Journal of Sustainable Development of Transport and Logistics
journal home page: https://jsdtl.sciview.net

Azemsha, S., Yasinskaya, V., & Hryshchanka, T. (2020). Sustainable development in Belarus: Goals for transport and universal access indicator movements. *Journal of Sustainable Development of Transport and Logistics, 5*(2), 37-48. doi:10.14254/jsdtl.2020.5-2.4.

ISSN 2520-2979

Sustainable development in Belarus: Goals for transport and universal access indicator movements

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Article history:

Received: May 10, 2020
1st Revision: July 12, 2020
Accepted: November 04, 2020

DOI:
10.14254/jsdtl.2020.5-2.4

Abstract: On September 25, 2015, UN member states adopted the 2030 Agenda for Sustainable Development. It contains 17 Sustainable Development Goals (SDGs). Two SDG targets are directly transport-related. Target 3.6: By 2020 to halve the number of global deaths and injuries from road traffic accidents. Target 11. 2: Aims to, by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations - women, children, persons with disabilities and older persons. There are other goals, the achievement of which is impossible without the development of transport. All SDGs related to transport are conventionally divided into 4 groups: safety, universal access, efficiency, green mobility. The purpose of this article is to review the dynamics of changes in the Republic of Belarus of indicators for achieving the goals of the universal access group.

Keywords: sustainable development goals, sustainable mobility, Universal Access, Efficiency, Safety, Green Mobility.

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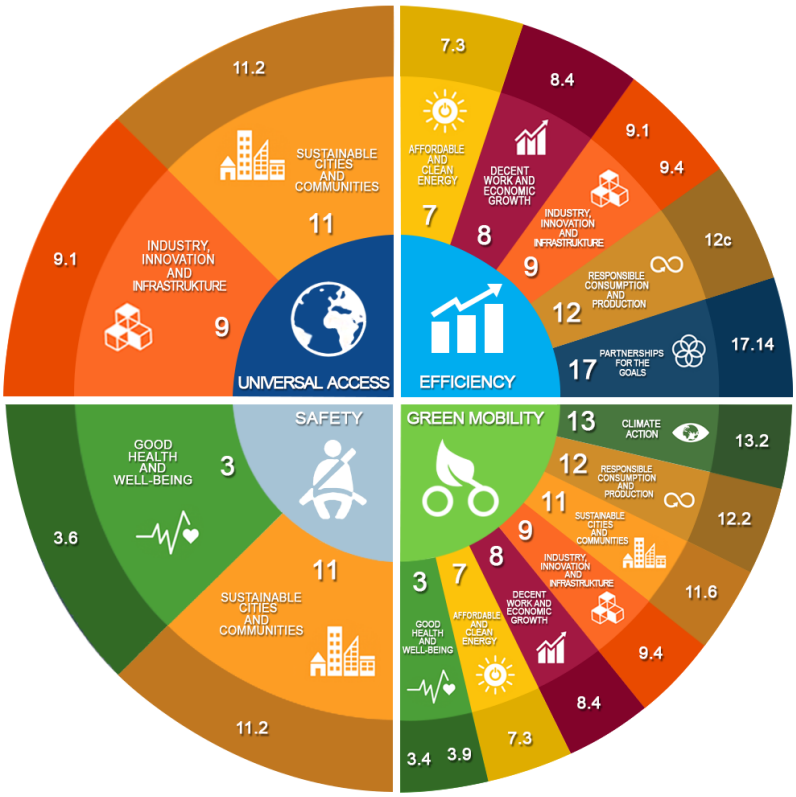
1. Introduction

Transport is a field of activity that concerns almost every citizen, and therefore a number of SDGs depend on the quality of its functioning. The list of such SDGs grouped in groups is shown in Figure 1 (Azemsha et al., 2020; Sustainable Mobility for All, n.d.).

Figure 1: Classification of the SDGs related to transport



In rural areas, where the majority of the world's poor live, limited access to transport is a key challenge to promoting sustainable development. Of course, this problem is most relevant for underdeveloped African countries. But at the same time, to some extent, it is relevant for developing countries, including Belarus.

In urban areas, where an additional two billion people are expected to be living in cities by 2045, the growth in population is far outstripping the growth in public transport. The lack of access to transport services has disproportionately negative impacts on specific groups like women and girls. For example, 6 in 10 women in major Latin American cities report they've been physically harassed while using transport systems (Sustainable Mobility for All, n.d.).

The universal access policy goal captures the ambition of transport "to connect all people and communities to economic and social opportunities, taking into account the needs of different groups, including the poor, those in vulnerable situations, women, children, the elderly, and persons with disabilities, across geographical locations." Attainment of SDG target 11.2, by focusing on urban access, and SDG target 9.1, by focusing on rural access, should be the main targets (to be achieved by 2030) for the Universal Access objective. While both SDGs acknowledge that transport should "leave no one behind," there is no internationally quantified target for this objective. Thus, setting target guidelines for these criteria and assessing the dynamics of their change is an urgent task and important to achieve the goals of sustainable development.

2. Literature review

An analysis of the SDG is devoted to many articles. So one of the tools for assessing the achievements of countries in the field of SDGs is the tool Country Dashboards (Sustainable Mobility for

All, n.d.). The results of this tool in the Universal Access indicator group for Belarus are shown in Figure 2.

Figure 2: Universal Access Indicator Values for Belarus

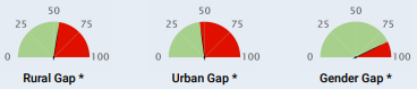
SUSTAINABILITY RATING BY GOAL

(A to D, with A the best performing group)

UNIVERSAL ACCESS			EFFICIENCY	SAFETY	GREEN MOBILITY	
Rural Access	Urban Access	Gender	Efficiency	Safety	Air Pollution	GHG Emissions
B	C	A	C	A	A	B

SUSTAINABILITY GAP BY GOAL*

UNIVERSAL ACCESS



INDICATOR	YEAR	VALUE	DELTA	AVERAGE IN REGION	AVERAGE IN INCOME GROUP	SOURCE
Principal (Rural): Rural Access Index (Percentage)	2001	64	n/a	75	71	WB
Principal (Urban): Rapid Transit to Resident Ratio (km per millions)	2018	18.3	n/a	12.71	8.51	ITDP
Principal (Gender): Workers in transport who are female (percentage)	2018	27	n/a	18	13	ILO
Air transport, freight (million ton-km)	2018	1.9	↓	702	1,247	ICAO
Air transport, passengers carried (number, million)	2018	2.760	↑	12.702	30.681	ICAO
Air transport, registered carrier departures worldwide (number, thousands)	2018	31.676	↑	105.853	248.585	ICAO
Airport Connectivity Index (0-100)	n/a	n/a	n/a	46.057	52.826	WEF
Quality of air transport infrastructure [value: 1 = worst to 7 = best]	n/a	n/a	n/a	4.39	4.37	WEF
Quality of port infrastructure [value: 1 = worst to 7 = best]	n/a	n/a	n/a	3.6	3.92	WEF
Quality of railroad infrastructure [value: 1 = worst to 7 = best]	n/a	n/a	n/a	3.12	3	WEF
Quality of roads [value: 1 = worst to 7 = best]	n/a	n/a	n/a	3.63	3.73	WEF
Rail lines (total route-km)	2017	5,459	=	9,298	13,052	UIC
Railroad density (km of railroads per sq. km)	n/a	n/a	n/a	25.03	13.57	WEF
Railways, passengers carried (million passenger-km)	2017	6,295	↓	9,848	46,380	UIC
Railways – goods transported (million ton – km)	2017	48,538	↑	158,079	310,037	UIC
Registered Vehicles (number, thousands)	2013	3900.442	n/a	5840.774	12714.402	WHO
Road Connectivity Index (0-100)	n/a	n/a	n/a	62	63	WEF

Note: in red is shown sustainability gap by making the difference between 100 (the best performing country) and actual country performance

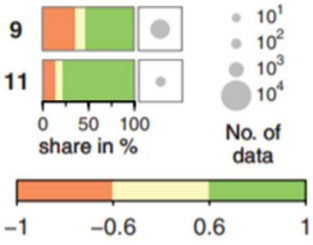
Source: Sustainable Mobility for All. (n.d.)

Figure 2 shows the presence of the largest gap in Urban area. To calculate the parameter values shown in Figure 2, 26 Supporting Indicators were used: quality of roads, quality of railroad infrastructure, quality of port infrastructure, etc. (Sustainable Mobility for All, n.d.).

Such an approach to assessing achievements in the field of sustainability shows a certain result. However, it should be noted the limitation of some values (for example, the Rural Access Index in Figure 2 was calculated in 2001). Also, from this kind presentation of information, the dynamics of changes in indicators is not visible.

The article (Pradhan et al., 2017) considers correlations between the SDGs based on data from 227 countries. The authors call the presence of a positive correlation between the SDGs as synergy, and the negative as a compromise. The authors evaluated the correlation within each SDG (Figure 3) and between the SDGs (Figure 4).

Figure 3: Correlation within the SDGs (fragment)

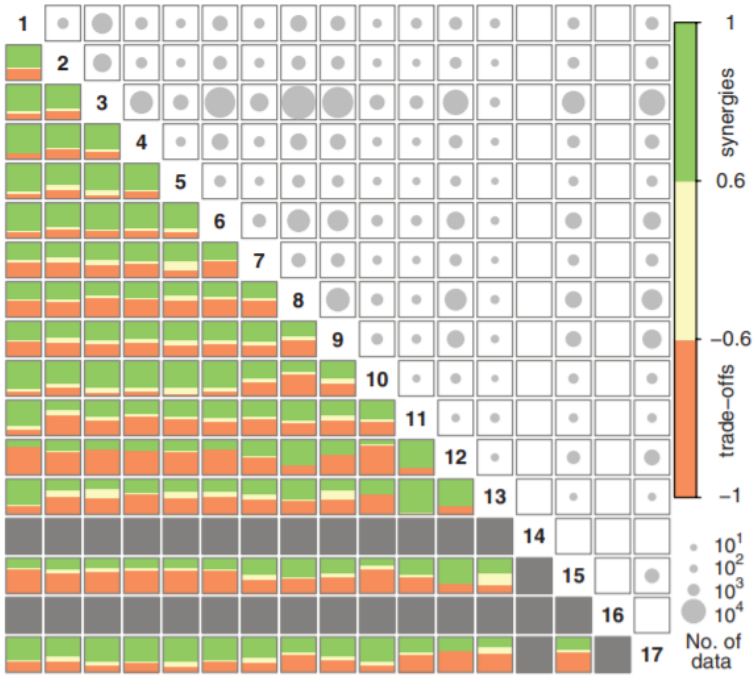


Source: Pradhan et al. (2017)

The color bars represent the shares of synergies (green), nonclassifieds (yellow), and trade-offs (orange) observed within a goal for the entire dataset. The gray bar depicts insufficient data for the analysis. The area of the circle in the boxes indicates the number of data pairs (see the legend for comparison). The SDGs are represented with the numbers in the left and the icons in the right. Within each goal the positive correlations largely outweigh the negative ones, however, negative correlations and nonclassifieds are also observed within all SDGs

Figure 3 highlights the existence of negative correlations within the goal 9 for 35% of the data pairs and 15 % within the goal 11 when all countries are considered. However, mainly SDGs 9 and 11 of the tasks have a positive correlation, i.e. improvement of some indicators leads to improvement of most of the remaining ones.

Figure 4: Observed synergies and trade-offs between the SDGs



Note: The color bars represent the shares of synergies (green), nonclassifieds (yellow), and trade-offs (orange) observed between the SDG pairs for the entire dataset. The gray bar depicts insufficient data. The area of the circle in the boxes indicates the number of data pairs (see the legend for comparison). The SDGs are represented by the numbers in the diagonal

Source: Pradhan et al. (2017).

Figure 4 shows that SDG 9 with all other SDGs correlates synergistically and trade-offs with approximately the same frequency. SDG 11 is associated with synergies with SDGs 1, 12 and 13.

The approach proposed in Pradhan et al. (2017) makes it possible to single out groups of goals that are synergistic with each other and to use the synergistic effect comprehensively to achieve the formulated SDGs.

A number of articles show the failure of the SDG criteria. So for example (Brussel, Zuidgeest, Pfeffer & van Maarseveen, 2019; Xu, Bai & Chen, 2019), the authors claim SDG that indicator 11.2 is supply oriented and measures access to transportation infrastructure, rather than accessibility to activity locations. Results show that SDG indicator 11.2 fails to represent the transport reality well. Its supply oriented focus neglects transport demand, oversimplifies the transport system and hides existing inequalities. Moreover, it does not provide useful evidence for targeting new interventions. As an alternative, developed two accessibility indicators that show substantial variation in accessibility across geographical areas. The proposed accessibility indicators provide a more diverse, complete and realistic picture of the performance of the transport system. These indicators also capture the large spatial and socio-economic inequalities and can help to target improvements in urban transportation.

(Vine, 2019) showed that cities are highly dependent on forests and trees, both within their borders and on their periphery. However, urban and suburban forests and the many ecosystem services they provide to cities face many challenges due to management, planning, and management gaps. At present, urban and rural landscapes are very diverse, there is tension around land use, social and economic changes are rapidly occurring, and opportunities for environmental renewal are limited. The decisive challenge is the adoption of a comprehensive and comprehensive territorial planning policy.

The work Devisscher (2019) shows the role of transport in achieving the SDGs, and also assesses the dynamics of changes in safety indicators in the Republic of Belarus. In particular, it was found that:

1. SDG dynamics 3.6.1. "Mortality from road traffic injuries" tends to decrease. At the same time, the calculations show that while maintaining such a dynamic of recession, the stated goals will not be achieved on time.

2. Dynamics of SDG indicator 11.2.1 "The proportion of the population with convenient access to public transport by gender, age and persons with disabilities" tends to increase. At the same time, calculations show that if these growth rates are maintained at 100%, public transport coverage will not be achieved by 2030, but by 2063.

3. Research methods

The article used methods of collecting and analyzing information. Data was collected from open sources containing information on changes in SDG 9.1 indicators "Develop high-quality, reliable, sustainable and resilient infrastructure, including regional and cross-border infrastructure, in order to support economic development and human well-being, with particular emphasis on providing affordable and equitable access for all" and SDG 11.2. "By 2030, ensure that everyone can use safe, affordable, affordable and environmentally sustainable transport systems, by improving road safety, in particular by increasing the use of public transport, paying particular attention to the needs of those in vulnerable situations, women, children , invalids and elderly persons " in the Republic of Belarus. These indicators were:

- for SDG 9.1:
- the proportion of the rural population living within 2 km of the year-round road;
- the volume of passenger and freight traffic by mode of transport;
- density of public roads with hard surface;
- for SDG 11.2:
- the proportion of the population with convenient access to public transport, disaggregated by sex, age and disability.

To analyze the data found, methods of statistical data analysis were used. In particular, linear and nonlinear regression analysis implemented in Statistica were used. Based on the obtained regression models, forecast values of the analyzed indicators are constructed. The obtained forecast values were compared with the target established by the legislative acts of the Republic of Belarus.

4. Research results

List of universal access indicators of SDGs is given in the Table 1.

As can be seen from the last column of Table 1, in the Republic of Belarus at the national level, one additional SDG indicator "9.1.3.1. Density of paved public roads" was introduced.

At the international level, the specific target values of the SDG indicators are formulated as follows:

- 9.1.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, with a focus on affordable and equitable access for all by 2030 (SDG tracker (n.d.);
- 9.1.2 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure (SDG tracker (n.d.);
- 11.2.1 Provide access to safe, affordable, accessible and sustainable transport systems for all by 2030 (SDG tracker (n.d.).

Table 1: List of universal access SDGs

SDG title	The name of the task	Global SDG indicator	SDG indicator in the Republic of Belarus
SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation	9.1 Develop sustainable, resilient and inclusive infrastructures	9.1.1 proportion of the rural population who live within 2 km of an all-season road 9.1.2. Passenger and freight volumes, by mode of transport	9.1.1 proportion of the rural population who live within 2 km of an all-season road 9.1.2. Passenger and freight volumes, by mode of transport 9.1.3.1. Density of paved public roads
SDG 11: Make cities inclusive, safe, resilient and sustainable	11.2 Affordable and sustainable transport systems	11.2.1. proportion of population that has convenient access to public transport, by sex, age and persons with disabilities	11.2.1. proportion of population that has convenient access to public transport, by sex, age and persons with disabilities

Source: Sustainable Mobility for All. (n.d.).

At the national level in the Republic of Belarus, specific target values of the SDG indicators are formulated as follows:

- 9.1.1 proportion of the rural population who live within 2 km of an all-season road 100% by 2020 (National platform for reporting indicators of Sustainable Development Goals (SDGs) (n.d.);
- 9.1.2. Passenger and freight volumes, by mode of transport (National platform for reporting indicators of Sustainable Development Goals (SDGs) (n.d.):

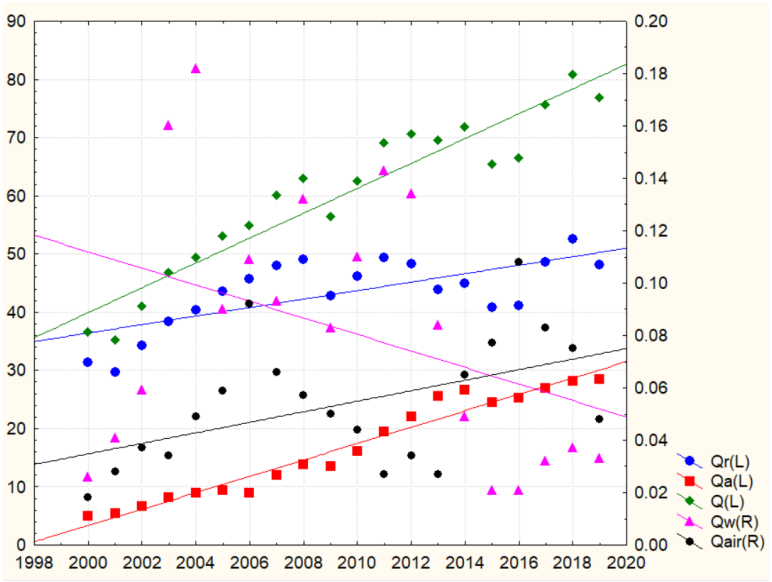
-- Growth rate of turnover (without pipeline), %:
2020: 123.5 in relation to 2015;
2025: 107.0 in relation to 2020;
2030: 107.5 in relation to 2025;
-- Passenger turnover growth rate (without taxi),%:
2020: 102.5 in relation to 2015;
2025: 101.5 in relation to 2020;
2030: 102.05 in relation to 2025;

- 9.1.3.1. Density of paved public roads 2020 – 363.5, 2025 – 364.5, 2030 – 365.2;
- 11.2.1 proportion of population that has convenient access to public transport, by sex, age and persons with disabilities - not formulated.

According to indicator 9.1.1 "Proportion of the rural population who live within 2 km of an all-season road", national statistics have only two numbers: for 2018 - 99.98%, for 2019 - 99.99%. Forecasting for two points for 2020 gives a value of 100%, which corresponds to the goals formulated in (National platform for reporting indicators of Sustainable Development Goals (SDGs) (n.d.).

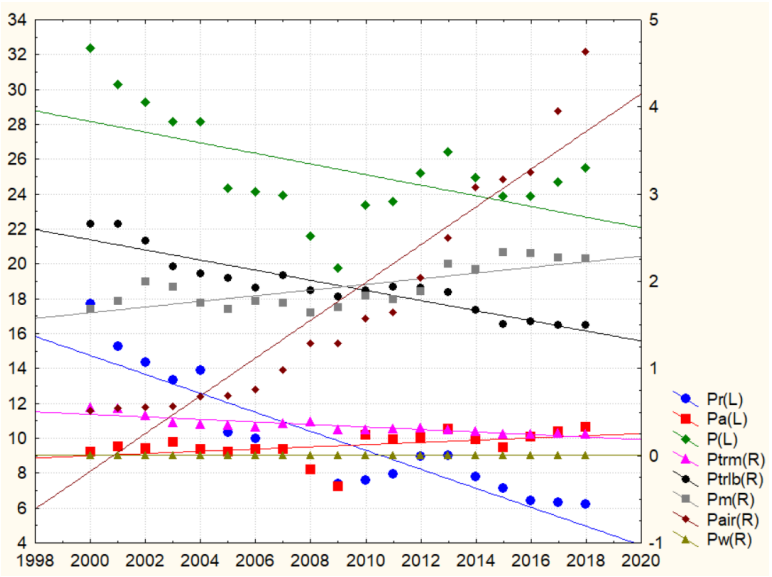
By indicator 9.1.2. "The volume of passenger and freight traffic by mode of transport" on the website of the sustainable development goals of the Republic of Belarus provides statistics on freight and passenger traffic. Although it is a well-known fact that the volume of passenger (freight) traffic is the number of passengers (cargo) transported, and passenger (freight) traffic is the product of transported passengers (freight) by the distance of carriage. Those one parameter (traffic volume) is declared as an indicator, and the target guidelines are formulated and statistics are maintained for another indicator - passenger turnover (cargo turnover). Further analysis will be made for the indicators presented on the website of the national goals of sustainable development of the Republic of Belarus - passenger and freight turnover, since it is for them that the target values are formulated. The dynamics of their change is presented in Figures 5 and 6, respectively.

Figure 5: Dynamics of changes in cargo turnover by means of transport, billion ton-km, and approximating straight lines



Note: on the left axis, freight turnover for rail (Qr), automobile (Qa) transport and total freight turnover are postponed; on the right axis the freight turnover of water (Qw) and air (Qair) modes of transport

Figure 6: Dynamics of changes in passenger traffic by mode of transport, billion pass km, and approximating straight lines



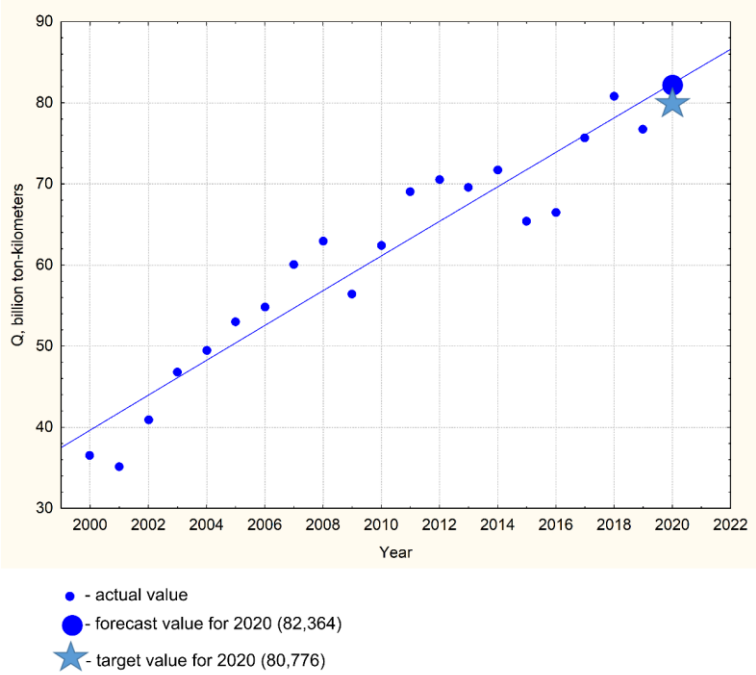
Note: on the left axis, the passenger traffic on rail (Pr), road (Pa) and all (except taxi) modes of transport (P); on the right axis the passenger turnover of the tram (Ptrm), trolleybus (Ptrlb), metro (Pm), air (Pair) and water (Pw) modes of transport

From Figure 5 it is seen that for the analyzed period there was a general growth dynamics of the total cargo turnover (Q). Also, there is a dynamics of growth in cargo turnover for all types of transport, except water (Qw).

Figure 6 shows that over the analyzed period, there was a general dynamics of a decrease in the total passenger turnover (P). Also, there is a dynamics of a decrease in passenger traffic in railway transport (Pr), tram (Ptrm), trolleybus (Ptrlb), and water transport (Pw).

To assess the reachability indicator 9.1.2. "The volume of passenger and freight traffic by mode of transport", a regression analysis of changes in passenger and freight traffic was performed. The results are presented in figures 7 and 8.

Figure 7: Assessment of the attainability of the goals for the completed cargo turnover

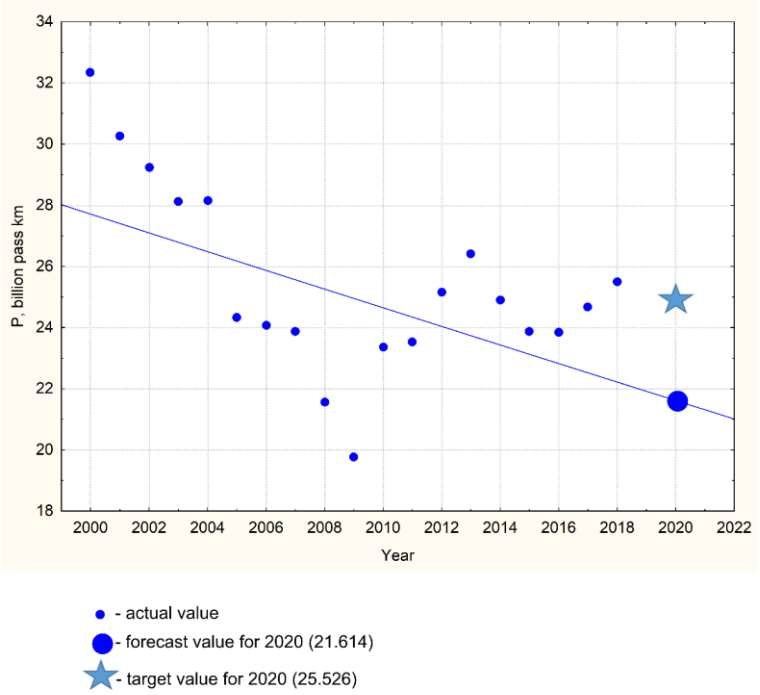


Source: National platform for reporting indicators of Sustainable Development Goals (SDGs) (n.d.)

The forecast model for cargo turnover has the form Q = 4355 – 8630725 / Year. For this model, the correlation coefficient is 0.95, and the coefficient of determination is 0.9. The values of the Student and Fisher criteria show the validity of the resulting model.

Figure 7 shows that the forecast value of freight turnover for 2020 is 82.364 billion tkm. The target value is equal to 80.776 billion tkm. Thus, it can be argued that while maintaining the inertial scenario of the development of events, the goals set for cargo turnover for 2020 will be achieved.

Figure 8: Assessment of the attainability of the goals for the completed passenger turnover



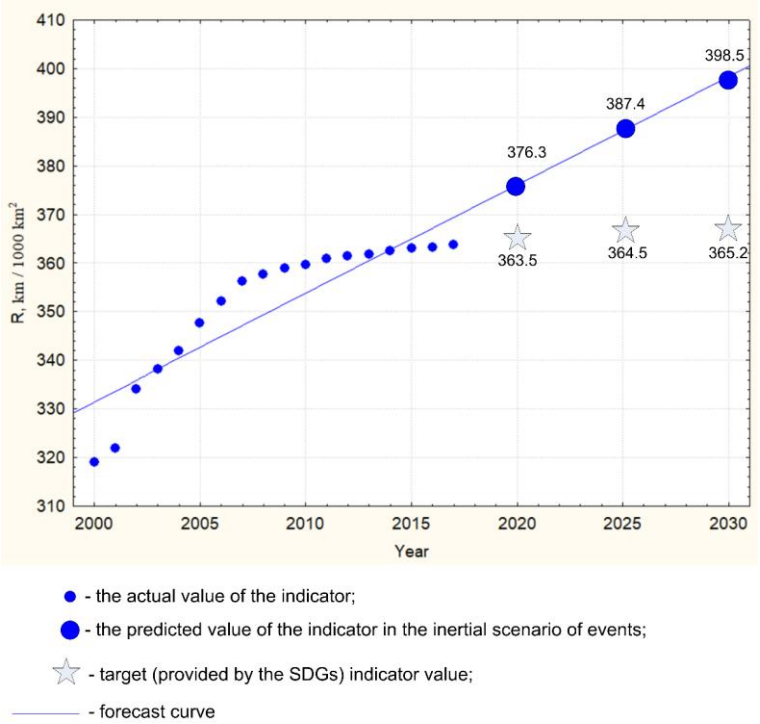
Source: National platform for reporting indicators of Sustainable Development Goals (SDGs) (n.d.)

The forecast model for passenger turnover has the form P = -588 + 1231421 / Year. For this model, the correlation coefficient is 0.56, and the coefficient of determination is 0.32. The values of the Student and Fisher criteria show the validity of the resulting model.

Figure 8 shows that the forecast value of passenger turnover for 2020 is 21.614 billion pass-km. The target value is 25.526 billion pass-km. Thus, it can be argued that while maintaining the inertial scenario of the development of events, the goals set for passenger turnover for 2020 will not be achieved.

Indicator 9.1.3.1 "Density of paved public roads (km / 1000 km^2)" - the length of paved public roads in kilometers per 1000 square kilometers of territory (country or region). The dynamics of this indicator, as well as target values and forecast values are shown in the figure is presented in Figure 9.

Figure 9: Dynamics of changes in the density of public roads with hard surface



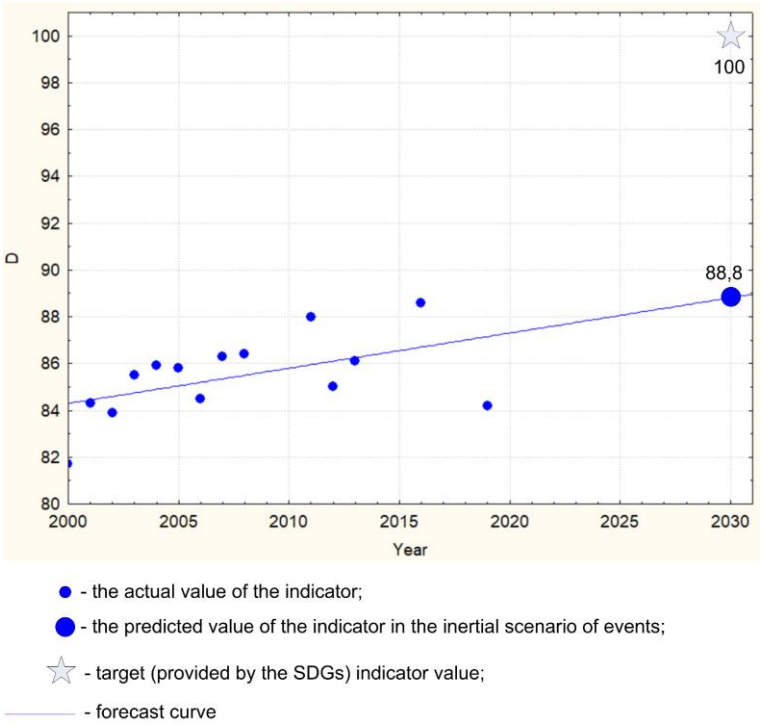
Source: National platform for reporting indicators of Sustainable Development Goals (SDGs) (n.d.)

The forecast model for density of public roads with hard surface has the form P = -33797.4 + 4490.1 Ln (Year). For this model, the correlation coefficient is 0.9, and the coefficient of determination is 0.81. The values of the Student and Fisher criteria show the validity of the resulting model.

Figure 9 shows that the forecast value of density of public roads with hard surface for 2020 is 376.3 km / 1000 km^2. The target value is 363.5 km / 1000 km^2. Thus, it can be argued that while maintaining the inertial scenario of the development of events, the goals set for density of public roads with hard surface for 2020 will not be achieved. A similar situation is observed for 2025 and 2030.

Indicator 11.2.1. "The share of the population with convenient access to public transport, disaggregated by sex, age, and disability" is the proportion of the population that takes no more than 15 minutes to travel by foot from home to the nearest public transport stop, in the total population, in percent. The dynamics of this indicator, as well as its target and forecast values are shown in Figure 10.

Figure 10: Dynamics of changes in the share of the population with convenient access to public transport



Source: National platform for reporting indicators of Sustainable Development Goals (SDGs) (n.d.)

A significant predictive model for predicting Indicator 11.2.1 values. "The share of the population with convenient access to public transport, disaggregated by sex, age, and disability" could not be established. Therefore, the tendency for this indicator to change using a linear model was evaluated (see Figure 10).

The forecast model for density of public roads with hard surface has the form P = -33797.4 + 4490.1 Ln (Year). For this model, the correlation coefficient is 0.9, and the coefficient of determination is 0.81. The values of the Student and Fisher criteria show the validity of the resulting model.

Figure 9 shows that the forecast value of density of public roads with hard surface for 2020 is 376.3 km / 1000 km^2. The target value is 363.5 km / 1000 km^2. Thus, it can be argued that while maintaining the inertial scenario of the development of events, the goals set for density of public roads with hard surface for 2020 will not be achieved. A similar situation is observed for 2025 and 2030.

5. Discussion of the results

The above classification of the SDGs associated with transportation into 4 categories seems very successful. This allows you to structure the list of all the SDGs, which, in turn, allows you to manage them more flexibly. In particular, many SDGs belonging to the "Universal Access" category and the dynamics of their change in the Republic of Belarus were examined.

Using regression analysis to assess the attainability of the SDGs also seems successful. This will allow us to assess the possibility of achieving (not achieving) the SDG target values and timely respond to possible delays.

6. Conclusions

Thus, this article shows the role of transport in achieving SDGs, as well as an assessment of the dynamics of changes in safety indicators in the Republic of Belarus. In particular, it was found that:

1. Analysis of the statistical data of indicator 9.1.1 "Proportion of the rural population who live within 2 km of an all-season road" showed that there is data only for 2 years. Estimated calculations show that the trend that has developed over these two years allows us to achieve the 100% planned by 2030.

2. There is a dynamics of growth in cargo turnover for all types of transport, except water. Also there was a general dynamics of a decrease in the total passenger turnover. There is a dynamics of a decrease in passenger traffic in railway transport, tram, trolleybus, and water transport, which indicates a bias in demand towards a personal car.

3. The forecast value of freight turnover for 2020 is 82.364 billion tkm. The target value is equal to 80.776 billion tkm. Thus, it can be argued that while maintaining the inertial scenario of the development of events, the goals set for cargo turnover for 2020 will be achieved. That is, goal 9.1.2. Passenger and freight volumes, by mode of transport in relation to freight transport will be achieved.

4. The forecast value of passenger turnover for 2020 is 21.614 billion pass-km. The target value is 25.526 billion pass-km. Thus, it can be argued that while maintaining the inertial scenario of the development of events, the goals set for passenger turnover for 2020 will not be achieved. That is, goal 9.1.2. Passenger and freight volumes, by mode of transport in relation to passenger transport will not be achieved.

5. Dynamics of SDG 11.2.1 indicator "Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities" has a growing trend. At the same time, calculations show that while maintaining such a growth rate of 100%, public transport coverage will not be achieved by 2030, but by 2063.

It is obvious that in order to achieve the target values of the universal access indicator in the Republic of Belarus, a number of systematic measures are needed. It is preferable to develop and implement such measures taking into account international experience as part of a consortium of a number of interested organizations from different countries under the auspices of an international project (Horison 2020, Erasmus +, etc.).

Citation information

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