Armenian Journal of Physics, 2019, vol. 12, issue 1, pp. 40-44

Ecological Monitoring of Environmental Safety of Non-Wood Products of Forest

G. Aidarkhanova

S. Seifullin Kazakh Agrotechnical University, Victory Avenue, 62, 01011, Astana, Kazakhstan
E-mail: exbio@yandex.ru

Received 12 January 2019

Abstract. An analysis of the condition, existing problems and ways of rational use of non- wood forest products in Kazakhstan compared with other regions of the world is presented. Special attention is paid to food safety of food products (wild berries, edible mushrooms) and fodder vegetation. The levels of contamination of the investigated forest areas with radioactive substances near the Semipalatinsk test site, the most toxic heavy metals near industrial enterprises in the Eastern Kazakhstan were established.

Keywords: forest ecosystems, non-wood forest resources, environmental safety, rational use, forest berries.

1. Introduction

Non-wood forest resources, which include wild forest berries, edible mushrooms, medicinal plants, cones of trees, needles, sawdust, shavings, hay of forest edges, seeds for introduction, etc. can be widely used for economic and environmental purposes. The raw material of non-wood resources of forest ecosystems - renewable natural resources, many of which are in great demand, is quite developed in many countries of the world. In this regard, the study of environmental safety of non-wood forest products is very relevant [1]. According to FAO, over the years, methods for the rational and sustainable use of various types of non-wood forest resources have been developed in various regions of the world: the regulatory and methodological base for assessing their reserves is being improved and supplemented, and the features of biology and ecology of various types of raw plants are being studied [2, 3].

The aim of the proposed publication is to study the environmental safety of non-wood forest products, to analyze existing problems and ways of rationally using them.

2. Materials and methods of research

Scientific publications, bulletins, stock materials, fragments of own research was used in the work. Radionuclide contamination of plants is determined by conventional methods of gamma spectrometric analysis [4]. To determine the elemental composition and heavy metals, atomic absorption spectroscopy methods have been used [5]. Plant identifiers of Kazakhstan were used when establishing the plant species. All names of species are given in S.A. Abdullina's "List of vascular plants of Kazakhstan" [6].

3. Results and Discussions

At present, the issues of the use of non-wood forest resources in the conditions of the formation of a market economy and the development of lease relations have acquired particular relevance. A significant proportion of non-wood forest products in some regions can solve the problems of food supply with natural raw materials. Research on the development of technologies for the creation of nurseries for wild-growing forest plants, the selection of their highly productive forms and the creation of varieties in breeding studies are of growing interest [7].

In recent years, the importance of non-wood forest resources has increased especially due to the increasing demand for them (primarily food and medicinal products) both domestically and abroad. At the same time, the anthropogenic press on forest ecosystems and their components also increases. The predatory use of non-wood resources has led to depletion of their reserves in a number of regions [8]. For example, in the Primorye Territory of Russia from 1999 to 2005, the stock of cedar wood continued to decline - from 465 to 424 million cubic meters (by 9% or 1.5% per year). At the same time, the stock of cedar wood in matures and over-matures cedar forests declined by 27% in 7 years. In general, the resource base for cedar has decreased by $3.5-4$ times [9].

FAO research has found that in many regions of the world, forest by-products are the main or additional source of food in most developing countries, animal feed, medicinal herbs and other food products that provide seasonal income [10-12]. The following picture for the market of non-wood forest products as a product of multi-purpose forest use in different regions of the world is available for 2014: Western Europe - 63.4% , North America - 36% , Oceania - 6.6%, CIS - 6.6% , Asia - 2.4% , Latin America - 1.7% , Africa - 1% [13].

An analysis of the use of non-wood forest products among the CIS countries showed that in practice the integrated use of non-wood forest resources was succeeded by Armenia and Belarus. The Armenian companies have created a map of the plant collection area and conducted training for pickers and their staff on sustainable collection, drying technologies, sanitary standards, safety regulations and traceability. In the future, laboratory analyzes were made to ensure certification standards, and product samples were prepared. All these activities give the rural residents and processing companies a significant additional income [14]. Approximately 30 enterprises in Belarus process berries, fruits and birch sap. All products are exported to Western Europe; its volumes are increasing by about 10% every year and currently amount to about 2 thousand tons [15].

According to the State Forest Fund, Kazakhstan is in the first place among the countries of Central Asia and the Caucasus in terms of forest area. According to Figure 1, the state forest fund of Kazakhstan excluding forest cover is about 27 million hectares [16].

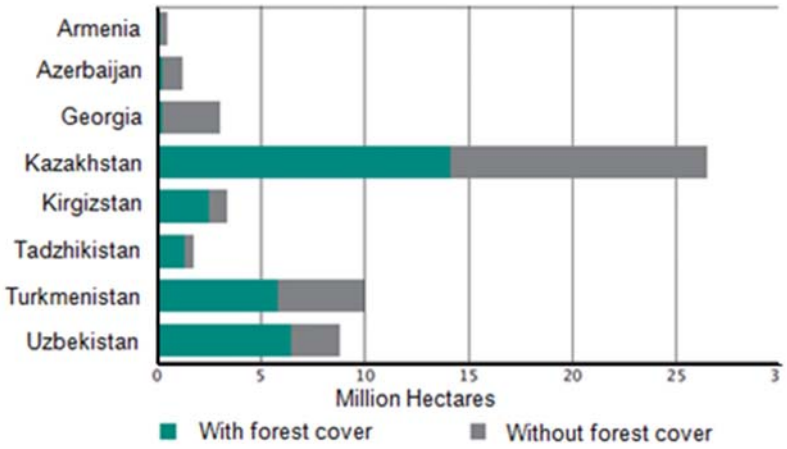

Figure 1. Forest cover of the State Forest Fund in the countries of Central Asia and the Caucasus [16].

However, the collection of non-wood forest resources on the territory of the State Forest Fund of Kazakhstan is regulated and controlled only at the level of local authorized bodies. The assessment of their food security, in general, is not mandatory. Samples of forest resources in the field of radiation safety, which allow us to recommend their use for economic purposes and harvesting in industrial quantities, were investigated. Such studies is due to the fact that local parts of pine forest along the right bank of the Irtysh River exposed to radiation are located on the near "trace" of radioactive fallout as a result of long-term nuclear tests in the atmosphere in the Semipalatinsk test site. The materials of the forest resources studied by us have a small scatter of the nuclides noted, which allows us to recommend their use for economic purposes and harvesting on an industrial scale (Table 1).

The studied facts of the current radioecological situation in forest ecosystems for clarifying the real radioecological situation contribute to the removal of social tension in the region and, in part, to the reduction of radiophobia. Also, we carried out assessment studies on environmental safety aimed at studying the gross concentrations of heavy metals in the berries of mountain forests of East Kazakhstan, polluted by wind-dust transfer.

Table 1. Levels of radionuclide contamination of plant species of forest by products

Name of samples	Range of measured values of gamma-emitting radionuclides, Bq / kg				
	^{226}Ra	^{40}K	^{228}Ac	^{137}Cs	^{241}Am
Maximum permissible concentrations				37,0	
Pine branches	32-62	45-85	< 9,7	< 2,0	< 0,9
Pine cones	33-91	до 52	< 9,0	< 2,0	< 0,7
Bark of pine	< 39,0	< 66,0	< 10	< 2,4	< 1,0
Sawdust	48-54	59-69	8.0-9.4	1,8-2,0	< 1,2

It is known that the mining industry (mines, mines of mineral deposits), which are widespread in the region, can be a source of pollution of forest resources components in the Eastern Kazakhstan. The results of laboratory studies are summarized in the Table 2.

Table 2. Average values of heavy metals in berries

№ n/o	Testing samples	Name of heavy metals, mg/kg					
		Cu	Zn	Mn	Pb	Co	Cd
1	*Ríbes rúbrum L.*	4,2	9,02	36,6	0,29	0,38	0,02
2	*Rósa aciculáris Lindl.*	4,0	8,7	30,7	0,2	0,4	0,02
3	*Vaccínium myrtíllus L.*	3,4	9,0	35,8	0,33	0,4	0,02
	Maximum allowable concentration	5,0	10,0	-	0,4	0,5	0,03

Samples were selected during the expeditions of 2016-2017 on the territories of forest ecosystems of Rudny Altai. Conducting research in the mountain forests of the Eastern Kazakhstan showed a satisfactory condition of contamination of forest berries with heavy metals. The species diversity of forest berries in the region is much wider, which requires continuing research to ensure food security for the population. The most important conclusion established in the course of the studies is that all samples selected meet the requirements of regulatory documents on the criterion of environmental safety. The obtained results of laboratory-field research characterize the wild berries of forest territories of the Eastern Kazakhstan as safe for wide application in food and medicinal purposes.

Herbaceous vegetation of forests is an important component of non-wood products used for pasturing cattle, wild animals. Table 3 summarizes the results of studies on the composition of mineral substances in fodder plants, harvested forestries for feeding wild herbivores in the forests of the Eastern Kazakhstan (elks, deer, etc.).

Table 3. Mineral composition of fodder vegetation of forest edges, (M ± m), n = 25

Indicators	Marked concentrations	Indicators of the norm
Potassium, mg/l, kg	1400±35,07	1740-1790
Sodium, mg/l, kg	450±7,50	350-450
Iron, mg/l, kg	305±15,8	625-850
Copper, mg/l, kg	115,0±0,8	120-130
Zinc, mg/l, kg	552,2±4,1	700-800
Cadmium, mg/l, kg	0,1 ±0,002	-

Among them, in the region, most of them were xerophytized [6], under the canopy of the pine forest there were few, but mostly steppe grasses. It was identified fescue, St John's feather grass, feather grass, koeleria, wormwood, Marshall wormwood, sand wormwood, wood bluegrass, etc. Comparative analysis of the availability of wild plants in forest areas with mineral substances shows a significant imbalance in the elements of mineral nutrition. This, apparently, is a consequence of consumer attitude of the population to natural resources. Hay land of forest edges need to be supplemented with mineral fertilizers, protection and rational nature management.

Specialists in the field of forestry have developed the main directions for the use of non-wood forest products, which are as follows:

- harvesting of non-wood raw materials (birch bark, stumps, bark, brushwood, woody forage, spruce, fir and pine paws, New Year trees, moss, forest litter, reeds, cane, etc.);

- procurement of food resources and medicinal plants (wild fruits, berries, nuts, mushrooms, seeds, birch sap, etc.);

- farming (haymaking, grazing animals, beekeeping, reindeer breeding, growing crops, etc.);

- cultivation of forest fruit, berry, ornamental and medicinal plants. The most complete analysis of the problem is presented in works [11, 12].

4. Conclusions

One of the important problems of rational nature management is the development of scientific foundations for the conservation of natural resources. The main method of obtaining accessible scientific information and achievements is conducting environmental monitoring of natural resources.

This research was carried out within the framework of a grant from the Ministry of Education and Science of the Republic of Kazakhstan (AP05136154).

References

[1] N.N. Tipsina. The study of blueberries, Bulletin of the State University of Civil Aviation, No. 11, 283 p., 2013.
[2] FAO. Global Forest Resources Assessment. Rome, Italy, 2015.
[3] Forest Europe. State of Europe's Forest. 2015 Report. http://foresteurope.org/state-europes-forests-2015-report/#1476293396492-81c05097- 0e949acd-b805.
[4] Guidelines for the Radiation Survey of the Forest Fund (for the period 1996-2000) / I.I. Maradudin, A.V. Panfilov, T.B. Rusina et al. Moscow: Rosleskhoz, 1995 - 34 p.
[5] G.I. Nikolaev, A.M. Nemets, Atomic absorption spectroscopy in the study of evaporation of metals, Moscow, 1982, 212 p.
[6] V.P. Goloskokov. Illustrated determinants of plants of Kazakhstan. Volume 1, 2.-Alma-Ata: Science, 1969, 1972, 644 pp., 571 p.
[7] Food and Agriculture Organization of the United Nations. Status of forest genetic resources in the Central Asian region, country report of the Republic of Kazakhstan. Turkey, Ankara, 2013.
[8] V.V. Grimashevich. Monitoring of resource-forming species of berry plants and edible fungi of Belarus. International Scientific and Practical Conference, Russia, Kostroma, 2014, 35 p.
[9] World Wildlife Fund. Korean cedar in numbers, 2017. URL: www.ruplоad/iblock/90d/ kedrvcifrah.doc
[10] FAO. Global Forest Resources Assessment 2000. FAO Forestry Paper 140, Rome, Italy, 2001.
[11] B.M. Bolshakov. Status and prospects for the use of non-wood forest resources. International scientific-practical conference, Russia, Kostroma, 7-11 pp., 2014.
[12] A.I. Pisarenko, V.V. Strakhov. Protection and protection of forests. Forestry in Russia: from use to management. 159-171 p., 2004.
[13] www.statista.com (2015).
[14] The Economy and Values Research Center (2007). The Economics of Armenia's Forest Industry, Yerevan, Armenia, 2016.
[15] F. Bagirov. Problems and prospects for the development of integrated forest management. Moscow, 2016 (In Russian).
[16] FAO. The main report of the Perspective Forestry Research for West and Central Asia "People, forests and trees in Western and Central Asia. Prospects until 2020, Rome, Italy, 2007.