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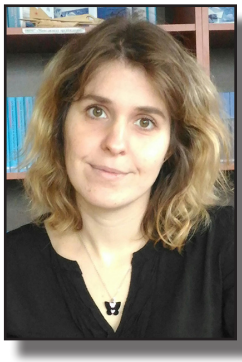
Development of Transport Accessibility and Transport Connectivity of the Black Sea Coast to Increase Mobility of Population and Develop Tourism



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ABSTRACT

Based on the analysis of the route network of railway transport, airports and road traffic, the article provides an assessment of transport accessibility of the resorts of the Black Sea coast aimed at increasing mobility of population and develop tourism The structure of the tourist flow is considered in the context of the modes of transport. More than 50 % of tourists come to the Black Sea coast of Russia by their own cars, which indicates insufficient use of air transport and leads to an excessive load on the highways and the ecology of Kuban and Krasnodar region. Polls have shown that the main reasons for the use of road transport by tourists are the lack of direct air transport flights from some major cities in Russia and insufficient transport connectivity within the Black Sea coast. The article defines the directions for opening of new domestic routes from three regional airports. To solve the problem of transport connectivity, it is proposed to develop maritime traffic using hydrofoils, which will increase the mobility of tourists within the coast area and attract additional tourist flow.

Keywords: resorts of the Black Sea coast, transport system, transport accessibility, transport connectivity, air transport, hydrofoils.

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INTRODUCTION

The Black Sea coast is the location of the largest resorts, namely Adler, Sochi, Tuapse, Gelendzhik, Anapa, Kerch, Feodosia, Sudak, Yalta, Sevastopol, Evpatoria, which are visited yearly by more than 20 million tourists. The demand for tourist services in Russian resorts continues to grow in the context of interruption of a large part of international transport links due to the worldwide spread of coronavirus infection.

Transport links of the regions of the Russian Federation with the Black Sea resorts is carried out by railways, road, and air transport. Air transportation is the fastest and most accessible for tourists from all the regions of Russia. On the territory of the Black Sea coast, air traffic is served by four airports located in the cities of Simferopol, Anapa, Gelendzhik and Sochi.

Even though the air transport is the most convenient, not a large percentage of tourists use its services [1]. Surveys conducted by the authors have shown that the priority use of private cars by tourists arriving at the resort is associated with insufficiently developed transport links between the cities of the Black Sea coast. Using a car simplifies the process of moving between tourist sites in the region and makes the rest more comfortable [2]. This opinion is shared not only by tourists arriving from the Central Federal District, but also from more distant regions. Even cars from the Siberian Federal District can be found on the Black Sea coast. A large flow of tourists arriving in their own cars creates an excessive load on the transport routes of Krasnodar region and Kuban, increases CO_2 emissions and leads to a deterioration of the environmental situation on the coast. The solution to this problem is seen in development of transport connectivity between the resorts of the Black Sea coast and Krasnodar region, which will allow reorienting incoming tourist flows from road to air transport.

RESEARCH METHODS

The study of transport accessibility of the Black Sea coast of Russia was carried out based on an analysis of the route network of interregional railway transport, the current route network of airports and road transport. The analysis of the structure of incoming tourist flows on the coast in the context of the modes of transport used was carried out based on statistical data of the Ministry of Resorts and Tourism of Krasnodar region.

The assessment of transport connectivity of the resorts was carried out based on calculation of the total travel time and the number of required connections of regional public transport routes using the Google Maps Geographic Information System. The travel time is compared to the travel time from the airport to the resort by taxi or private car. Resorts which are not connected at all by passenger transportation were also considered since this hinders the tourist mobility on the Black Sea coast.

International experience of increasing passenger traffic at resort airports is considered using the examples of Bari airport on the northern coast of Italy and Liverpool airport on the northern coast of England. The practices regarding these airports were reviewed based on the final report of the European Commission on regional policy.

RESULTS

Passenger Traffic and Airport Route Network of the Black Sea coast

The busiest airport on the Black Sea coast of Russia is Sochi airport, which is due to the attractiveness of this resort and the proximity of the Republic of Abkhazia, which does not have its own air connection with Russia. Sochi airport ranks 5th in Russia in terms of passenger turnover after the airports of Moscow aviation hub and Pulkovo airport. Simferopol airport is ranked second, Anapa – 3rd, Gelendzhik – 4th. The comparative volume of passenger flows, the number of arrivals and departures, and the breadth of the route network in 2020 are presented in Table 1.

The total volume of passenger turnover arriving on the Black Sea coast by air in 2020 amounted to 6 611 181 people. About 50 % of passengers arrived through Sochi airport, and 35 % through Simferopol airport. This is due to the density of the route network of these airports. Sochi Airport serves 9 international destinations and 44 domestic destinations. Simferopol Airport serves 43 domestic routes. Direct air transportation is carried out only between Sochi and Simferopol airports, other airports on the Black Sea coast do not have direct air communication between them. The largest flow of tourists arrives from Moscow, St. Petersburg, and Novosibirsk.

However, the share of air transport accounts for an average of about 55,5 % of tourists arriving in Krasnodar region [3]. The total volume of the

Table 1

Passenger turnover and route network of airports in 2020

Airport	Passenger turnover, persons	Arrived passengers, persons	Departed passengers, persons	Route network of the airport
Gelendzhik	148 374	74 549 (1,1 %)	73 825	5 destinations: Moscow; St. Petersburg; Yekaterinburg; Novosibirsk; Surgut
Anapa (Vityazevo)	1 813 128	922 594 (14,0 %)	890 534	19 destinations: Moscow; St. Petersburg; Yekaterinburg; Novosibirsk; Surgut; Krasnoyarsk; Arkhangelsk; Murmansk; Petrozavodsk; Apatity; Syktyvkar; Nizhny Novgorod; Kostroma; Kazan; Perm; Ufa; Orenburg; Ivanovo; Cherepovets
Simferopol	4 630 569	2 321 290 (35,1 %)	2 309 279	43 destinations: Moscow; St. Petersburg; Yekaterinburg; Novosibirsk; Khabarovsk; Tomsk; Barnaul; Surgut; Novokuznetsk; Omsk; Krasnoyarsk; Irkutsk; Arkhangelsk; Murmansk; Syktyvkar; Magadan; Nizhnevartovsk; Salekhard; Kaluga; Kirov; Kostroma; Ulyanovsk; Noyabrsk; Voronezh; Kazan; Volgograd; Kursk; Cheboksary; Nizhnekamsk; Perm; Tyumen; Ufa; Orenburg; Chelyabinsk; Ivanovo; Saratov; Lipetsk; Tambov; Cherepovets; Minerlnie vody; Krasnodar; Sochi; Belgorod
Sochi	6 505 301	3 292 748 (49,8 %)	3 212 553	53 destinations: Riga; Dubai; Minsk; Sofia; Tashkent; Aktau; Nur-Sultan; Istanbul; Yerevan; Tel Aviv; Kaliningrad; Moscow; St. Petersburg; Nizhny Novgorod; Chelyabinsk; Yekaterinburg; Novosibirsk; Tomsk; Surgut; Novokuznetsk; Kemerovo; Khanty-Mansiysk; Krasnoyarsk; Arkhangelsk; Murmansk; Syktyvkar; Nizhnevartovsk; Kirov; Kazan; Samara; Cherepovets; Astrakhan; Volgograd; Noyabrsk; Kursk; Nizhnekamsk; Izhevsk; Penza; Perm; Tyumen; Ufa; Orenburg; Kurgan; Saratov; Saransk; Bugulma; Lipetsk; Tambov; Cherepovets; Mineralnie vody; Krasnodar; Makhachkala; Simferopol; Belgorod
Total	13 097 372	6 611 181	6 486 191	

Table 2

Tourist flow, mln persons*

Years	Krasnodar region	Sochi	Anapa
2016	14,70	5,00	3,70
2017	14,90	6,00	4,50
2018	15,80	6,50	5,00
2019	16,00	6,40	4,98
2020	11,50	5,10	5,00

*The table was compiled based on data of the the Ministry of Resorts and Tourism of Krasnodar region.

tourist flow arriving to the Black Sea coast by all modes of transport is presented in Table 2.

Analysis of the structure of passenger traffic in the context of the modes of transport used showed that the share of tourists arriving on the Black Sea coast by air is 40 % on average. If in Sochi the share of air transport in servicing the tourist flow is quite high and amounts to about 55,5 %, and the rest mainly falls on railway transport (39,1 %), then in the city of Anapa the situation looks different (Pic. 1).

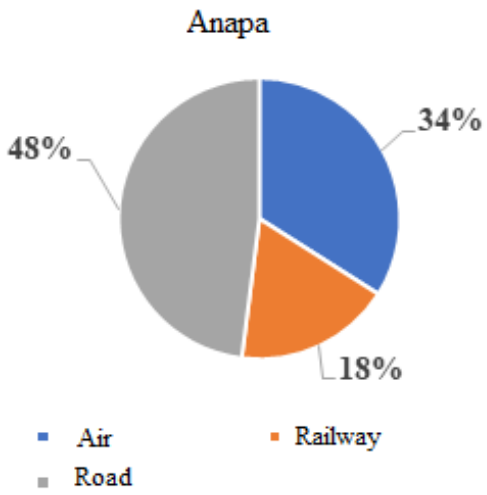
A large share of road transport in servicing incoming tourist flows of Anapa is due to poor transport connectivity of the Black Sea coast resorts, railway stations and the airport network. The analysis of the distance and travel time between individual resorts on the Black Sea coast and airports, using alternative modes of transport, is presented in Table 3. The distance to Gelendzhik airport was not considered due to its very insignificant route network.

It can be seen from the Table 3 that there is no passenger bus service between most of the

Table 3

Distance and travel time between airports and some Black Sea resorts

Route	Distance via highway, km	Travel time by taxi or private car	Travel time by bus (number of changes)	Travel time by rail
Simferopol–Evpatoria	71,0	1 h 24 min	no	no
Simferopol–Sevastopol	87,8	1 h 30 min	5 h 44 min (3 ch.)	5 hours
Simferopol–Foros	109,0	1 h 25 min–2 h	6 h 40 min (3 ch.)	no
Simferopol–Yalta	98,8	1 h 40 min	4 h 20 min (2 ch.)	no
Simferopol–Alushta	65,0	1 h–1 h 50 min	3 h 10 min (2 ch.)	no
Simferopol–Sudak	113,0	1 h 25 min–2 h	no	no
Simferopol–Koktebel	163,0	2 h 10 min–2 h 40 min	no	no
Simferopol–Feodosia	123,0	1 h 20 min–2 h	no	no
Simferopol–Kerch	213,0	2 h–2 h 50 min	no	no
Simferopol–Anapa	334,0	4 h 30 min–6 h 10 min	no	no
Anapa–Kerch	120,0	2 h 20 min–3 h 20 min	no	no
Anapa–Novorossiysk	52,2	55 min–1 h 40 min	no	no
Anapa–Gelendzhik	82,7	1 h 25 min–2 h 40 min	no	no
Anapa–Sochi	330,0	5 h 50 min	14 h (3 ch.)	no
Sochi–Gelendzhik	227,0	4 h 50 min–7 h	no	no
Sochi–Tuapse	144,0	2 h 50 min–4 h 30 min	no	3 h 55 min
Sochi–Sukhum	122,0	2 h–2 h 40 min	5 hours (1 ch.)	7 h 41 min



Pic. 1. The structure of the incoming tourist flow in Anapa in the context of the modes of transport used.

coastal resorts, in principle, and if available, travel time exceeds 4 hours. This limited transport accessibility reduces mobility of tourists within the coastline and forces them to use their own vehicles to travel to the resort. A large share of personal motor transport of visiting tourists creates great tension on the highways of Kuban and Krasnodar region and increases the environmental burden on the region. The development of transport connectivity on the coast will not only solve these problems, but also attract a larger flow of tourists by creating the ability to easily move between the coastal resorts, making various sightseeing tours, which is especially attractive for foreign tourists.

Analysis of World Practices of Development of Transport Connectivity of Coastal Resort Areas

The sea coastal resort territories all over the world are distinguished by their focus on servicing tourist flows. Some of them are national resorts; some attract tourists from all over the world. Service of the tourist flow of resort areas is carried out, as a rule, by all available modes of transport. Meanwhile, air transport is of

particular importance since it allows getting to the resort as quickly as possible and spending more time on vacation. All airports can be divided into two groups: hub airports, providing wide range of services and serving domestic, continental and intercontinental passenger and cargo transportation with an evenly distributed passenger traffic throughout the year; regional airports connecting regions with centres of economic activity, having seasonal peaks and troughs in passenger traffic [4; 5].

Airports serving resort areas have a pronounced seasonality of peak passenger traffic [6]. The seasonality of loading affects the return on investment in fixed costs. The solution to this problem is to increase income during peak loads by increasing passenger traffic. One of the main solutions to this problem in world practice is the expansion of the route network of resort airports with international and domestic communications [7; 8].

In this study, we reviewed the experiences of Bari Airport on the north coast of Italy and Liverpool Airport on the north coast of England. To increase passenger traffic, three vectors were chosen: development of transport infrastructure connectivity (rail links between the airport and the city); expansion of the region's connectivity with major centres (expansion of the airport route network); development of a transport hub (modernisation of the airport and its passenger terminal). The development of transport connectivity made it possible to increase the airport transport accessibility index of Bari airport. The modernisation of the airport has led to an increase in its capacity, resulting in the growth of annual passenger traffic from 2001 to 2007 by 2 times. Expansion of the route network linking it to the largest centres of Western and Eastern Europe made it possible to attract additional tourist flow, which during the period under review increased by 62 % mainly due to an increase in passenger traffic from Northern Europe using air transport. The opening of new routes was subsidised from the national and regional budgets [9].

Liverpool is not a seaside resort but also serves regional tourist routes. An analysis of the experience of Liverpool Airport also shows that the expansion of the route network and development of charter services has led to a sharp increase in passenger traffic. So, if in 1997 the airport served 3 destinations, then in 2007 it served as many as 60 destinations. The annual growth rate of passenger traffic during this period amounted to 23,2 % versus 5 % in the UK in general. The structure of passenger traffic was as follows: 63 % – international low-cost air transportation, 16 % – domestic low-cost air transportation; 8 % – domestic full-service air transportation; 1 % – external full-service transportation; 11 % – international charter flights; 1 % – others [8].

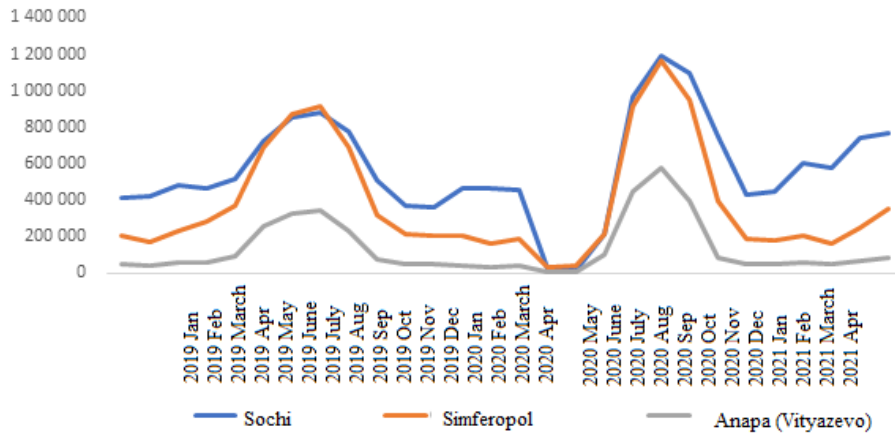
Thus, there are three streamlines for increasing the passenger traffic of resort airports: modernisation of the airport and increasing its capacity; expansion of the domestic and international route network; development of transport links between the airport and the coastal resorts and their transport infrastructure.

Directions for Development of the Route Network of Airports and of Transport Connectivity of the Resorts of the Black Sea Coast

The Concept of the federal target program «Development of domestic and inbound tourism in the Russian Federation (2019–2025)», approved by the Government of the Russian Federation and dated May 5, 2018, No. 872-r, identified 15 promising large-scale tourist investment projects with high potential for expanding tourist proposals for specific priority types of tourism, including the «Black Sea Coast» project [3]. The implementation of projects for development of transport accessibility and transport connectivity of the Black Sea coast of Russia can be invested in the framework of this program.

The peak of passenger traffic in the airports of the Black Sea coast occurs from May to October. The exception is Sochi airport, located near the ski resort, Krasnaya Polyana, Pic. 3.

It can be seen from this graph that the general trend in passenger traffic prevails in all considered airports. In 2020, due to introduction of restrictions on international flights, the tourist flow on the Black Sea coast during the peak season increased at all of the airports under consideration, and in August it turned out to be practically at the same level in Simferopol and Sochi. In 2020, passenger traffic at the airports of Simferopol, Anapa and Sochi amounted to 4,6, 1,8 and 6,5 million people, respectively. At the same time, the capacity of Simferopol airport is 6,5 million people a year, of Anapa airport – 2,6 million people per year, and of Sochi airport – 9,3 million people per year. Consequently, the



Pic. 3. Dynamics of passenger traffic at the airports of the Black Sea coast of Russia, persons.

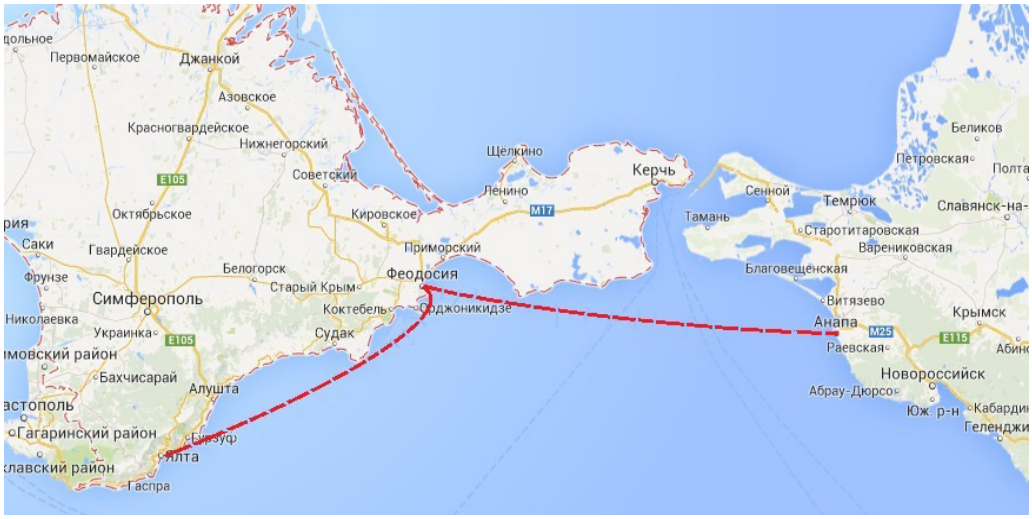
capacity of the airports under consideration is not a limiting factor in increasing passenger traffic, especially due to the load during off-peak seasons.

To increase passenger turnover, it is proposed to expand the route network of the airports under consideration to large cities in Russia. It is possible to open routes from Sochi to the million-plus cities Volgograd and Voronezh, from Simferopol to Nizhny Novgorod and Samara, from Anapa to Volgograd and Chelyabinsk. It is also advisable to open direct charter flights in the summer to large cities in Siberia and the Far East: Yakutsk, Khabarovsk, and Vladivostok.

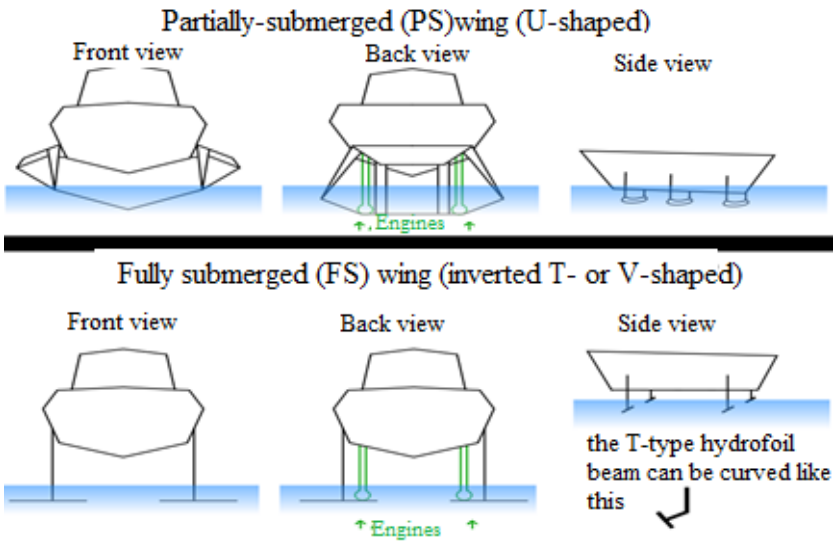
The second, more serious problem referring to increase in passenger traffic at the airports of the Black Sea coast is poor transport connectivity [10]. As a solution to this problem, it is proposed to develop a marine mode of transport based on hydrofoil vessels. Domestic and foreign experience proves the evident efficiency of using hydrofoils to ensure transport mobility of tourists not only on the seacoasts, but also for river transportation [11–13]. When using this type of transport, the travel time, for example, from Feodosia to Anapa will be 1 hour 50 minutes, from Anapa to Sochi – 2 hours 40 minutes, and from Feodosia to Sochi – about 4 hours, which is 4 times faster than provided by the existing bus service. The implementation of this project will have not only great economic importance from the point of view of development of the Black Sea resorts and increasing the attractiveness of air transport for their service, but also social significance. The need for investment will be associated mainly with the acquisition of the ships themselves since the port infrastructure for servicing local sea traffic in large coastal resort cities already exists (Sochi, Gelendzhik, Anapa, Kerch, Feodosia, Yalta, Balaklava, Sevastopol). Besides; hydrofoil vessels will reduce the time required to travel to Abkhazia and create conditions for increasing tourist mobility within the coastal area. All this, in addition to attracting an additional tourist flow, will reduce the proportion of tourists coming to the coast by their own car, reduce the load on the transport routes of Krasnodar region and Kuban, and improve the environmental situation in the region. Currently, there is an opportunity to get by sea to various resorts of the Black Sea coast, for example, daily sea vessels go from Anapa to Feodosia and Yalta. The length of the sea routes is 250 and 150 km respectively. But, since these flights are sightseeing, their average speed is 43 km/h. Travel time from Anapa to Feodosia is 3,5 hours, Pic. 3 [14].

The advantage of hydrofoils is that they are supported above the water surface by the hydrodynamic forces of the hydrofoils, Pic. 4.

The wings under the ship's hull create lift forces that lift the ship above the surface of the sea water, which leads to a significant decrease in resistance to movement. This allows this type of vessel to develop a speed that is unattainable for motor ships. The economically feasible speed of movement of the vessel on the underwater wings is limited to about 100 km/h [15]. This constraint is due to the problem of cavitation, which is the process of bubble formation in an aqueous medium, followed by the collapse of bubbles and the release of a large amount of



Pic. 4. Existing sea routes between the cities of the Black Sea coast.



Pic. 5. The scheme of movement of the hydrofoil vessels.

internal energy, which arises as a consequence of external physical influences. Cavitation of submerged wing sharply reduces the hydrodynamic characteristics of the vessel [16; 17].

Hydrofoils are widely used today in several European countries. For example, these ships have been actively plying between Kaliningrad and the Polish cities of Frombork and Elblag. This line has been mainly operated by the Polish counterparts. In Asia, the most popular sea line connects the Korean city of Busan and the Japanese city of Fukuoka. There are five flights per day along this line [18; 19]. The positive experience of operating hydrofoil vessels for servicing the seacoasts proves the need for a phased introduction of this type of vessel into the permanent operation of sea terminals.

BRIEF CONCLUSION

Analysis of international and Russian experience allowed to reveal main trends of development of transport accessibility of resorts of Black Sea coast to increase transport mobility of population, develop tourism and create for it more comfortable conditions, to identify

promising character of development of air transportation and greater connectivity of coastal resorts with water transport at the expense of redirecting tourists from the use of personal cars, to suggest new destinations from three regional airports. To solve the problem of transport connectivity, it was proposed to develop sea transportation with the help of hydrofoil vessels that will allow to increase tourist mobility within the coastal area and to attract extra tourist flows.

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