PASSENGER-CARGO CAPACITY OF INLAND WATERWAYS OF RUSSIAN EUROPEAN AND TRANS-URALS NORTH

Kiselenko, Anatoly N., *laboratory of the transport problems of the Institute of socio-economic and energy problems of the North of the Komi Scientific Center of Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia.*

Sundukov, Evgeny Yu., *laboratory of the transport problems of the Institute of socio-economic and energy problems of the North of the Komi Scientific Center of Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia.*

Tarabukina, Nadezhda A., *laboratory of the transport problems of the Institute of socio-economic and energy problems of the North of the Komi Scientific Center of Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia.*

ABSTRACT

The article assesses current state of inland waterways transport in European and Trans-Urals parts of the Russian North. Basing on a scheme of waterways an analysis of traffic volumes dynamics in the region during 1995–2014 period is offered. The article argues that inland water transport is the only mode of transportation allowing residents of certain areas in navigation period to reach regional and district centers, having no alternative in passenger transportation. The ways to increase passenger-cargo structural framework of inland water transport are identified, possible guidelines of reconstruction programs are highlighted regarding river ports, water tourism, cruise ships and routes, logistics technologies.

Keywords: inland water transport, inland waterway vessels, Russian North, Trans-Urals, the Northern Sea Route, transportation.

Background. *In terms of area Russian European North is the largest geographical district of the European part of Russia. It includes Arkhangelsk (including the Nenets Autonomous District), Vologda, Murmansk regions, the Republics of Karelia and Komi. At the same time it is characterized by the lowest population density [1]. Trans-Urals [Priuralsky, if produced literally from Russian] North includes Yamal, Shuryshkarsky and Priuralsky districts of the Yamalo-Nenets Autonomous District (YaNAD) and the cities of Salekhard and Labytnangi.*

Objective. *The objective of the authors is to consider passenger and cargo potential of inland water transport in Russian European and Trans-Urals North.*

Methods. *The authors use general scientific methods, economic and social evaluation, comparison, statistical analysis.*

Results.

Identification and optimization

Inland waterways here are natural pathways from sources of cargo flows to water areas of the Northern Sea Route, White, Barents and Kara Seas, as well as for transit cargo flows. Pic. 1 shows a scheme of waterways of Russian European and Trans-Urals North and area of Gulf of Ob. The scheme is based on the program of categories of navigation equipment and its and operating terms, and of guaranteed clearance during navigation in 2015–2017 [2]. Data were used on White Sea-Onega, Volga-Baltic (within the boundaries of Vologda region), Ob-Irtysh (within Trans-Urals North), Pechora, Northern Dvina basins of inland water ways (IWW).

The names of key points and symbols are shown in Tables 1 and 2. In Pic. 1 the first figure in parentheses shows the length of each section of waterways in kilometers, the second figure shows the guaranteed size, depth in cm. A specific number of the key point as it is given in Table 1 is indicated in rectangular frames next to each key point.

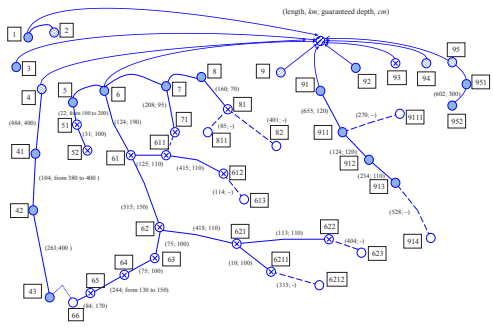
In [3], basins of inland waterways, considering their guaranteed depth, are divided into four groups. First group contains basins of IWW, where the length of waterways and their depth have been maintained almost at the same level as in 1991. The second group includes basins of IWW, where at least one third of the length of routes has the same depth as in 1991. The river networks within the third group are characterized by a complex hydrological regime and moving bottom sediment soils. The fourth group is constituted by the basins of IWW that have almost lost navigable depth characteristic of 1991. Let us compare the IWW within the framework of that ranking.

White Sea-Onega basin (arc 4–41, Pic. 1) belongs to the first group, and 86,5% of its length has the same depth as in 1991 thanks to favorable natural hydrological and channel conditions.

The part of the length of Volga-Baltic basin (arcs 41–42, 42–43, Pic. 1.) with depth of the required level is 42,0%, and it belongs to the second group. It includes lakes and reservoirs, artificial navigable canals, regulated and free sites of navigable rivers.

Although waterways of Northern Dvina basin (arcs, incident to key points 5, 6, 7, 8, and their descendants, see Pic. 1) and of Ob-Irtysh basin (arc 951–952) by the length of remaining clearance as compared to 1991 year have good performance (48,4% and 32,9% respectively), they have been attributed as belonging to the third group. Deterioration of qualitative characteristics of waterways of those basins is conditioned by a significant reduction in the volume of dredging operations.

On waterways of Pechora basins (arcs incident to key point 91 and its descendants) guaranteed navigable depths have been almost lost as compared to 1991, traffic volumes declined significantly.



Pic. 1. Scheme of waterways of Russian European and Trans-Urals North

Table 1

List of key points of the scheme

№ of key point	Name of key point	№ of key point	Name of key point	№ of key point	Name of key point
1	Murmansk	65	mouth of Vologda river	811	v. Keba
2	v. Teriberka	66	Vologda	9	v. Indiga
3	Kandalaksha	611	v. Kholm	91	Naryan-Mar
4	Belomorsk	612	v. Severny	911	v. Ust-Usa
41	Vytegra	613	v. Sogra	912	Pechora
42	Belozersk	621	Syktyvkar	913	Vuktyl
43	Cherepovets	622	v. Nebdino	914	v. Ust-Unia
5	Onega	623	v. Voldino	9111	v. Petrun
51	v. Porog	6211	backwater Krasny Vodnik	92	v. Varandey
52	v. Ust-Kozha	6212	v. Koigorodok	93	v. Amderma
6	Arkhangelsk	7	v. Dolgoschelie	94	v. Ust-Kara
61	v. Ust-Pinega	71	v. Kulogory	95	Sabetta
62	Kotlas	8	Mezen	951	New port
63	Veliky Ustyug	81	mouth of Vashka river	952	Salekhard
64	v. Mikhailovka	82	v. Koslan		–

Table 2

Symbols in the scheme

Symbol	Designation
	Existing sea and river ports
	Promising sea ports
	Ports and piers, activity of which can be restored
	Piers, availability of which is carried out only during «spring flood»
	Exit to the Northern Sea Route
	Exit to the Northern Sea Route from a sea port
	Communication that can be performed in «spring flood»
	Communication that can be performed during the entire navigation period
	Northern Dvina sluice system (depth 140–150 cm)

Operation of water transport of the northern territories experienced since the 1990s problems of system nature, characteristic of all inland water transport of Russian Federation. Table 3 shows the dynamics of indicators in the period of 1995–2014, which illustrate instability of volumes of transportation of goods and passengers in the studied region [4].

The draft of the «Strategy of development of inland water transport of the Russian Federation for the period up to 2030» [5] underlines system problems of inland water transport of the country (insufficient clearance of navigable channels, high obsolescence and physical deterioration of the vessels, unstable financial and economic conditions of transport operators, transport infrastructure underdevelopment etc.), the same problems are typical of northern territories. It is noted that realization of advantages of inland water transport on the basis of a set of measures aimed at restoring infrastructure of IWW, ports, modernization of transport fleet, state support for river transportation, will ensure balanced development of the transport system by:

– unloading rail and road infrastructure in the period of peak demand during navigation season;

– switching of a part of flows of bulk cargo from congested road sections;

– optimization of transport schemes of cargo delivery;

– improvement of availability of transport services in Far North, Siberia and Far East;

– transit capacity growth.

Following an innovative scenario of economic development of Russia potential of shifting cargo flows from road to inland water transport could reach 8,7 mln t by 2030, under energy and raw materials (conservative) scenario it could reach only 5,2 mln t.

A set of relevant programs has been adopted at the federal level and in territorial entities of the region to solve these problems: the sub-program «Inland water transport» of the federal target program «Development of transport system of Russia (2010–2020)», long-term target program «Development of public passenger transport of Arkhangelsk region for 2012–2016», state program of Vologda region «Development of transport

Table 3

Transportation by water public transport in the regions of European and Trans-Urals parts of the Russian North

Year / Territorial entity	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cargo transportation																				
Arkhangelsk region, [1] including NAD, mln t	2,7	3,13	2,76	1,45	1,69	1,2	1,97	1,53	1,66	1,84	1,58	2,7	1,97	2,99	1	1,55	2,19	2,28	2,69	...
Vologda region, mln t	4,3	...	...	3,4	2,4	2,7	...	...	...	...	5,5	4,4	2,6	3,6	2,7	2,4	2,1	...	...	...
Republic of Karelia, mln t	7,3	...	4,5	2,5	1,3	1,5	...	...	...	...	2,1	2,3	0,5	0,6	0,6	0,5	0,6	...	...	...
Republic of Komi, [2] mln t	0,7	1,1	0,4	0,3	0,2	0,4	0,6	0,5	0,3	0,2	0,2	0,7	0,6	0,8	0,9	1	0,5	0,7	0,4	0,3
Yamal-Nenets Autonomous District, [2] thos.t	...	...	...	...	...	...	...	...	...	...	201	1375	918	769	559	556	694	668	599	545
Passenger transportation																				
Arkhangelsk region, including NAD, mln people	1,1	0,8	0,8	0,8	1,1	1,1	1,1	1	1,1	1,1	1,1	0,9	1	1,1	0,9	0,9	0,9	1,2	1,1	...
Vologda region, mln people	0,5	...	...	...	...	0,3	...	...	...	...	0,1	0,05	0,1	0,1	0,1	0,1	0,1	...	...	...
Republic of Karelia, mln people	...	...	...	...	...	0,2	...	...	...	...	0,2	...	0,1	0,1	0,06	0,07	0,06	...	...	...
Republic of Komi, [2] mln people	0,03	0,04	0,02	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,06	0,14	0,12	0,08	0,25	0,43	0,43	0,53	0,54
Yamal-Nenets Autonomous District, [2] thous.people	...	...	...	...	...	...	...	...	...	...	52,3	113	136	158	170	176	153	146	73,9	83,8

... – data not available.

[1] Without enterprises (organizations)of small business, for 2006–2008, 2010–2011 years data are shown for a full range of organizations that have a license to transportation activity.

[2] Since 2006 – for organizations of all types of economic activities.

Sources: *Regional office of the Federal State Statistics Service of Arkhangelsk region / Official website URL: http://arhangelskstat.gks.ru; Regional office of the Federal State Statistics Service of Republic of Komi / Official website URL: http://komi.gks.ru; Reports on socio-economic development of the Yamal-Nenets Autonomous District / Official website of Economic Department URL: http://de.gov.yanao.ru/ser-yanao/doklady-o-ser-janao. – Last accessed 08.04.15.*

system», state program of the Republic of Karelia «Development of transport system in the Republic of Karelia for 2014–2020», state program of the Republic of Komi «Development of transport system», regional target program «Cooperation» (Tyumen region, Yamal-Nenets Autonomous District).

IWW of European and Trans-Urals parts of the Russian North should be considered as a part of the inland water transport system of the Russian Federation, in liaison with the network of European IWW [6]. In general, these links are provided through the Arctic transport system [7]. Therefore, more efficient use of the Northern Sea Route [8] and increase in economic activity on the Yamal Peninsula will create conditions for increasing the volume of cargo transportation by regional water transport.

From Khibiny to Yamal

Ways to increase passenger-cargo resources of inland water transport are widely reflected in the literature [3, 6, 9, 14].

The main ones are:

1) Timely implementation of hydrological study of channel activities on navigable rivers. This will optimize volumes of operational dredging for established values of guaranteed clearance of navigable channels.

2) In the absence of regular dredging operations for river transportation it is offered to use vessels having small draft, as well as promising vehicles of water transport.

In 2012, the Government of the Republic of Komi decided to resume passenger river transportation on rivers of Pechora basin. To do this, funds were allocated from the republican budget for purchase of five new riverboats brand CS-110–32A with passenger capacity of 28 people with a draft of 0,43 m; a regional transport company was created, which deals with acquisition, management and maintenance of passenger water transport; four water routes were developed. In 2013 boats CS-110 in navigation period transported about 82 thousand people in Vuktylsk, including ferry, Ust-Tsilma, Izhemsk districts, cities Pechora and Usinsk. In 2012, a passenger ship «Ust-Sysolsk», built in Vologda for ferry transportation between Aleshino and the village Sedkyrkesch, was delivered to Syktyvkar. Its passenger capacity is 120 seats, draft –70 cm.

One of factors affecting passenger transportation by water transport in northern conditions is speed of movement. To the greatest extent this requirement is met by modern high-speed vessels: planning boats, hydrofoil vessels and air-cushion vessels [10, 11]. Now, however, air-cushion vessels are mainly used for organization of crossings in the off-season, particularly at Ob crossing Labytnangi–Salekhard. According to experts, air-cushion vessels are far from design constructive perfection, their operation is expensive, they consume large amounts of fuel to create suspension, a couple of vessels is required for the servicing a river crossing so that one could come to the aid of another in a critical situation.

Airfoil boats are now used more often [12, 13].

Navigation of 2014, held in conditions of low water levels, showed a weak capacity of water transport regarding adaptation to natural factors (levels below design values have been reported in 13 basins per 17,7 thousand km of inland waterways). However, new technical solutions were identified in designing of river and river-marine vessels that would be effective in such conditions, namely:

– «superfull» vessels with a fullness factor, greater than 0,90, which is a record in the world practice of building of self-propelled vessels;

– combined vessels (self-propelled vessels plus barge attachments) and barge-towing vessels that choose maximum possible dimensions, allowable by traveling conditions;

– combined vessels with load at both ends;

– vessels with reduced air draft, which allows to save travel time due to passage under bridges without their raising.

3) Implementation of inland water transport development strategy, providing measures of state support for water transportation on socially important directions, as well as there, where such transportation mode does not have alternatives [14], should be a prerequisite and criterion of success for regional administration.

The need for such measures has been clearly shown by results of implementation of regional target program «Cooperation» in Tyumen region from 2006 to 2011 in particular in YaNAD.

Using the funds of the program, dredging operations were carried out; passenger floating landing stages and berthing mooring pontoons, motor boats of new design were manufactured and delivered, passenger transportation was carried out on socially significant routes with preferential tariffs.

This ensured the growth of passenger transportation in the starting 2006 year in comparison with 2005 more than by twice, and cargo transportation volumes growth by nearly seven times. In subsequent years, the volume of cargo transportation declined slightly, which can be explained with crisis phenomena, and after termination of the program the rate of decline increased even more. Growth in terms of passenger transportation continued until 2010, then passenger transportation declined, and after termination of the program sharply dropped (by twice in 2013 compared with the previous year).

4) Water tourism, cruise passenger transportation will be able to attract passengers to water transport only under certain conditions, in the first place if personnel safety will be provided.

Meanwhile, there are good opportunities in the region for development of water tourism. In particular, we can name transporting groups of tourists by a boat or a speedboat up the river (Pechora, Vychegda, Usa, Pinega, Mezen, etc.), then descending down the river in boats or other small vessels. Modern navigation tools allow tracking movement of such ships that along with qualitative training of accompanying guides allows ensuring safety of tours.

Cruise transportation is popular mainly in White Sea-Onega and Volga-Baltic basin, where guaranteed depth of 400 cm helps navigation. However, during «spring flood» tours are possible on routes of other water basins. Pilgrimage tours are also not excluded, for example, following the «Way of Stephen Permsky».

5) Effective use of IWW is real for solving certain tasks during navigation and can significantly ease the burden on transport infrastructure in general.

In Western Europe, volumes of transportation by water transport nominally do not decrease, besides even a slight increase in cargo turnover is observed (in 2000–115,4 mln t·km, in 2010–123,0 mln t·km), although in relative values these indicators are more than inferior to road transport [9]. Nevertheless, IWW of Europe play an important role in the European transport system.

In the Ukraine, in the context of economic and political crisis, there was paradoxically even a slight increase in water cargo transportation at some moment. This example shows that in case of various contingencies, such as destruction of roads and bridges as a result of natural disasters, water transportation can be in

demand. However, it is necessary to maintain the infrastructure of water transport.

In Russia over past 25 years, this infrastructure has been only deteriorating; many river ports have been disappearing. To remedy this situation an intervention at the legislative level is obviously required.

River boars, meanwhile, not to forget, can be effectively used to serve major seaports and their links with river ports; to transport heavy and oversized cargo, goods, technology in remote areas where there is no other suitable infrastructure.

Conclusions.

1. It is necessary to take measures to restore and increase guaranteed dimensions of navigable channels on sections of waterways of European and Trans-Urals parts of Russian North characterized by a sufficiently high intensity of shipping.

2. If regular dredging operations are impossible, then vessels with shallow draft, as well as promising means of water transport, should be used for river navigation.

3. It is required to provide state support for water transportation along socially important directions.

4. Water tourism, cruise passenger transportation will be able to attract passengers to water transport only by providing safe and high qualitative service.

5. Inland water transport can be effective in transportation logistics schemes in interaction with other transport modes, taking into account seasonality and other related factors.

REFERENCES:

1. Perepechenko, V. P. Economy of North-West [*Ekonomika Severo-Zapada*]. Vologda, Akademia publ., 2004, 175 p.

2. Inland waterways [*Vnutrennie vodnye puti*]. Internet portal of the Federal Agency of Sea and River Transport. [Electronic resource]: http://www.morflot.ru/deyatelnost/vvt.html. Last accessed 06.11.2015.

3. Gladkov, G. L. Providing conditions for navigation on inland waterways [*Obespechenie uslovij sudohodstva na vnutrennih vodnyh putjah*]. *Transport Rossijskoj Federacii*, 2014, Iss. 1, pp. 8–14.

4. Kiselenko, A. N. On development of transport system of European North of Russia [*O razvitii transportnoj sistemy Evropejskogo Severa Rossii*]. *Regional'naja ekonomika: teorija i praktika*, 2014, Iss. 11, pp. 2–11.

5. The project «Development Strategy of inland water transport of the Russian Federation for the period up to 2030» [*Proekt «Strategija razvitija vnutrennego vodnogo transporta Rossijskoj Federacii na period do 2030 goda»*]. The official website of the Ministry of Transport of the Russian Federation. [Electronic resource]: http://www.mintrans.ru/upload/iblock/5ca/13%2010%2003%20стратегия%20развития%20ввт.pdf. Last accessed 08.10.2015.

6. Belyakov, A. A., Shcherbakov, E. T., Loginova, T. G., Nazarova, V. O. Integrated network of European inland waterways and prospects for Russia's accession [*Edinaja set' evropejskih vnutrennih vodnyh putej i perspektivy prisoedinenija k nej Rossii*]. *Sovremennye proizvoditel'nye sily*, 2014, Iss.1, pp. 101–108.

7. Polovinkin, V. N., Fomichev, A. B. Perspective trends and problems of development of Arctic transport system of the Russian Federation in XXI century [*Perspektivnye napravlenija i problemy razvitija Arkticheskoj transportnoj sistemy Rossijskoj Federacii v XXI veke*]. *Arktika: ekologija i ekonomika*, 2012, Iss. 3, pp. 74–83.

8. Kiselenko, A. N., Sundukov, E. Yu., Malashchuk, P. A., Tarabukina, N. A. Transport connections of European Northeast with waters of northern ports and routes [*Transportnoe soobshhenie Evropejskogo Severo-Vostoka s akvatorijami severnyh portov i putej*]. *Regional'naja ekonomika: teorija i praktika*, 2013, Iss. 13, pp. 2–9.

9. Eglit, Ya. Ya., Galin, A. V. Features of development of inland waterways of Europe [*Osobennosti razvitija vnutrennih vodnyh putej Evropy*]. *Transport Rossijskoj Federacii*, 2014, Iss. 1, pp. 38–41.

10. Baturova, G. V., Zakharchenko, Yu. A., Konovalov, A. M., Sokolyansky, V. P. Introduction of innovative aviation and amphibious vehicles to transport system of Russia and prospects of their use in remote regions of the Arctic zone and the Russian Far East [*Vnedrenie innovacionnyh aviacionno-amfibijnyh transportnyh sredstv v transportnuju sistemu Rossii i perspektivy ih ispol'zovanija v trudnodostupnyh regionah arkticheskoj zony i Dal'nego Vostoka Rossijskoj Federacii*]. *Sovremennye proizvoditel'nye sily*, 2014, Iss. 2, pp. 35–39.

11. Kuznetsov, V. I. Device for the Air Cushion Apparatus. *World of Transport and Transportation*, Vol. 7, 2009, Iss. 4, pp. 26–29.

12. Dementiev, V. A. Airfoil vessels – universal transport of North: proposals for creation [*Ekranoplany – universal'nyj transport Severa: predlozhenija po sozdaniju*]. *Problems of development of transport infrastructure of European North of Russia. Iss. 5: Proceedings of interregional scientific-practical conference*. Kotlas, SPGUVK publ., 2012, pp. 3–6.

13. Surzhik, V. A. Siberian Ecranoplans. *World of Transport and Transportation*, Vol. 7, 2009, Iss. 2, pp. 156–157.

14. Kornev, A. B., Malyshkin, A. G., Fedorov, L. N., Shamanin, Yu. L. On problems of socially significant passenger transportation on river transport [*O problemah social'no znachimyh passazhirskih perevozok na rechnom transporte*]. *Sovremennye proizvoditel'nye sily*, 2014, Iss. 2, pp. 51–57.

15. Lobov, V. River workers suffer losses [*Rechniki nesut poteri*]. Official press organ of the Ministry of Transport of the Russian Federation «Transport of Russia» [Electronic resource]: http://www.transportrussia.ru/rechnoy-transport/rechniki-nesut-poteri.html. Last accessed 06.11.2015. ●

Information about the authors:

Kiselenko, Anatoly N. – D.Sc. (Eng.), D.Sc. (Economics), professor, head of the laboratory of transport problems of the Institute of socio-economic and energy problems of the North of Komi Scientific Center of Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia, kiselenko@iespn.komisc.ru.

Sundukov, Evgeny Yu. – Ph.D. (Economics), researcher at the laboratory of transport problems of the Institute of socio-economic and energy problems of the North of Komi Scientific Center of Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia, translab@iespn.komisc.ru.

Tarabukina, Nadezhda A. – junior researcher at the laboratory of transport problems of the Institute of socio-economic and energy problems of the North of Komi Scientific Center of Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia, nadandtar@mail.ru.

Article received 06.11.2015, accepted 15.02.2016.