basic requirements (new version)".

Draft state standard STB "Group certification of forest management and forest use. Requirements";

Draft state standard STB 2157-2016 "Identification of wood and non-wood forest products upon origin. Basic requirements".

Brief description of the main results:

Restoration of natural stands should be made mainly through natural regeneration, and only if application of this method is impossible restoration is made with usage of forest cultures. Even in case of clean sanitary cuts it is necessary to ensure possibility of natural or combined restoration. It is vital to consider possibility of establishment of forest genetics reservations as sites of permanent seed management base.

Particularly taking into account necessity of conservation of gene fund, natural and especially high productive stands on the territory of the specially protected nature territories are of high interest. Because of this, amendments are proposed to the article 24 "Regime of protection and use of specially protected nature territories" of the Law on specially protected nature territories and should include possibility of lay out of forest genetics reservations in any types of the specially protected nature territories. This type of sites of permanent forest seed base is used in very limited manner, and first of all, as source of seed or vegetative material for establishment of forest seed plantations and especially population plantations inheriting completely features of the mothers' local populations including sustainability and productivity.

Draft amendments to the technical and normative legislative documents were prepared upon analysis of the national legislation.

Matrix of contradictions in the national legislation in relation to the forest use, and contradictions because of the common practice of forest use was prepared. The largest number of contradictions are revealed in the state standard STB 1359-2002 "Sustainable forest management and forest use. Requirements to the forest protective actions" approved and put into action by the Resolution of the State Standard of the Republic of Belarus as of 09.12.2002 No.54. This is caused by the fact that the standard was not revised during the last 10 years from one side, and from the other side significant changes were introduced to the legislation of the Republic of Belarus in this period.

2 round tables on new approaches to the conservation of landscape and biological diversity on the territory of the forest fund of the Ministry of Forestry of the Republic of Belarus were held with 132 participants. Draft normative and technical documents were also discussed at the round tables.

Due to the epidemiological situation caused by COVID-19 in the Republic of Belarus and based on the recommendations on limitation of organization of public events, corrections have been made to the initial plan of the activities. Amount of face-to-face participants of the round tables was limited to ensure social distancing. Because of this, distant online participation of the people was ensured via platform "Peregovorka" (https://peregovorka.by/).

Photo 15. Lichen pine forests

Photo 16. Black alder and white birch forests at the excessively wet soils and fen mires

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PROJECT ACTIVITY: Training of professionals engaged in forest sector, forest science, forest education and Ministry of Natural Resources and Environmental Protection on issues related to sustainable forest management and forest use aimed to promote forest ecosystems resilience and conservation under climate change

Implementation period: October 2020, April 2021

Goal of the activity:

General goal of the activity was to organize and hold training "Modern ecologically oriented technologies for application of plant-protecting means and fertilizers in forest nurseries", including practical classes on the basis of the Republican forest selection and seed center; and publication of educational and information materials.

Activity is implemented by: Belarusian State Technological University

Target audience: staff of research institutions and educational organizations; workers of forest enterprises and forestry units of the Ministry of Forestry; students of High Sch

Photo 17. Practical studies at the Republican forest selection and seed center

Photo 18. Practical studies at Negorelskij educational and experimental forest enterprise

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