

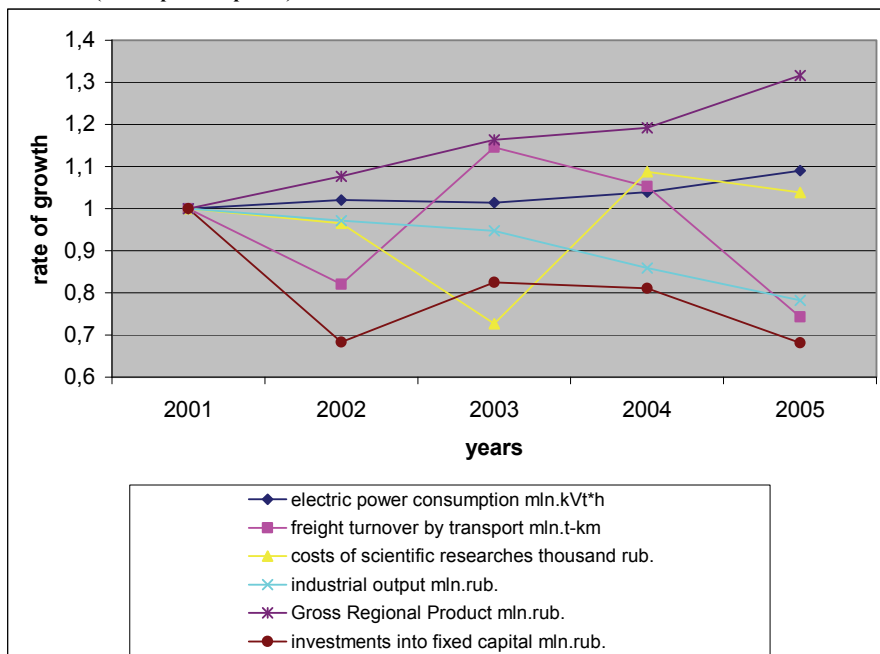
CHAPTER 5. ROLE OF ROADS IN SOCIAL AND ECONOMIC DEVELOPMENT OF ASTRAKHAN REGION

Integrally the concepts of sustainable economic growth of any region can be traced by dynamics of five macroeconomic proportions: science linkage of GRP, power intensity of GRP, «intellectuality» of GRP and freight transportation intensity of GRP, as well as by the parameter of summarized value of investments into fixed capital. The one before last parameter can be interpreted as increase in gross value added not due to physical increase of production output. In case of sustainable development, a rate of increase in turnover of goods, production output, electric power consumption should be lower than a rate of increase in GRP, and inputs for science - higher. Figure 5.1 in full measure illustrates relatively sustainable character of Astrakhan Region development: its obvious deficiency is chronic lag of increase in inputs for scientific research and design works compared to the growth of GRP. However, not only the fact of diagrams' disposition is of importance, but also "gaps" between the line of GRP and other lines. E.g., the tendency of keeping increase in turnover of goods compared to drop of production output (over 20%) and reduction of investments into fixed capital (over 30%) for 5 years is extremely important and obviously negative. At the same time GRP growth followed by increased power consumption, which increased for this period by 9%.



Figure 5.1

Dynamics of changes in economic characteristics of Astrakhan Region sustainable development in 2001-2005 (in comparable prices)



Freight transportation intensity of economics

Transport system is one of the most important sectors of Astrakhan Region economics. Without steady work of transport system and, first of all, without advancing development of road infrastructure, new efficient schemes of goods delivery it is impossible to achieve high quality and mobility of services for all consumers and decrease in risks of economic activities. Otherwise, transport and roads could become a factor restraining economic growth.

To-date transport renders noticeable influence on economic development of the Region. Transport provides obtaining of 13.64% (2004) of Gross Regional Product (GRP). It is higher than, for example, in Tatarstan (6.5%), but lower than in Krasnodar Krai (15%). A matter of maximization of transport share in GRP is disputable in virtue of dual nature of transport.

It would be more correct to consider that a share of transport in GRP remained the same or monotonously decreased, and a role of other manufactures and services increased (not in the last instance due to transport system). It is not casual that, for example, transport strategy of Kazakhstan envisages decrease of transport share in GDP. And this decrease is directly related to development of logistics and clusters (the latter, in fact, is logistically conditioned by a set of inter-complemented manufactures). Growth of transport share in GRP is justified only in case of growth of export services in this sector which is quite admissible in the transit position of the Region.

Transport component in the cost price of production in plant cultivation is evaluated by values around 27.2%, cost prices of freight transportation – up to 50% that is substantially higher than average Russian level, but the transport component in construction and industry is 3 times less than across Russia. In transport (and in sectors of communication) 32.8 thousand people are employed, that makes 10.8% of employed in economics of the Region. Accordingly, in road sector 2.1 thousand people are employed, that makes 0.69% of all employed in economics.

In the existing conditions of transport and road complex of Astrakhan Region and limitation of investments, bringing of all parts of transport system, especially related to bulk public tours, to standard condition becomes a primary task, in order to stimulate interior demand providing, mainly, doubling of GRP.

Digression №4. Stimulating of interior demand by transport

Different sectors of economics do not have equal effect on increase of interior demand. E.g., one ruble of agricultural product stimulates interior demand for 53 kopeks, construction product – for 48, transport – for 37, trade – for 24 [8]. Due to this, rough prognosis of cumulative interior demand stimulated by transport can be received using the following formula:

$$A_i = \sum_{i=2007}^{2030} (B_i * 0.37), \text{ where}$$

B_i – output of transport sector.

The results of computation are represented in the table below.

Prognosis of cumulative interior demand depending on development of transport and roads

	2010	2020
Transport as a whole, bln. rub.	24.6	188.6
Including road sector, bln. rub.	0.1	0.68

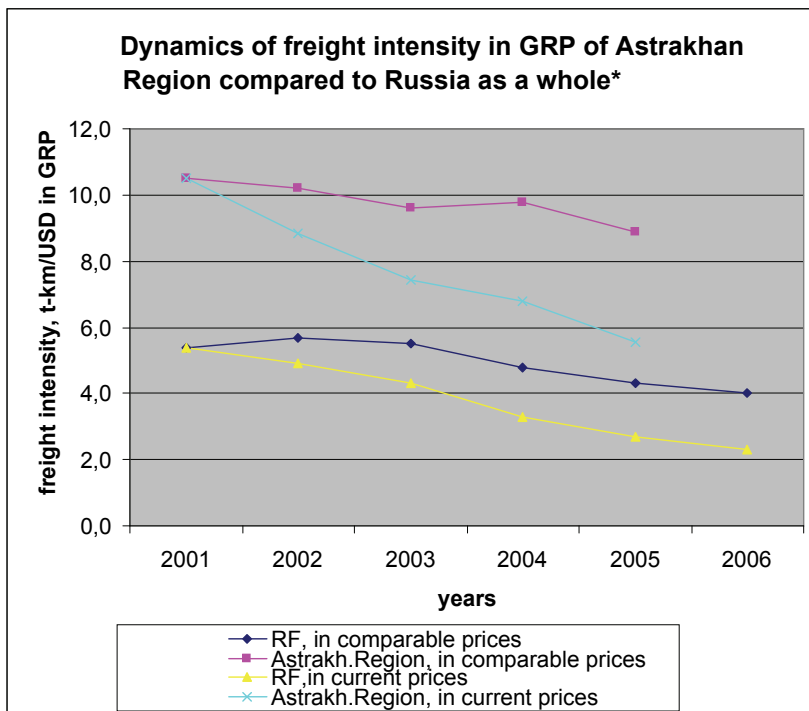
In the process of formation of market relations, the approach to further planning of transport development should be based on defining ultimate results of this development. One of parameters working as an ultimate result for this sector, is freight transportation intensity of the economics calculated as a ration between turnover of goods and a volume of GDP/GRP. Typical feature for both Russia as a whole, and Astrakhan Region is relatively high value of freight transportation intensity. And freight transportation intensity of Astrakhan Region is twice higher than that for all Russia (see Figure 5.2).

Together with this, freight transportation intensity of Astrakhan Region is gradually decreasing in consistency with global tendencies. And the difference between all-Russia value (both in current, and in comparable prices) and the value of freight transportation intensity in Astrakhan Region grew a little – from 1.9 times in 2001 to 2.1 times in 2005.

Obviously, industrial growth is impossible without growth of freight transportation. However, their growth should be less than growth of GDP. It is necessary to strive for constant decreasing of the value of this parameter, as it shows nothing else but burdensome expenses in the process of manufacturing which effect competitiveness of domestic products. This is proved also by retrospective analysis of variation in freight transportation intensity of GDP: transition of developing countries to a level of developed countries and, in general, social progress are followed by monotonous decreasing of transport’s burden to economics.

Figure 5.2

Dynamics of Astrakhan Region freight transportation intensity compared to all-Russia value



* No data for Astrakhan Region in 2006 is available.

Essential decrease of Astrakhan Region freight transportation intensity for the last years (by 47% in current prices and by 15% in comparable prices) is related to advancing growth of Gross Regional Product which was higher than increase in turnover of goods (see Table 5.1). And further decrease of freight transportation intensity of GRP is a reserve for enhancement of the role of transport in economic growth, and importance of road network in this process cannot be overestimated.

Table 5.1

Freight transportation intensity of Astrakhan Region economics					
Parameters	2001	2002	2003	2004	2005
GRP (mln. USD) (in comparable prices for 2000)	1,350	1,454	1,571	1,609	1,776
Turnover of goods per types of transport (mln. t-km)					
<i>Total</i>	12,919	12,729	13,226	14,751	14,841
Railway	11,771	11,633	12,328	13,893	14,037
Motor	159	158	191	202	221
Internal water	230	132	107	187	149
Air	0.6	1.5	0.5	0.3	0.1
Freight transportation intensity (t-km/1 USD GRP, in comparable prices)	10.49	10.18	9.58	9.78	8.88

In international practice there are following approaches to decreasing of freight transportation intensity of GDP (in the sequence of importance):

1. efficient disposal of productive forces (potentially high freight transportation intensity is often provisioned at the stage of working out sectoral programs; such mistakes are hard to correct);
2. decrease of demand for the services of carriers of freight by local manufactures which is possible in case of changed structure of GDP due to advancing increase in services – their transport consumption is by an order less than for goods;
3. redirecting of production companies, especially to increasing the portion of high-tech products.

There are several countries where super-high rate of decrease in freight transportation intensity were observed (though by its economic essence it is a monotonous process). They are India (the first five-year periods after obtaining independence) and Japan (despite the fact that, without having its own raw material resources, the country extremely depends on their transportation).

The thesis of cargo transportation growth should be clarified. From the viewpoint of management of the Region economics, it is impossible to pose a problem of transport work maximum growth, which supposedly should necessarily result in the growth of GRP. Such a position is convenient for those who provide transportation services, but it contradicts with macroeconomic purposes of economics functioning. Growth of transportation work in the conditions of opening markets is inevitable, but its rate should not surpass the rate of GRP growth. It is necessary to point out that this refers to all non-transit transportation; compared to GRP, the rate of transit growth could be equal to or even surpass it.

Therefore, there is a direct connection between favorable macroeconomic conditions for functioning of economics and advancing development of road sector.

To the parameters describing economic applicability of transport, alongside with freight transportation intensity, such parameters as volume of freight and passenger transportation, as well as goods and passenger turnover, can be referred. The data in Table 5.2 show that the demand for passenger and freight transportation in Astrakhan Region has unilateral tendencies. E.g., passenger transportation by public transport was approximately at the same level in 2001-2005. Minimum values were observed both in the first reporting period (2001, 131 mln. people), and in the last (2005, 110 mln. people). Volumes of transported cargo differ in different years: some years it was lower, some - grew, but the general tendency shows the growth of freight transportation. Both of these tendencies do not reflect on balanced result of the work of transport (Table 5.3) when greater relative profit (loss) in one type of transport was in combination with less relative profit (loss) in the other types of transport one and the same year.

From the aforesaid we can draw an encouraging conclusion that transport sector in Astrakhan Region, after a certain recession, started a trajectory of growth.

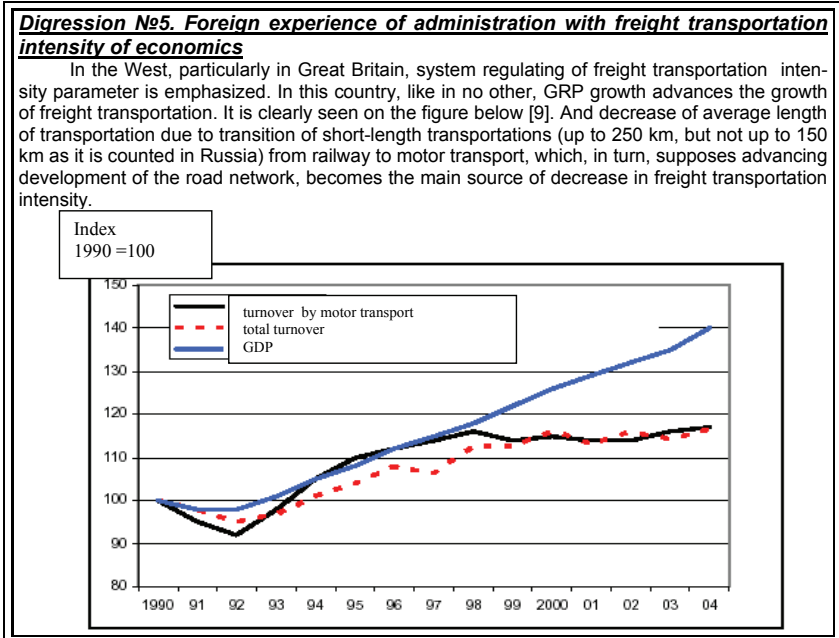


Table 5.2

Parameters of transport work in Astrakhan Region

Parameters of work of the transport sector (by types of public transport)					
Parameter	2001	2002	2003	2004	2005
Volume of freight transportation by types of transport, mln. tons					
Railway	8.222	10.263	10.988	11.692	10.295
Motor*	0.999	0.736	0.823	0.528	0.424
Interior water	2.161	1.773	1.710	2.151	1.783
Air	<0.001	<0.001	<0.001	<0.001	<0.001
Total	12.003	13.209	13.920	14.687	12.819
Volume of passenger transportation by types of transport, thousand people					
Motor	59,928	75,634	99,305	99,617	93,738
Railway	5,217	4,506	3,622	3,426	2,597
Interior water	987	694	603	501	436
Air	69	65	62	64	16
Total	131,420	141,243	147,564	149,062	110,106

* At commercial basis.

Within 5 last years the transport system of Astrakhan Region was at the edge of zero profitability. Traditionally negative financial result is typical for municipal electric transport (in Astrakhan Region it is tram and trolley-bus). It is necessary to point out that sea transport was prof-

table only in three out of five considered years (except for 2003 and 2005), same applies to the interior water transport, unprofitableness of which became apparent for the last two considered years. No data about railway and air transport is available.

Table 5.3
Balanced financial result (profit minus loss) of the work of transport companies, mln. rub.*

Type of transport	2001	2002	2003	2004	2005
Transport -total, including:	n/a	n/a	n/a	n/a	n/a
railway	n/a	n/a	n/a	n/a	n/a
motor (bus)	-13.36	-12.15	-31.96	-44.54	-36.37
municipal electric transport	-34.89	-44.98	-58.52	-65.70	-60.35
interior water	11.01	10.70	1.05	-11.48	-4.55
air	n/a	n/a	n/a	n/a	n/a
sea	8.10	27.60	-18.94	4.68	-6.08

Proportion between individual types of transport in summarized transport work is the most important characteristic of the transport system and economics of the Region as a whole. Knowledge of what type of transport carries the biggest volume of freight and passenger transportation plays an important role at defining priorities in the Long-term Strategy of Road Network Development in Astrakhan Region.

The structure of freight and passenger transportation in Astrakhan Region is represented in Table 5.4.

Table 5.4
Structure of turnover of passengers and goods in Astrakhan Region

Structure of goods turnover (% of total)*					
Type of transport	2000	2001	2002	2003	2004
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Railway	91.1	91.4	93.2	94.2	94.6
Motor	1.2	1.2	1.4	1.4	1.5
Internal water	1.8	1.0	0.8	1.3	1.0
Sea	5.9	6.3	4.5	3.2	2.9
Air	<0.1	<0.1	<0.1	<0.1	<0.1
Structure of passenger turnover (% of total)					
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Railway	64.9	58.5	52.7	50.6	50.1
Motor	22.5	29.8	38.7	41.1	46.7
Municipal electric transport	7.7	7.5	4.9	4.8	1.7
Internal water	1.0	0.8	0.7	0.6	0.6
Air	3.7	3.4	3.1	2.9	0.9

Note. Without pipeline transport.

For the last years the main role in the structure of freight turnover falls on railway transport, and with overwhelming advantage, then sea and motor transport follow. Air transport has an insignificant portion which was gradually decreasing since 2000.

With regard to passenger transportation, here motor and railway transport play nearly equal role, however a portion of the first has a tendency to grow, whereas a portion of railway transport keeps decreasing (since 2000).

Global tendencies in the area of mining operations and fuel consumption denote that energy carriers, including mineral oil, will rise in price. Due to this, increased costs of transport companies will result in reduction of transport portion in GRP (increase in interim consumption will be ahead of increase in output). One of the ways to compensate negative consequences of the rise in prices for fuel and lubricants is, for example, to reduce their consumption owing to improvement of roads.

Transport Strategy of Russia envisages decrease in freight transportation intensity of GDP by 20% for 15 years. The task of Astrakhan Region should be set even more tough (and hard) – to decrease freight transportation intensity of GRP by over one half. In order to make it possible, it is necessary to strive for achievement of such a proportion of predicted values of goods turnover and GRP which would provide preservation of the tendency of decrease in burdening expenses for transport.

Effectiveness of transport accessibility improvement

The results of infrastructure activity reveal, first of all, outside of it, dissolving in economic characteristics of sectors. Hence objective evaluation of the role of infrastructure is possible only with system analysis of its interaction with other sectors of economics, complete defining of those social and economic consequences (costs and results) which would take place not only inside, but also outside infrastructure.

In order to evaluate the effect of sectors on social and economic development of Astrakhan Region, data of Goscomstat were used and results of similar researches carried out by «Geogracom» in a number of regions in Russia.

Comprehensive evaluation of transport sectors impact to social and economic development of regions was performed using mathematical methods for development of basic data with evaluation of their reliability, study of regression relations (over 250) linking parameters of operations effectiveness in transport sector, agriculture, industry with parameters describing united transport system of regions.

The results of regression analysis are given in Table 5.5.

As we can see, in some cases no links were discovered (the Table represents only 13 statistically most reliable equations). One of the reasons for this is that not long enough row of values (5-8 values) was used for analysis. In particular, analysis of relation between plant cultivation cost price and ITA produced a very precise model, however it is fair for only eight districts. One more reason is the following: the factors effecting the studied parameter most of all were not included into analysis.

Precision of the model is very high in 2, 4, 5, 7 and 8 equations. Transport environment improvement makes the strongest impact, with respect to economics, on freight transportation (5.5 bln. rub.), plant cultivation (1.425 bln. rub.). In other sectors the impact of road network is either weak (like in construction), or not noticeable at all (like, for example, in extraction and processing of gas). Respectively, in freight transportation and plant cultivation the portion of road component in cost price of production comprises 50.6% and 27.2% which is much higher than average over Russia.

The impact of road network on social well-being of population in Astrakhan Region turned out to be much higher than in Krasnodar Kraj, Kirov Region, Tatarstan where similar researches were carried out. The quality of road network has especially strong impact on the value of unemployment and the rate of deaths caused by traffic accidents.

In case of ITA improvement by 1 hour, investments into construction will increase by 215 mln. rub., into housing and communal services – by 320 mln. rub., into trade – by 21 mln. rub.

Based on the given above equations, economic equivalents were received for basic sectors of Astrakhan Region economics related to improvement of integral transport accessibility by 1 hour (Table 5.6).

The researches show that economic effect of variation of one and the same parameter by the same value is different for different districts due to different number and composition of road services users. For example, the results of transport accessibility improvement by one hour in Krasnoyarsky district (minimum secured economic effect is equal to 1109.6 mln. rub. by 1 hour of ITA in current prices) and in Limansky (economic effect is equal to 135.5 mln. rub. by 1 hour of ITA in current prices) differ more than by a factor of 8. For comparison, minimum and maximum values of economic effect of ITA variation in a region by 1 hour differ among the districts of Krasnodar Kraj by 20 times, Republic of Tatarstan - by 35 times, Tula Region – by 29 times, Omsk Region – by 16.3 times, and in Pskov Region – by 10.4 times; in Arkhangelsk Region the difference is 268 times. Hence, for Astrakhan Region territorial contrasts by voluminous parameters are typical, which was stated above, but not by environment parameters. Therefore, effectiveness of investments into development of the transport system in various parts of the Region will not differ so much as in other regions. This fact was taken into account when the investment program was developed.

Economic effect in different sub-sectors (types of economic activity) substantially differs per districts of Astrakhan Region. E.g., in construction 80% of effect fall on three districts (Akh-toubinsky, Narimanovsky, Privolzhsky); in Krasnoyarsky district improvement of transport accessibility gives 50% of effect for cost price of freight transportation (without account of pipeline transport). Whereas the effect of ITA improvement in the area of agriculture is distributed in Astrakhan Region rather evenly.

Based on results of calculations of economic effect obtained from improvement of integral transport accessibility within Astrakhan Region, analysis of annual financial losses caused by deficiencies in development of united transport system was carried out.

Table 5.5

Results of regression analysis								
Nos.	Description of function	Equation	Measure units	Prognosis of impact of ITA improvement by 1 h	Notes (level of importance)	Portion of ITA in cost price, %	Precision of the model (R^2)	Potential benefit from ITA improvement by 1 h, min. rub.
1	Cost price of plant cultivation	$F=49.3+62.5X$	kop./rub.	Improvement of ITA (for freight transportation) by 1 hour results in decrease of cost price by 62 kop./rub.		27.2	0.435	1425.0
2	Cost price of construction (specific costs)	$F=88.34+3.65X$	kop./rub.	In case of improvement of ITA by 1 hour, cost price of construction will decrease by 4.52 kop./rub. (for comparison, in Kirov Region – 7)	The model is more precise and stable without Krasnoyarsky and Volodarsky districts	2.9	0.803	25.9
3	Cost price of passenger transportation	$F=-0.85+8.89X$	rub./10 pass.-km	Improvement of ITA by 1 hour results in decrease of cost price by 9 rub. (per 10 pass.-km), for comparison, in Kirov Region – 2	With the account of all districts	3.7	0.408	416.6
3a	Cost price of passenger transportation	$F=-3.18+10.3X$	rub./10 pass.-km	Improvement of ITA for passenger transportation by 1 hour results in decrease of cost price by 1.03 rub./10 pass.km	Without Privolzhsky and Krasnoyarsky districts. More precise and stable model	7.73	0.751	73.2
4	Cost price of freight transportation	$F=-13.4+76.96X$	rub./10 t-km	Improvement of ITA by 1 hour results in decrease of cost price by 7.7 rub./10 t-km (for comparison, in Krasnodar Krai – 4.81, in Kirov Region - only 1.58)	All districts	50.6	0.658	5048.8
5	Mechanical increase of population	$F=1.11-0.07X$	men/year	Improvement of ITA (for passenger transportation) by 1 hour results in increase of mechanical growth by 8.1 %		-	0.625	Annual increase of population 2,420 men
6	Level of unemployment	$F=-26.9+2.38X$	%	Improvement of ITA by 1 hour results in decrease of unemployment by 2.4%	Weighted by population regression	-	0.620	Growth of GRP 0.5% [10]
7	Crime rate	$F=-17.2+34.9X$	unit/100 thousand men	Improvement of ITA by 1 hour reduces crime rate by 34.9 cases (per 100 thousand men) per year		-	0.749	-
8	Rate of deaths caused by traffic accidents	$F=-0.22+0.44X$	ppm	Improvement of ITA by 1 hour is followed by reduced death rate by 0.44 men/1000 men (by 13%)	Weighted by population regression	-	0.509	Growth of GRP 0.09% [10]



Chapter 5. Role of roads in social and economic development of Astrakhan Region

Nos.	Description of function	Equation	Measure units	Prognosis of impact of ITA improvement by 1 h	Notes (level of importance)	Portion of ITA in cost price, %	Precision of the model (R^2)	Potential benefit from ITA improvement by 1 h, mln. rub.
9	Infant mortality	$F=0.4+1.18X$	ppm	Improvement of ITA by 1 hour results in reduction of infant mortality by 1.18 men (per 1000 those who lived to a year)		-	0.194	-
10	Rate of provision with doctors	$F=33.91+4.69X$	men/housand men	Improvement of ITA by 1 hour results in increased provision with doctors by 4.69 men/1000 residents (by 17%)		-	0.257	-
11	Rate of deaths caused by infectious and parasitic diseases	$F=0.47+3.16X$	unit /thousand men	Improvement of ITA by 1 hour results in reduction of death rate by 3.15 cases	Maximum precision		0.21	
12	Rate of deaths caused by tuberculosis	$F=0.31+2.86X$	unit/thousand men	In case of improvement of ITA by 1 hour, rate of deaths caused by tuberculosis reduces by 2.9 cases per 1000 men	Maximum precision		0.253	
13	Rate of deaths caused by tumors	$F=3.02+13.69X$	unit/thousand men	In case of improvement of ITA by 1 hour, rate of deaths caused by tumors reduces by 13.7 cases per 1000 men	Maximum precision		0.166	

Table 5.6

Minimal secured economic equivalent of improvement of integral transport accessibility by 1 hour, mln. rub.

District	Construction	Agriculture	Freight transportation	Social sphere				Total (mln. rub.)
				social effect, total	including passenger transportation	including rate of deaths caused by traffic accidents	including rate of deaths caused by a group of diseases	
Akhtoubinsky	17.3	75.4	50.2	72.57	7.80	1.54	12.35	215.47
Volodarsky	0.0	142.4	63.1	10.66	2.10	0.56	1.49	216.16
Enotaevsky	0.0	143.8	0.0	5.66	4.80	0.06	0.15	149.46
Ikryaninsky	6.3	88.5	103.1	10.62	21.35	1.24	3.36	208.52
Kamyzyaksky	0.0	147.4	21.5	10.07	4.35	0	1.14	178.97
Krasnoyarsky	0.0	123.3	360.7	625.56	350.50	0.42	54.84	1109.56
Limansky	3.7	98.3	24.2	9.39	7.90	0.1	0.26	135.59
Narimanovsky	14.4	148.3	32.5	6.94	1.80	0	1.26	202.14
Privolzhsky	15.1	218.4	47.5	25.45	21.63	0.25	0.66	306.45
Kharabalinsky	0.0	311.4	4.1	11.14	10.00	0.08	0.20	326.64
Chernoyarsky	1.4	146.7	10.3	1.63	0.91	0.05	0.13	160.03
TOTAL	58.3	1643.9	717.2	819.69	433.14	4.31	75.6	3239.09

Note: 0.0 – insignificant value.

In the current prices this parameter is equal to 1.98 bln. rub.:

$$(3.95 \text{ h (ITA}_{\text{actual}}) - 3.34 \text{ h (ITA}_{\text{standard}})) \times 3239.1 \text{ mln. rub.} = 1.976 \text{ mln. rub.},$$

which corresponds to nearly 2.0% of GRP of the Region. This figure is completely confirmed by system analysis of financial scenarios of road development in Chapter 8. Thus, annual damage caused to all road users, and through them to economics of the Region as a whole, more than twice exceeds the volume of funds allocated for financing of territorial road network in the Region (0.93 bln. rub. in 2005). As we can see, there is what to loose for Astrakhan Region: poor road sector is capable to slow down a rate of economic growth. This is also proved by other analytical data.

Improvement of the road network results in substantial improvement of such parameters as health of population, decrease of unemployment, crime rate and rate of deaths caused by traffic accidents, growth of migration attractiveness (see lines 5-13 in Table 5.5).

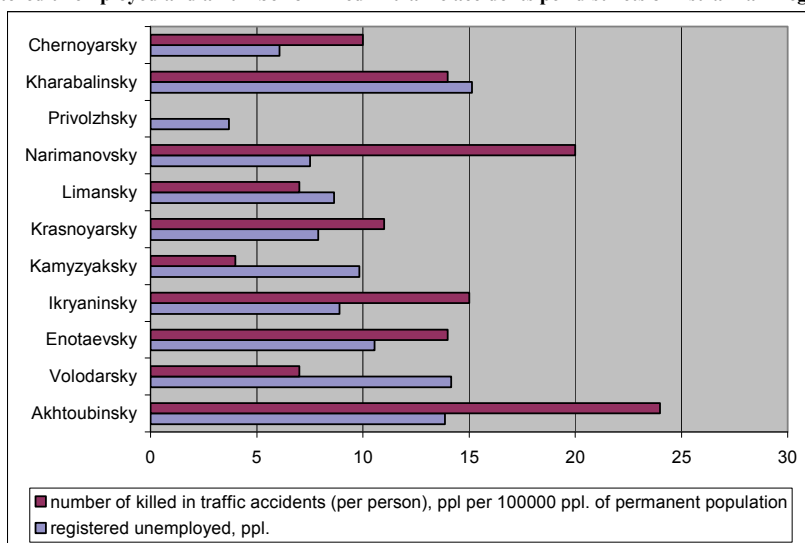
E.g., in case of variation (decrease) of ITA by 1 hour, the total number of unemployed will reduce by 2.4%. What is also indicative it is a potential decrease in a number of deaths in traffic accidents at improvement (decrease) of ITA with respect to passenger transportation by 1 hour - 13% (diagram 5.1)

Relationship between economics and road infrastructure will be considered in more details below.

Figure 5.3 clearly shows that in different districts the same worsening of transport accessibility results in different variation of social indicators, for example, from the viewpoint of decreasing of unemployment, Kharabalinsky, Akhtoubinsky and Volodarsky districts are most sensible to improvement of roads.

Figure 5.3

Comparative impact of ITA_{pass.} improvement by 1 hour on decrease of a number of registered unemployed and a number of killed in traffic accidents per districts of Astrakhan Region



Evaluation of road impact on economic complex of Astrakhan Region

For comprehensive evaluation of the road network impact on sectors of Astrakhan Region economics, a conjugated analysis of GRP structure and the results of regression analysis of effectiveness of ITA improvement in individual sectors were performed. Its results are represented in Table 5.7.

Table 5.7

Economic input of roads per different sectors of Astrakhan Region economics, 2004

Sectors	Portion of sector in value added cost, portions	Portion of motor transport and roads in cost price, %	Portion of motor transport and roads in value added cost of the sector, %
Production of goods:	0.505		
Agriculture	0.056	27.2	1.52
Forestry	0.009	22.0*	0.20
Construction	0.158	2.9	0.46
Others	0.005	0.3*	0.002
Production of services:	0.495		
Transport	0.136		
Including motor transport	0.031		
Incl. freight transportation	0.012	50.6	0.61
Incl. passenger transportation	0.019	3.7	0.07
Non-market services	0.118	0.3*	0.035
Total:	1.0		
Input of transport and road sector into GRP			2.91
Net input of roads	2.91 – 0.031		2.88
Integral expenses for roads, % of GRP			0.58
«Road active»	2.91 – 0.58		2.3
Effectiveness of road financing			3.97



* Average all-Russia values.

Let's consider this Table in more details:

1. The second column represents portions of sectors and sub-sectors of economics in the Region in Gross Regional Product. As Table 5.9 shows, the portion of agriculture – 5.6%, transport – 13.6, etc.
2. With the help of regression analysis road component in cost price of economic complex was defined (column 3). The highest values of this parameter occur in cargo transport (50.6%), agriculture (27.2%). In other words, these sub-sectors are most of all interested in development of the road network.
3. Listed in column 3 portions of roads in the cost price of produce make it possible to define the portion of roads in GRP of Astrakhan Region. As is seen from the Table, summarized input of roads into GRP is 2.88%. Whereas as per the data of Astrakhan Regional Committee of State Statistics it comprises 0.027%. Such a huge deviation is related to the defects in the system of national accounting which does not take into account specifics of the road sector as an infrastructure. The sectors consuming road services wrongly appropriate added value. Owing to a new Method of evaluation of road net input into GRP, developed by «Geogracom» as per assignment of Rosavtodor, «economic justice was reinstated». As an example, we can cite a classic situation in timber cutting. More than half of routes for hauling timber run over public roads, the former road tax for exploitation of which was cancelled long ago. As a result, these roads are rehabilitated by road administrations, and the cost price of timber cutting decreased by 10% which, in turn, decreased interim consuming and increased added value in GRP. However, this growth of value added cost should be completely referred to the road sector, as there is no merit of foresters here.
4. Input of roads into GRP surpasses expenses for roads nearly 4 times which indicates economic expediency to keep the sector at the high level of financing. However, so high profile of effectiveness of road financing should be a warning for us, as such situation cannot last forever. Without damage to development of other sectors, it is necessary to raise a current level of financing (0.99% of GRP in 2006) by nearly one and a half times (for more details about this see Chapter 8).

From given below diagram 5.4 we can see that net effect of spent for roads from all sources funds comprise 2.3% («road assets»). **Therefore, the road sector of Astrakhan Region «gives back» 4 times more than it «takes». Hence, an answer to the question: Is there sense for the State to invest money into development of roads, is apparent.**

An important ultimate aim of improving the road network is a necessity to approach within medium-term prospects the standards of quality stated in Minimum Transport Standard, including prospective values of Integral transport accessibility (Figure 5.5). An integral effect constitutes product of a cost of 1 hour ITA equivalent (Table 5.6.) for each district and a difference between existing and prospective levels of road network development. The highest economic effect of approaching the standards of sustainable development was found in the districts: Krasnoyarsky and Kharabalinsky. Maximum improvement of ITA (over 1 hour) upon implementation of the Strategy is typical for Kharabalinsky, Narimanovsky, Enotaevsky and Akhtoubinsky districts. And it is the residents of these districts who will be the first to feel wholesome impact of road programs implementation in all aspects of everyday life. And it should be pointed out that maximum improvement of integral transport accessibility not always correspond to maximum amount of economic benefits (integral economic effect), as everything depends here on the composition of users of «assets» on the territory.

Figure 5.4

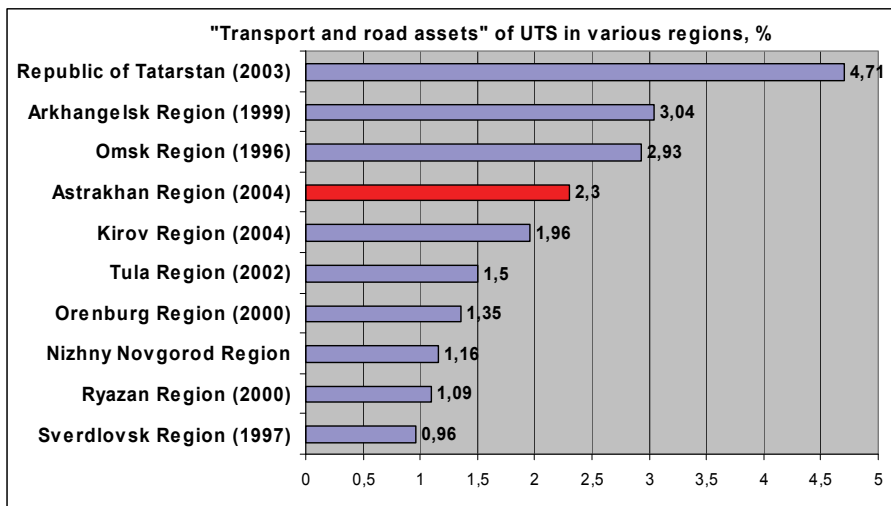
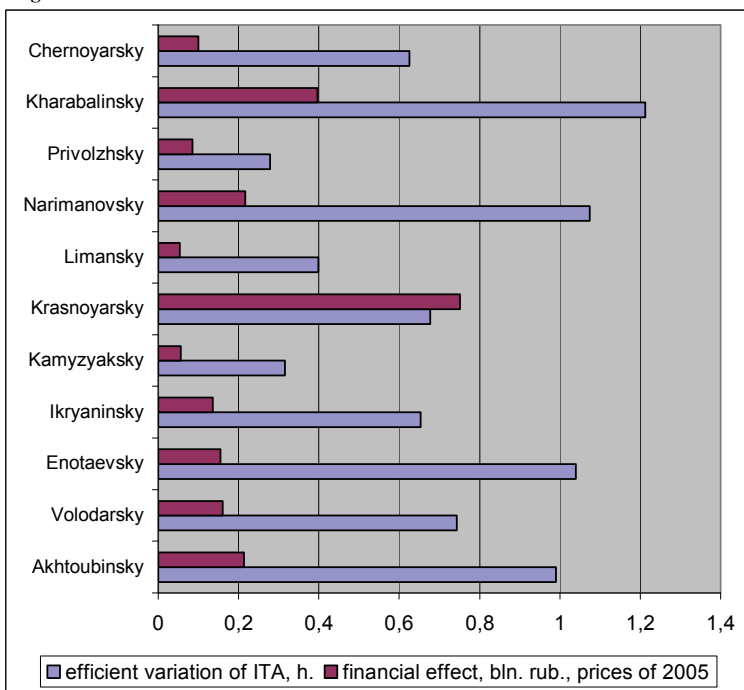


Figure 5.5

Integral economic effect of the road network improvement in the districts of Astrakhan Region



Impact of road network development on social parameters in Astrakhan Region

Evaluation of social results of the Project supposes that the Project is in conformity to social norms and standards. Main types of social results of the Program of Road Network Development in Astrakhan Region are: saving of spare time, variation of the level of population's health, decrease of crime rate, increase in employment of population. Saving of population's spare time expressed by men-hour from implementation of the Program makes 21.2 mln. men-hours. For cost evaluation of this type of results it is recommended to use the standard of 1 men-hour evaluation in the amount of 50% of average hourly salary per contingent of capable of working population [11]. Total effect of saving spare time is 869 mln. rubles (prices of 2005).

One of the basic notions characterizing transport and communication environment in the region is transport discrimination of population – a phenomena when, due to insufficient development of transport system, the services of social secured minimum (education, health care, social service, provision of cultural and household facilities, etc.) are not available for people.

Basic measure for the level of transport discrimination of population is a standard of time spending – integral transport accessibility (ITA). This standard is the average time for which it is required to reach any point of the territory (or individual settlements) within the scope of United Transport System (UTS) from a given habitation area. It is calculated separately for freight and passenger transportation and includes specifics of pattern and technical condition of transport communications. UTS by its technical parameters and reliability of pattern should be so as to provide the above stated standards, which, in turn, depend not only on technical and topological reliability of UTS, but also on the system of settling (including administrative status of settlements), sizes of inhabited areas. Otherwise, habitation areas will be ranked as provincial, and their population will suffer transport discrimination. The level of transport discrimination is defined by a percentage of population living outside the standard zone of transport accessibility.

Table 5.8

Social indicators of transport accessibility in Astrakhan Region

District	Level of transport discrimination of population		Lost spare time, thousand men-hour (standard - 0)	Average weighted unaccessibility of services, hours a week per 1 adult resident (standard - 0)	Contrast range of transport conditions, % (standard – not more than 30%)
	%	thousand men			
Akhtoubinsky	58.9	62.7	66.7	0.626	489
Volodarsky	14.7	7.0	-3.7	-0.078	327
Enotaevsky	<0.1	<0.1	-9.1	-0.324	278
Ikryaninsky	2.3	1.1	-17.7	-0.366	296
Kamyzyaksky	61.0	30.4	32.2	0.647	260
Krasnoyarsky	3.9	1.4	-19.0	-0.519	297
Limansky	19.8	6.7	4.4	0.129	320
Narimanovsky	24.7	10.9	30.0	0.683	390
Privolzhsky	0.4	2.0	-32.2	-0.060	356
Kharabalinsky	9.4	3.7	7.9	0.020	303
Chemoyarsky	24.3	4.9	1.6	0.076	273
Astrakhan Region	8.7	86.5	19.46	0.02	442

Note. Grey background marks unsatisfactory values of transport discrimination of population (>10%) and of contrasts of transport conditions (>30%). Figures for the Region as a whole evaluate periodic needs, unlike the need in everyday services – for the districts.

By the level of transport discrimination of population all districts of Astrakhan Region can be divided into four groups (Table 5.7):

1. Favorable level 0-5%
2. Satisfactory level 5-10%
3. Unsatisfactory level 10-50%

The level of transport discrimination of population varies significantly from district to district in the Region. Only 4 districts have favorable level of transport discrimination.

In Enotaevsky district the level of transport discrimination of population is less than 0.1%.

Unsatisfactory level of transport discrimination of population (over 10%) exists in six districts, including Akhtoubinsky and Kamyzyaksky districts where it is over 50%.

In Astrakhan Region high level of differentiation is observed between territories with respect to their provision with transport which shows how much transport conditions of life within the scope of districts are unequal, contrast. It is inadmissible in principle that within a rural administrative district the difference in provision of its residents with transport was more than 30%. In reality the situation is much worse: people living in a district centre and in remote places of a district are separated by a huge gap. Their transport conditions of life differ by 2-3 times (200-300%), and within Akhtoubinsky district – even by 4.9 times (Table 5.8). And so an alternative mechanism will be considered below for leveling of transport conditions of living by way of compensation payments.

An important parameter, reflecting summarized damage to population caused by insufficient development of united transport system, is a characteristic of summarized fund of lost spare time per individual districts of the Region (with respect to everyday services). Akhtoubinsky district is especially distinguished as there total losses of spare time is the most due to greater number of population living in habitation areas with the parameter of transport accessibility exceeding the standard ITA (see Table 5.8). Opposite to that, in 5 districts the parameter of summarized fund of lost spare time is negative, i.e. each resident of the given district gains additional time due to accessibility of objects in their districts for everyday services by existing to-date transport system (relative to the standard calculated for each of the districts).

Product of this parameter, not depending on total population, is the parameter of average weighted unaccessibility of services from social guaranteed minimum (hours per week) which ideally, same as the fund of lost spare time, should be equal to zero. The worst conditions according to this parameter exist in Akhtoubinsky, Kamyzyaksky and Narimanovsky districts (the value exceeds 0.6 hour). And also in 5 districts the parameter of average weighted unaccessibility has negative values, as a result even today a resident in each of these districts gets additional advantages from saving time for everyday services provided by way of public transport.

Growing mobility of population with social and cultural purposes is a standard of civilized society

One of basic characteristics of the role of passenger transport in economic life of the Region is passenger capacity of its gross product. Dynamics of passenger capacity in Astrakhan Region does not correspond to global tendencies: in 2005 substantial decrease of this parameter was observed compared to the year of 2001 (Table 5.9). However, analysis of population's mobility shows that this negative tendency can be explained, first of all, by advancing rate of GRP growth compared to passenger turnover. In addition, absolute value of passenger capacity in Astrakhan Region is higher than in Russia as a whole and in developing countries. As is well known, the higher level of industrial and economic development of the country, the higher a parameter of population mobility in it. And in western countries only 35-40% of passenger turnover falls on working trips (in Russia and developing countries - 60% and more).



Table 5.9

Passenger capacity of Gross regional Product in Astrakhan Region					
Parameters	2001	2002	2003	2004	2005
Gross Regional Product, bln. rubles	36.442	45.192	54.693	62.568	76.483
Volume of passenger transportation (by public transport, thousand people)					
Motor	59,928	75,634	99,305	99,617	93,738
Railway	5,217	4,506	3,622	3,426	2,597
Water	987	694	603	501	436
Air	69	65	62	64	16
Total (including municipal electric transport)	131,420	141,243	147,564	149,062	110,106
Passenger turnover per types of transport (by public transport, mln. pass.-km)					
Motor	598	791	1,087	1,223	1,179
Railway	1,725	1,555	1,481	1,505	1,264
Water	27	21	19	17	16
Air	98	91	86	97	22
Total (including municipal electric transport)	2,653	2,658	2,812	2,975	2,523
Passenger capacity (pass.-km/1USD GRP) (in comparable prices of 2001)	1,965	1,828	1,790	1,849	1,421
Mobility (pass.-km/1 resident)	2,638	2,645	2,809	2,980	2,538

Mobility of population in Astrakhan Region has values comparable to the regions of Southern Federal District, and for the recent years some reduction of mobility was observed, which is inadmissible. The strategy is aimed at the change of this tendency and achievement of standard values by 2030, first of all by way of creating of favorable transport and communication environment and increase in the role of public transport (Table 5.10).

Digression №6. Mobility of population

The Strategy of transport development in Russia envisages growth of population mobility by 2020 by 30% relative to the level of 2003 when it comprised 4300 km per 1 man a year. In USSR in 1990 it was 8700 km. Whereas in well-developed countries of the world, first of all in the countries of Western Europe, this parameter already now approaches or even exceeds 10 thousand km/men per year (in FRG - 10.7 thousand km). Compared to other regions of Russia, Astrakhan Region has medium characteristics of population mobility (about 2.6 thousand km/men).

Transport strategy of Russia provides for the growth of mobility and maneuverability of population by 2010, first of all due to increase of vehicle fleet from 21 to 31-33 mln. pcs. and increase in the share of cars in passenger transportation from 33% to 53%. And total mobility should grow by 10-15%.

Mobility, expressed by a number of trips (with the account of their length) calculated per 1 resident, is used mainly for analysis of general tendencies in development of regional transport systems. It facilitates forecasting of demand for passenger transportation based on the tendencies existing in well-developed industrial countries (with bad demographic situation).



Table 5.10

**Existing and prospective social and cultural mobility of population
in Astrakhan Region (% of standard)**

District	2006	Upon Strategy implementation
Akhtoubinsky	65.0%	85.1%
Volodarsky	35.0%	54.9%
Enotaevsky	63.0%	83.1%
Ikryaninsky	40.0%	60.3%
Kamyzyaksky	30.0%	47.8%
Krasnoyarsky	90.0%	105.6%
Limansky	70.0%	88.5%
Narimanovsky	64.0%	84.3%
Privolzhsky	73.0%	92.2%
Kharabalinsky	40.0%	61.1%
Chernoyarsky	50.0%	69.6%

From Table 5.10 we can see that only in Krasnoyarsky district mobility of people with social and cultural purposes will be in conformity with the European level. In other districts this level will not be reached by the years of 2030-2035.

Table 5.11 shows discrepancy between the role of each type of transport and its input in ITA, i.e. voluminous characteristics of transport work and parameters evaluating spatial structure do not coincide. E.g., motor transport carries about 47% of total passenger turnover, whereas it provides nearly 87% of summarized integral transport accessibility (due to short-distance trips, mainly within a city and suburbs). Opposite to that, railway transport provides over 50% of passenger turnover, but its input in ITA is insignificant - only 13%. It is explained by minor spatial role of railways (less than 20% of habitation areas are situated at the railway).

Table 5.11

Proportion between the structure of passenger turnover and input into ITA before and after implementation of the Strategy of transport system development in Astrakhan Region

Type of transport	Structure of transport sub-sectors, %			2027	Structure of transport sub-sectors, %		2027
	For passenger turnover	For ITA 2004			For passenger turnover	For ITA 2003	
Motor	46.73	85.5	86.7	n/a	81.1	87.3	
Railway	50.10	12.5	11.5	n/a	14.3	9.6	
Water	0.6	2.0	2.7	n/a	4.2	3.0	
Air	0.9	0.001	0.1	n/a	-	0.01	
Total	100	100	100	n/a	100	100	

Roads and poverty

Roads are an engine of sustainable development – this conclusion was made by experts of the World Bank even over 25 years ago as they found virtually linear relation (with confidence level of 97%) between a length of paved roads and GDP per head. Actually in all concepts of social and economic development in the regions, as a constituent parameter, a portion of paved roads is used. However, this parameter is contradictory, and we replaced it with a level of road network reliability (% of region provision with integral transport accessibility).

A principal question of this sub-section is how roads affect decrease of poverty rate. The World Bank and a specialized organization under UN (UNDP) defined poverty not only as material asperity, but also as poor health and related to it little life interval and insufficient education. These three elements, meaning staring conditions and opportunities for a person to live full life, is the essence of human potential development index (HPDI) which is calculated annually by



international organizations and UN. E.g., Russia since 1997 rose up from 67 to 55 place in 1999. To-date HPDI of Russia is 0.775 (1985 – 0.826 – 24 place in the world), and the leader – Norway has 0.934. Astrakhan Region occupies according to this parameter only 32nd place among the regions of Russia (0.741). Existing network of roads as an important element of productive and social infrastructure also effects the level of population's life. *Three* aspects of direct effect of insufficient level of road network development in the Region on extermination of poverty can be marked out.

1. *Disparity of urban and rural population* is expressed in not only incomparable levels of provision with personal services (water supply, sewage), of intrans, incomes, but also in non-comparable transport conditions being a prerequisite of normal life. The latter is characterized by three most important parameters the first two of which are included in Minimum Transport Standard.

Average weighted unaccessibility of services from social secured minimum – weekly non-productive spending of time each resident of the Region has to suffer due to the lack of roads, in order to get a social secured minimum of services. Actual average weighted unaccessibility among the districts of Astrakhan Region varies from -0.324 h (i.e. there is saving of time) in Enotaevsky district to 0.683 h in Narimanovsky district (Table 5.11). As a reference point the value of average weighted unaccessibility in the MTS of 0.3 hour can be used. In all districts (except for Akhtoubinsky, Kamyzyaksky and Narimanovsky) this parameter is less than MTS parameter, i.e. we can consider that for these districts the services are not very available. In general over the Region average weighted unaccessibility of services corresponds to the recommended value of MTS according to which specific lost fund of spare time for 1 man per week should be not more than 0.5 hour.

Lost fund of spare time - summarized non-productive spending of time for obtaining of services from the social secured minimum by all residents of the Region. If the services of social secured minimum are unavailable in the districts, it results in increased respectively lost fund of spare time. Summarized lost spare time in Astrakhan Region is a bit over 19.5 thousand men-h, which is substantially less than in majority of regions in the European part of Russia. But the reason for this is not so much the quality of the road network, as efficient structure of settling.

Losses of spare time were noted in all districts, and the highest value – 66.7 thousand men-h – is observed in Akhtubinsk district (totally over all territory of the district). In five districts of the Region the value of lost fund of spare time is negative – i.e. there is saving of time due to high-quality and dense transport system.

The role of roads is especially important with respect to *unaccessibility of health care and education facilities*. If the situation with secondary education does not call any special concern, the situation with health care is more alarming, directly affecting the period of life. There is a relatively complete set of diagnostics and treatment only in the district central hospitals accessibility of which should not be over 30 min. It was noted long ago that if a rural settlement is situated at the distance over 4 km from a paved road, the level of population clinic examination on average falls 2.5 times, nearly in the same proportion chronic diseases grow and as a result death rate. Detailed investigation performed by the company Geogracom in Aktiubinsk and Atyrau Regions of Kazakhstan proved direct impact of the road network on the rate of diseases, specifically on two types of diseases: infectious, tuberculosis, as well as infant mortality.

In Astrakhan Region more statistically established dependences of disease rate and death rate for a number of diseases from the quality of the road network were revealed: on tuberculosis (0.253), infections (0.21), diseases of cardiovascular organs (0.195), cancer (0.165), as well as infant mortality. Of course, the role of roads expressed in ultimate figures is relatively small (figures in brackets evaluate precision of the model), but clearly there is a connection between them.

Compensation for poor transport and road conditions

In cases when even in the remote future a problem of transport discrimination of population will not be solved, it is reasonable to introduce compensation payments for poor transport conditions from regional (or municipal) budget (similar to allowance for poor environmental conditions of living or northern allowance). The power should be interested in the villages not to become depopulated, and if it is admitted that it is impossible to solve the problem of transport discrimination relatively soon (within one generation period, i. e. 20-25 years), then these unfavorable conditions are to be compensated. And this will be a stimulus to carry out a road program, as only upon achievement of MTS standards subsidies could be cancelled.

In Table 5.12 evaluation of possible compensations to population living in the zones of high transport discrimination is given. Such is considered the population of only those habitation areas transport accessibility of which will remain 10% worse than standard even after 2040.

There are such habitation areas only in 2 out of 11 districts in Astrakhan Region. Altogether there are 2 such habitation areas where now (as of 1.07.06) about 308 men live.

For each district, based on existing system of settling, pattern and condition of roads, ITA value of extreme level of transport discrimination will be its own (the first column). E.g., in Enotaevsky district it is 1.753 hour. And there is one settlement in it (village Kozinka situated on the opposite to the rest part of the district side of the river Volga) where 7 gainful (economically active) men live – the second and third columns. Whereas in the rest of the districts (except for Narimanovsky) there is no one settlement, as due to territorial and economic specifics of these districts, there is a wide range of standard critical ITA – from 0.561 h (Privolzhsy district) to 1.728 h (Volodarsky district), but none of settlements got beyond this scope.

The volume of compensations is formed of two components: additional tariff costs (due to remoteness of habitation areas from each other and from the strict center) and non-productive losses of spare time which adult residents (gainfully employed population) would rather spent with more use for upbringing of children, intellectual and physical development and leisure, if they lived in habitation areas where ITA would be not worse than standard. Specific cost of one hour of these losses (the fourth column) depends on average level of income (size of salary). The most expensive spare time is in gas extracting Krasnoyarsky district (104 rub.), whereas in all the rest districts it does not exceed 34 rubles.

Table 5.12

Evaluation of compensation payments to population for poor road conditions

District	1	2	3	4	5	6	7	8	9
Akhtoubinsky	1.602	0	0	29.08	0	0	0	0	0
Volodarsky	1.728	0	0	17.53	0	0	0	0	0
Enotaevsky	1.753	1 (Kozinka)	7	18.65	8.2	4.9	3.3	1,171	2.1
Ikryaninsky	1.503	0	0	22.91	0	0	0	0	0
Kamyzyaksky	1.217	0	0	18.04	0	0	0	0	0
Krasnoyarsky	1.680	0	0	104.36	0	0	0	0	0
Limansky	0.963	0	0	24.19	0	0	0	0	0
Narimanovsky	1.961	1 (Karaagash)	210	33.14	375.3	134.3	241.0	1,787	97.9
Privolzhsy	0.561	0	0	23.86	0	0	0	0	0
Kharabalinsky	1.298	0	0	19.31	0	0	0	0	0
Chernoyarsky	1.326	0	0	17.52	0	0	0	0	0
Total			217		383.5	139.2	244.3	1,767	100

Notes:

- 1- ITA with extremely high level of transport discrimination (10% worse than standard) in 2040, h.
- 2- Number of habitation areas where critical level of ITA will remain after 2040.
- 3- Number of gainfully employed population in habitation areas where ITA is worse than the critical level (in 2040), men.
- 4- Cost of 1 hour of lost spare time for one gainful resident, rub.
- 5- Total amount of compensation, thousand rub. (per month), including:
- 6- **Tariff costs, thousand rub. (per month);**
- 7- **Cost of losses of spare time, thousand rub. (per month).**
- 8- Compensation for 1 gainful man, rub. (per month).
- 9- Portion of a district from total value of compensation payments, % .



Total volume of compensation, as well as its components, is given respectively in columns 5, 6 and 7. In the majority of districts tariff component does not exceed cost estimate of spare time losses.

It should be pointed out that 97.8% of total amount of compensation falls on Narimanovsky district which is related both to a big number of population living in the area of extreme transport discrimination, and to high cost of tariff costs of gainful population with existing unfavorable system of settling (see column 9).

Finally, column eight represents values of average over the district payments counted per one gainful person living in extremely unfavorable road and transport conditions. It is supposed to pay each discriminated resident in respective settlements on average from 1,171 rub. in Enotaevsky district to 1,787 rub. in Narimanovsky district. These amounts allow making one trip per month to the district center (or other center inside or outside the district), in order to get the services from social secured minimum. By this, starting conditions of vital activity for people living on the same territory but in contrast transport conditions will be equalized.

Environment and roads

Roads effect environmental safety, first of all, through decrease of fuel consumption by motor transport, decrease of “greenhouse” gases emission and general environment pollution by motor transport. Table 5.13 shows the share of motor transport in the current and prospective environment pollution by transport. As we can see, transport produces 96.4% of all pollutants emission into atmosphere, but by 2027 it will decrease by 21.6%.

It is having no prospects to fight with a vehicle directly. Struggle for decrease of harmful impact of motor transport on environment is ambiguous.

Table 5.13

Decrease of basic environmental parameters of Minimum Transport Standard in Astrakhan Region in the process of transport strategy implementation

District	Portion of motor transport in summarized environment pollution by transport (regarding emission into atmosphere), %		
	before Strategy implementation (2005)	after Strategy implementation (2027)	Decrease of parameter, %
Astrakhan Region	96.40	75.6	21.6
Akhtoubinsky	98.6	78.8	20.0
Volodarsky	99.1	79.4	19.9
Enotaevsky	99.6	79.8	19.9
Ikryaninsky	98.2	78.4	20.2
Kamyzyaksky	99.5	82.0	17.6
Krasnoyarsky	81.8	67.9	17.0
Limansky	98.9	80.5	18.6
Narimanovsky	99.8	80.0	19.8
Privolzhsky	99.4	80.6	18.9
Kharabalinsky	99.7	80.1	19.7
Chemoyarsky	99.7	80.2	19.6

E.g., if traffic speed decreases twice, emission of carbon monoxide decreases by 17.5%, nitrogen dioxide– by 31.8%. And also decrease of the traffic flow decreases atmosphere pollution proportionally. Capacity of modernization of engines is nearly exhausted, transition to alternative types of fuel in Russia has essentially slowed down.

Under these conditions, improvement of the road network may play a big role in enhancement of natural environment. As per the data provided by NIIAT, over-expenditure of fuel



per 100 km run for the truck on unpaved road makes 17 l, compared to the trip over a paved road.

Transport noise is more of an urban problem. Losses caused by noise in well-developed countries do not exceed 2.5-3% of summarized losses due to transport, whereas atmosphere pollution gives 12% of general losses [12] (the rest of losses are caused by traffic congestion, traffic accidents, financial damages).

The global environmental problem is climate warming due to growing emission of «greenhouse» gases. The share of carbon dioxide and other «greenhouse» gases in total emission reaches 40% (in Great Britain – 27%), whereas in total transport emission the portion of CO₂ is seldom less than 70%. In connection with ratification of Kyoto Protocol by Russia, it is important to perform monitoring of decreasing the volume of carbon monoxide by each sector of economics. Table 5.14 shows transport «greenhouse gases intensity» of GRP in Astrakhan Region compared to other regions and countries.

Table 5.14

Transport greenhouse gases intensity of GDP/GRP (2004)

Country, region	Total volume of CO ₂ emission by transport, mln. t	Share of transport in total emission of CO ₂ , %	Transport greenhouse intensity of GRP/GDP, g/USD
Russia	152.5	7.94	367.5
Astrakhan Region (2006)	0.47*	0.79	140.5
Kirov Region	0.08	63.8	30.7
Tatarstan	3.24	29.0	303.0
USA	555.0	8.01	49.26
Great Britain	49.1	26.7	28.9

* With the account of companies in communication sector.

Source: Data from Administration of Technological and Environmental Supervision in Rostechnadzor of Astrakhan Region.

Saving of fuel consumption by motor transport

In compliance with Methodology of the World Bank, consumption of fuel was calculated for groups of vehicles: medium trucks, heavy trucks, cars, with the account of average traffic volume on roads of the Region (federal, territorial, departmental) - Table 5.15. As a result of implementation of the Road Development Program in the Region, saving of gasoline may make 73.9 mln. l, diesel oil – 3.7 mln. l which is essentially less than in Tatarstan and Kirov Region. This is explained by less length of the road network. Summarized saving of fuel results in direct annual profit of all road users in the amount of 70 mln. rubles annually in current prices.

Such a significant value of saving is related both to variation of the structure of vehicle fleet, and to essential changes in the quality of the road network in future.

Table 5.15

Saving of fuel consumption by motor transport

Type of fuel	Volume of fuel consumption (mln. l)		Increase of fuel consumption (mln. l)	Decrease of fuel discharge per 1 mach-km a year	Saving of fuel (mln. l)
	before Program implementation	after Program implementation			
Diesel oil	84.7	143.5	58.	0.011	3.7
Gasoline	191.3	262.8	71.5	0.045	73.9

Digression №7. Prospects of biofuel

Sales of gasoline – fuel ethanol (10% spirit (ethanol)) actively grow in the world. 10 bln. l of ethanol were produced in USA in 2005. Directive of ES establishes that by 2010 in Europe the share of biofuel should reach 12%. In the forefront today – Brazil where all gasoline is sold with the additive of fuel ethanol. The most important is that 10% additive reduces toxicity of emission by 30% [13]. And if in Astrakhan Region, same as in Brazil, all gasoline was sold with the additive, then, together with decrease of specific fuel consumption, decrease of the share of transport in total environment pollution would reach 40%.

It is common knowledge that transport (same as any economic activity) generally affects natural environment negatively. The reverse is less obvious: negative impact of nature on the work of transport. For the first time synthetic maps were developed, showing the degree of such impact – through probability of emergency situations on transport due to unfavorable natural conditions. Earthquakes, tornadoes, squalls, glazed frost, fog, snow storms, precipitations were taken into consideration. Emergency situations caused by unfavorable natural conditions can be divided in two groups:

- 1 – those which can be eliminated within three days (ES-1);
- 2 – to eliminate these it will require from three days to a year (ES-2).

Within the limits of Astrakhan Region natural phenomena dangerous for roads (frazil, blizzard, ultra low temperatures, storm) occur with probability 0.10-0.19 for ES-2 (i.e. when it requires over three days to eliminate an emergency situation).

SUMMARY:

1. Freight transportation intensity of Astrakhan Region economics exceeds average Russia values which decreases the opportunities for economic growth. However, a tendency for decreasing values of this macroeconomic characteristic, also due to development of the road network, is observed.

2. Improvement of road conditions will have most of all effect on decrease of unemployment, crime rate and a death rate resulting from traffic accidents, a well as decrease of productions cost in plant cultivation, construction, freight and passenger transportation. With respect to the districts, Krasnoyarsky and Khara-balinsky districts will get most advantages.

3. Astrakhan Region annually loses nearly 2 bln. rubles as a result of insufficient development of the road network, which corresponds to 2% GRP, whereas less than 1 % GRP (2006) is spent for roads.

4. Practical input of roads in GRP makes 2.88 %

5. After implementation of the Strategy, mobility of population with social and cultural purposes will increase at average by 20%, transport discrimination of population will disappear as a phenomena, environment pollution by motor transport will decrease by 21.6 %.

6. Saving of fuel as a result of road network improvement will comprise 73.9 mln. tons of gasoline and 3.7 mln. tons of diesel oil.

