BASIC STAGES AND TENDENCIES OF THE LAND USE DEVELOPMENT IN THE AMUR RIVER BASIN

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The Amur River basin is the great region occupying about 1800 thousands km^2, with wide diversity of natural systems and natural resources. Here, there are considerable reserves of petroleum, coal, non-ferrous metals including gold, platinum, silver, forest and land resources, water storage including hydropower, fish resources (in the lakes, rivers, storage ponds), construction materials. The various recreation resources are also available (Fig. 1).

By now, different types of land use – agricultural, forestry, industrial-transport etc. – occur in the region. The land use in Russia is understood from two points of view: in the narrow sense – it is use of lands as the major resource, largely, in the agriculture. In the large sense of the word, the land use is any use of natural resources and other kinds of the economic activities of a human related to usage of the land resources. In so doing, the land resources are used as those accompanying to one or another kind of activities. In this connection, the land resources hold a specific central position in the natural-resources systems. The use of any kind of natural resources is only possible at the simultaneous use of land resources, for example, the allotments of land for production of petroleum, coal, metal ores, for water ponds, thoroughfares, industrial engineering and settlements including cities etc. We (Baklanov, 2000) have established the following rule: in any kind of the human economic activity, a combination of several kinds of natural resources including land, water, and air ones is always used. For example, the enterprise in any industry is always using the land resources (territory occupied by the enterprise's objects) as well as air and water resources. In so doing, the land resources are most universal and geographically pronounced in the nature management.

The types of nature management are variable in time and space. On the whole, the regional nature management is determined by the peculiarities of the territorial natural and natural-resources systems as well as by the kinds of the human economic activities which are developed in the region. The combination of human activity kinds forms the territorial economy structures. Therefore, the nature management types are determined by the interaction of territorial natural-resources systems and territorial-economic structures which becomes apparent in a certain territorial structure of nature management (Fig. 2).

As to the Amur River basin region, one can identify several stages of the nature management development. The first stage took place before the demarcation between Russia and China (Aikun and Peking treaties of 1858 and 1860). Before this time, the nodal agricultural and forestry management has largely occurred and it is little different on each side of Amur River.

Fig. . The Basin of the Amur River.

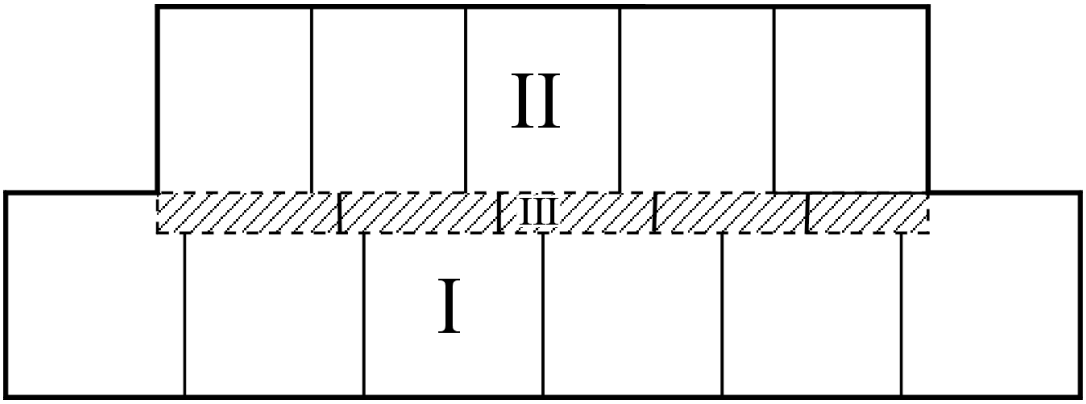

Fig. 2 Diagram of establishment of the nature management types
I – territorial natural-resources structure; II – territorial structures of economy; III – territorial structures of nature management

The second stage is 1860-1890s. After the establishment of the frontier between Russia and China – from the middle of the XIX century – more and more discriminate nature management on the Chinese and Russian territories. This was first of all caused by the essential differences in the farming and nature management culture in Russia and China as a whole. On the Chinese side, the traditional Chinese types of nature management with the specific agrotechnics, crop rotation and melioration became to concentrate and develop. For example, the traditional Chinese cultures – green bristle grass, soybean and, somewhat later, rice and maize – have predominated. On the Russian side, in the second half of the XIX century, the agriculture has been actively developed by the people migrating here from the western regions of the country: Ukraine, Central Russia, Volga region, Transbaikalia etc. In so doing, the people coming here from other geographical areas have developed the agriculture using the experience of other, largely, western regions. For example, in the plant cultivation, the cereals – wheat, rye, and oats have been predominant. Therefore, the nature management structures and types in the Russian and Chinese parts of the Amur River basin begin to more and more differ after 1860. Such the differentiated nature management within the common geographical system along the Amur River was called by us asymmetrical.

The third stage has lasted from the end of 1890s to beginning of 1920s for Russian territories and to the beginning of 1930s for Chinese one. In connection with the building of the greatest railways on the Russian territory – the Trans-Siberian Railway – and on the Chinese territory – Chinese East Railway (Transbaikalia – Harbin – Vladivostok – Port Arthur), the transport land use has appeared.

The land allotments for these railways have reached 15-20 thousands hectares each. At the same time, many settlements were established along the railways – from not great ones intended for servicing of railway to large cities (Harbin, Qiqihar etc in China; Svobodny, Birobidzhan, Spassk-Dalny, Ussuriisk in the Far East of Russia). In this connection, the industrial and building land use has become to develop which has led to the sharp growth of felling both on the Chinese and Russian territories. In Russia, this stage has been ended by the civil war while in China by the Manchuria occupation by Japanese.

The fourth stage is: 1920s – middle of 1930s in Russia and 1930s – end of 1940s in China. The peculiarities of this stage in Russia were transformations of the land tenure on the basis of development of the state centralized plan economy. The collective farms and state farms were formed in the agriculture and forestry's and timber industry enterprises in timber industry. In the Chinese regions, there was some intensification of the agriculture related to the needs of the Japanese Army etc.

The fifth stage is a period from the end of 1930s to middle of 1940s in Russia and from the end of 1940s to middle of 1960s in China.

In the Far-Eastern regions of Russia, for a period of prewar years – second half of 1930s – many new great industrial enterprises including ones of military profile were placed. For example, new great city of Komsomolsk-on-Amur has been built; the great works in Khabarovsk, Blagoveshchensk, Birobidzhan have been established. Accordingly, the population of the southern Far East has increased and agricultural and forestry land use has grown. In addition, in the second half of 1930s, the large-scale development of the north-eastern Russia has started. Their supply with the agricultural products and timber has been provided from the southern regions. This period for Chinese areas is characterized by the start of the centralized Socialist plan transformations in the agriculture and forestry – forming of communes, cooperatives etc. In the connection with the development of industry, growth in population number, the agricultural and forestry land use has developed.

The sixth stage has lasted from the end of 1940s to the mid-1970s in Russia and from the mid-1960s to the end of 1970s in China.

In the Russian regions, for this period, there has been the post-war restoration of economy, building of new mining, machine-building, woodworking enterprises and agriculture development. The population number has also grown.

Therefore, the agricultural and forestry land use for this period has enlarged. The use of mineral fertilizers in agriculture has essentially increased.

In the Chinese areas, this period is characterized by the stagnation in the land use in connection with the Cultural Revolution.

The seventh stage has been identified from the mid-1970s to the beginning of 1990s in the Russian regions while from 1980s to present day in China.

During this period, on the Russian territory, the construction of the Baikal-Amur Railway, many new railway stations, settlements, enterprises for production of construction materials was in progress. About by 500 thousands people, the population has increased due to the migrants from different regions of the USSR. In this connection, the agricultural, transport, industrial and building land use has developed. At the same time, the citizens of Korean People's democratic Republic and Cuba have carried out large-scale timber cutting.

In the Chinese regions, the large-scale changes in the agriculture in connection with the beginning of root reforms started. The land was passed to lease to the peasant families, the introduction of new agrotechnics began, the labor productivity increased. The use of chemical fertilizers rose sharply. As to the forest exploitation, the felling began to reduce in the natural forests to the point of absolute prohibition late in the 1980s. The artificial forest plantations

were considerably enlarged and, in 1990s, the felling and use of the artificial forests began to increase.

In the Russian regions, one more stage – eighth – was identified: from 1990s to this day. Under conditions of the root reforms in Russia, the former forms of the economy organization (kolkhozs, sovkhozs, goskhozs, timber industry enterprises etc.) have disintegrated for this period and have begun to arise new ones – farmer households, joint-stock companies etc. On the whole, this period is characterized by fundamental crisis phenomena in all spheres of economy, great recession (more than 2 times) in the agriculture and forestry, reduction in land use, fertilizer application, and suspension of production. Only in 2000s, a tendency towards growth, expansion and intensification in the agriculture and forestry has been revealed.

Below, the basic features of the dynamics of the agricultural and forestry land use in the southern Far East and province Heilongjiang are considered. The territory with its natural-resources and social-economic potential within which the maximum ecological and social-economic interferences of the neighboring countries and which was identified within the integrated geosystem is considered by us as the international transboundary one (Ganzei, Mishina, 2002; Baklanov, Ganzei, 2004).

To evaluate the possibilities and promises of the sustainable land use including that in the Amur River basin, it is necessary to realize the international research projects within the international transboundary territories and, thereupon, to develop the international complex programs of the sustainable development.

The changes in the agricultural land use are first of all determined by the dynamics of the rural population (Fig. 3).

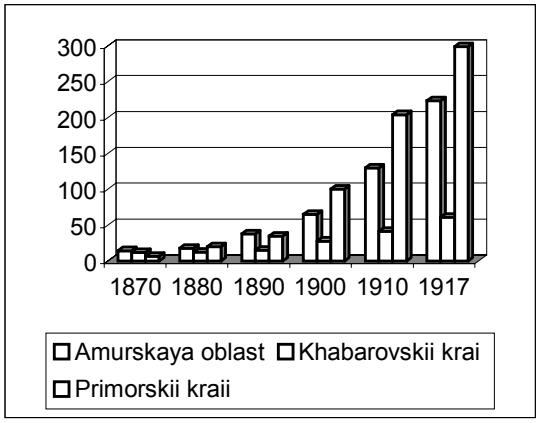

Fig.3 Dynamics of population variations (thousands people) occupied in the agriculture in the Russian part of the Amur River basin for a period of 1870-1917.

In the rural area, more than a half of total population has resided. In 1917, a weight of the rural population in the total population was 69.7% in Amur Oblast, 57.5% in Khabarovsk Krai, 58.8% in Primorsky Krai. The rate of growth of rural population for a period of 1870-1917 was 45.3 times for Primorsky Krai, 15.3 times for Amur Oblast, 5 times for Khabarovsk Krai (Tibekin, 1989). The maximum increase in population was observed before the First World War.

By 1917, the sown areas reached 545.6 thousands ha in Amur Oblast, 33.6 thousands ha in Khabarovsk Krai, 304.5 thousands ha in Primorsky Krai. Until 1879, Amur Oblast had the

major sown areas. A period of 18979 – 1900 was characterized by a growth in the sown areas in Primorsky Krai which have nearly compared with the areas of crops in Amur Oblast. However, by 1917, the sown areas in Amur Oblast have exceeded those in Primorsky Krai by 241.1 thousands ha. For this period, the sown areas have increased 58.6 times in Primorsky Krai, 37.1 times in Amur Oblast and 4.9 times in Khabarovsky Krai (Fig. 4).

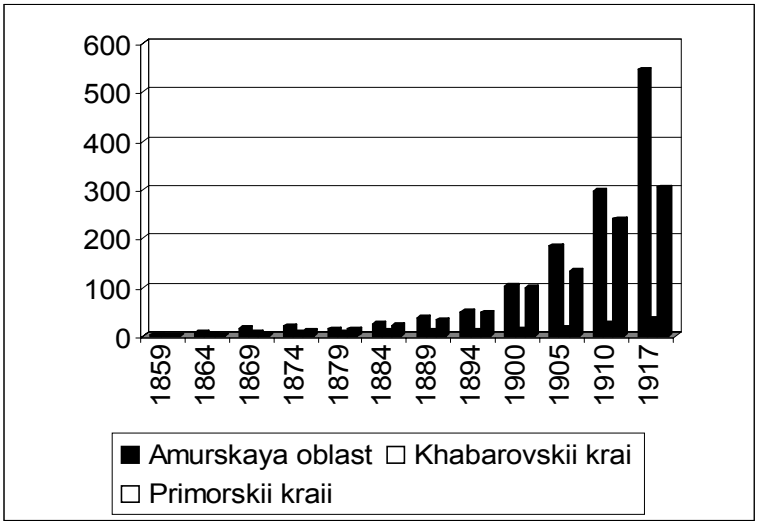

Fig. 4 Dynamics of sown areas (thousands ha) in the Russian part of the Amur River basin for a period of 1859-1917

For a period of 1870-1917, the structure of sown areas have undergone essential changes (Table 1). A position of the cereal and groats crops has decreased which is explained by the satisfaction of needs of population in bread and cereals and change-over to growing of crops being in the increased requisition.

A share of the forage crops has essentially increased: 2 times in Amur Oblast, 1.5 times in Khabarovsk Krai and 3.1 times in Primorsky Krai. To expand the sown areas, the hayfields and pastures were ploughed up. Since 1890, the oil-bearing crops began to be sown. In 1917, in Amur Oblast, 3549 ha were occupied by sunflower, 879 ha by false flax, 43 ha by soybean. In Khabarovsk Krai, 88 ha were occupied by soybean and 66 ha by sunflower. In Primorsky Krai, 15200 ha were occupied by oil flax, 8403 ha by soybean, 2061 ha by sunflower. In 1917, the oil-bearing crops in Amur Oblast have occupied 1% of total sown areas, in Khabarovsk Krai 0.5% while in Primorsky Kray 8.5%. A weight of potatoes has increased in the sown areas as follows: from 0.6 to 1.3 % in Amur Oblast, from 7.1 to 10.3 % in Khabarovsk Krai and from 1.9 to 4.1% in Primorsky Krai.

The farming system was based on the systematic ploughing-up of virgin soils, withdrawal from use and converting to fallow ones of lands used for long, application of fallow land and winter tillage, alternation of crops. Early in the XX century, the decisions were made in all of peasant households which limited a period for fallow lands which reached three to seven years. During 1945-1965, a growth in the sown areas of all crops was noted (Fig. 5).

Table 1 Structure of sown areas (in %) in the Russian part of the Amur River basin for a period of 1874-1917

Crops	Amur Oblast			Khabarovsk Krai			Primorsky Krai		
	1874	1890	1917	1874	1890	1917	1874	1890	1917
Cereal and groats crops including	78,8	67,2	55,2	68,1	64,3	54,7	85,7	71,8	50,5
wheat	12	24,8	52,5	13,9	19,8	39,4	10,2	26,3	30
rye	45,1	32,7	1,2	32,7	32,3	4,0	1,0	22,0	1,9
buckwheat	21,7	6,5	0,9	19,2	10,7	8,6	6,4	12,7	11,8
Fodder grain	19,7	29,3	39,7	20,7	27,9	31,3	10,6	21,9	33,3
Including oats	19	27,4	39,4	18,8	25,2	30,1	8,6	18,8	32,1
Oil-bearing crops	0	0,6	1,0	0	0,4	0,5	0	1,3	8,5
Including soy-bean	0	0	1,3	0	0	0,3	0	0	2,8
Potatoes	0,6	2,1	0,5	4,9	4,9	10,3	1,9	2,9	4,1
Truck crops	0,9	0,8	2,3	2,5	2,5	3,2	1,8	2,1	3,6
Forage crops	0	0	0	0	0	0	0	0	0

Fig. 5 Dynamics of sown areas of all crops for a period of 1940-1965 (thousands ha). Black color is the South of the Russian Far East, white one – Far East.

In 2001, Primorsky Krai, Khabarovsk Krai and Amur Oblast have produced 63.4 % of total output of the Far-Eastern Federal Region agriculture. In 2001, after a quite long stagnation period in the output of agricultural products, a rising was outlined in the southern Far East. This shows the indices of the physical volume of agricultural products. As compared with 2000, a growth in Primorsky Krai is 116%, in Khabarovsk Krai 106%, in Amur Oblast 107% and in Jewish Autonomous Region 109%. In all of these regions, a growth was mainly reached due to a rising in production of plant growing industry (Regions of Russia, 2002). In 2002, the sown areas in the southern Far East were 1289.9 thousands ha and 25.5 (or 327.7 thousands ha) of them were occupied by soybean, 11.6 % (or 149.5 thousands ha) by wheat, 9.1 % (or 117 thousands ha) by potatoes, 2.5 % (or 32.1 thousands ha) by vegetables while

areas occupied by maize reached 7.4 thousands ha or 1.3 %. Rice was grown only in Primorsky Krai and its sown area were 6.5 thousands ha or 0.5 % of the whole sown area in the southern Far East.

The most sown areas are in Amur Oblast (695.5 thousands ha), Primorsky Krai ranks next to it (448.1 thousands ha), and further are Khabarovsk Krai (102.6 thousands ha) and Jewish Autonomous Region (79.7 thousands ha).

BASIC FEATURES OF THE FOREST EXPLOITATION DYNAMICS

Amur Oblast is one of the major forest regions of the southern Far East entering into the Amur River basin. In many respects, the history of the forest exploitation of this region reflects the problems of the forest exploitation of the Russian part of the Amur River basin.

Quick development of the gold-mining industry, river navigation and, then, the construction of the Trans-Siberian Railway late in the XIX century have demanded a significant amount of timber. There has been intense disafforestation along the floatable rivers, roads, gold-mines and dwellings. Early in the XX century (until 1917), in addition to the intense development of the Zeya-Bureya lowland, the felling has begun within the sub-mountain areas and along the valleys of great tributaries of Amur River – Zeya River and Bureya River. The dynamics of forests for a period of 1910-1917 is given in Table 2.

Table 2 Forests' area in Amur Oblast and delivery of timber for a period of 1910-1917 (Yaborov, 2000).

Total area	Area of forests, thous. ha	By major species, thousands ha					Including exploited ones, thousands ha		
		Korean pine	pine	larch	Spruce, fir	deciduous	Area, thous. ha	Delivery of timber, thousands m^3	
								actual	possible
35247,1	23186,9	607,5	1664,7	9997,7	1504,6	8849,6	2654,7	1472,8	14261,8

As a result of a disorderly felling, the forest resources within the most developed southern part of Oblast were seriously undermined.

A period of the Civil War (1918-1922) was characterized by the uncontrolled felling. By the early 1923, a realization of timber of the state forests has reduced to the least amounts and reached 11 thousands m^3.

Period of 1923-1940 was characterized by the enactment of a number of laws and declaration of forests in which the major rules of forest exploitation in the southern Far East territory were regulated. Until 1925, the felling was carried out free of charge, then the tariffs of forest exploitation were introduced. From 1923, the industrial logging began. However, forests were exploited irrationally and, mainly, along the floatable rivers, within a zone of 2-2.5 km wide. The major share of felling has fallen at such species as pine and larch. By 1930,

the forestries became to be established which harvested a timber in the areas distant from the railways.

A period of 1941-1953 was characterized by intensification in timber production and felling. Especially, the logging has increased during the post-war period. By the end of 1945, the logging in Oblast has reached 1.5 millions m^3.

A period from 1965 was characterized by the most intense development of forestry of Amur Oblast.

By 1965, investments to the forestry have increased 2.5 times. For a period of 1966-1975, the forest recreation operations have increased 2.5 times and reached 255.3 thousands ha. In 1975, the logging has been 79.5 thousands m^3, i.e. 2 times more than in 1965. A dynamics of forest valuation indices in Amur Oblast is presented in Table 3.

Table 3 Dynamics of the average indices of forest valuation in Amur Oblast for a period of 1966-1998 (Yaborov, 2000; 2003).

Indices	1966	1973	1978	1983	1988	1993	1998	2002
Area covered by forests, mil ha	19351,9	19948,0	20851,2	21244,2	21777,0	21852,9	22460,1	22551,8
Total average increase, mil m^3	25,47	24,07	27,20	26,96	27,51	26,71	26,91	28,89
Average increase of area covered by forests per 1 ha, m^3	1,34	1,23	1,40	1,39	1,38	1,36	1,20	1,28
Average age, years	84	83	85	70	80	79	77	77
Average stock per 1 ha of area covered by forests, m^3	108	94	97	98	97	89	89	89
Average stock per 1 ha of mature and overmature forests, m^3	134	128	132	133	131	130	130	130

The area of forests in Amur Oblast for this period has increased by 3199.9 miln ha. The total average growth has reached 3.42 millions ha. It should be also noted that the average stock of timber per 1 ha of mature and over mature forests remained a quite high – 130 m^3/ha although it reduced by 4 m^3. And that is the case, in spite of the fact that the logging volumes for a period of 1960-1990 have steadily grown (Fig. 6) and reached in 1990 6643 thousands m^3. As before, the most valuable species – pine, larch and spruce – have been subject to the maximum exploitation.

Table 4 presents a dynamics of variations of the design cutting area in Amur Oblast.

At present, the forests in the southern Amur Oblast near the Amur River, Zeya River, Bureya River and along the Trans-Siberian Railway have lost their economical and ecological potential as a result of their long-term exploitation.

On the conservation of the Oblast's forest resources, the forest fires have a profound effect (Table 5).

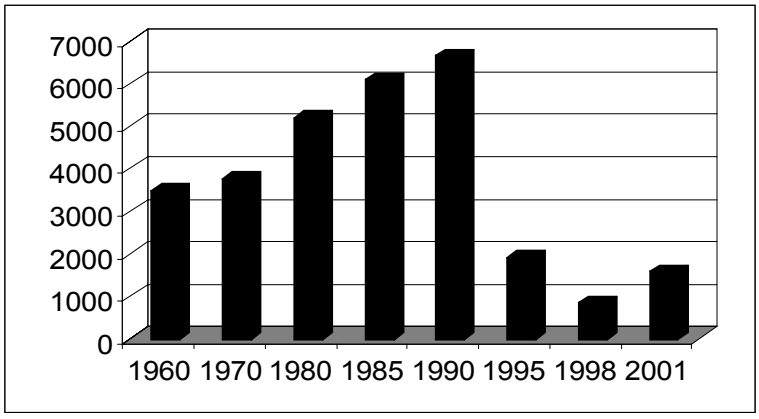

Fig. 6 Volumes of logging (thous. m^3) in Amur Oblast for a period of 1960-2001 (according to data of Yaborov, 2000; 2003)

Table 4 Dynamics of the design cutting area variations (thous. m^3) in Amur Oblast. for a period of 1960-2000 (Yaborov, 2003)

Year	Design cutting area				Actual felling				Usage level, %			
	Total	Including			Total	Including			Total	Including		
		Conifers	Hardwood	Softwood		Conifers	Hardwood	Softwood		Conifers	Hardwood	Softwood
1980	11494	7798	200	3496	4801	4544	13	239	41,8	58,3	6,5	6,8
1985	10915	7663	200	3052	5695	5320	51	324	52,2	69,4	25,5	10,6
1990	10915	7663	200	3052	6057	5572	18	467	55,5	72,7	9,0	15,3
1995	15838	11555	53	4230	1715	1595	2	118	10,8	13,8	3,8	2,8
2000	160039	11755	53,4	4231	1253	1147	0,4	105	7,8	9,8	0,7	2,5

Table 5 Dynamics of combustibility of the Amur Oblast's forests for a period of 1949-1998 (Yaborov, 2000).

Indices	1949-1954	1955-1964	1965-1974	1975-1984	1985-1994	1995-1998	Total
Quantity	1893	2341	4452	3993	3769	1345	17793
Area of fires, thousands ha	330	239,8	136	201,5	226	205	1338
Average area of 1 fire, ha	227	24	28	50	60	152	75
Average number of fires a year	315	234	445	399	377	338	356

For a period of 1949-1998, 177793 fires took place on the Amur Oblast territory which has touched upon a total area of 1338 thousands ha of forests. On the average, during this period, 356 fires with an average area of 75 ha have occurred every year. A peak of fires has fallen at 1951, 1954, 1960 and 1964 and this was related to the dry years. The building of the Baikal-Amur Railway has also resulted in the growth of the number of fires. The basic cause of fires, in addition to natural one, is the fire method of removal of the last year's grass from the hayfields and pastures. Uncontrolled agricultural burns at present are the major source of forest fires in the southern Far East.

Particular emphasis is placed on the forest recreation works in Amur Oblast (Fig. 7). A beginning in these works on an industrial scale has been made in 1948. However, in so doing, the forest recreation works were limited by insufficient development of nursery forests. The young pines were mainly planted, the attempts were made to plant Amur cork-tree, poplar, The latter has been mainly used for landscape gardening in the settlements. Basic objects of the forest recreation are oak-woods, birch woods and aspen forests.

In all, in Amur Oblast, 218.1 thousands ha of the forest plants were covered with the forest recreation work. Of them, 89% were planted with pine, 9% with larch, 2% with spruce and fir and less than 1% were planted with Amur cork-tree and poplar.

It should be noted that, for a period of 1910-1966, the forest area in Amur Oblast has reduced 1.8 times while for a period of 1910-2002, 1.6 times. During 1966-2002, an increase in the forest area by 3399.9 millions ha or 1.2 times was observed. In the last years (from 1995), a growth in the forest area of Amur Oblast was related to two major causes: reduction in the logging volumes and intensification of natural processes of growing-over of the unused arable lands. As of January 1, 2002, 2251.8 thousands ha of 36191.3 thousands ha of the Amur Oblast territory are covered with forests and percentage of forest land is 73.8%.

Fig. 8 presents a dynamics of forest area of Amur Oblast for a period of 1910-2000.

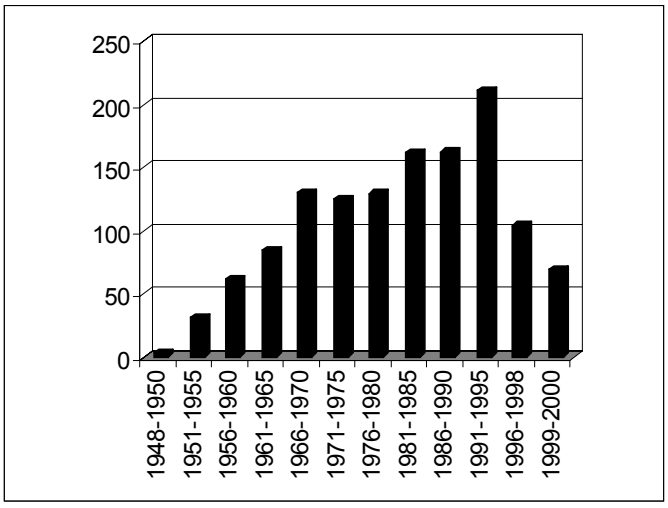

Fig. 7 The forest recreation works (thousands ha) in Amur Oblast for a period of 1948-2000 (Yaborov, 2000)

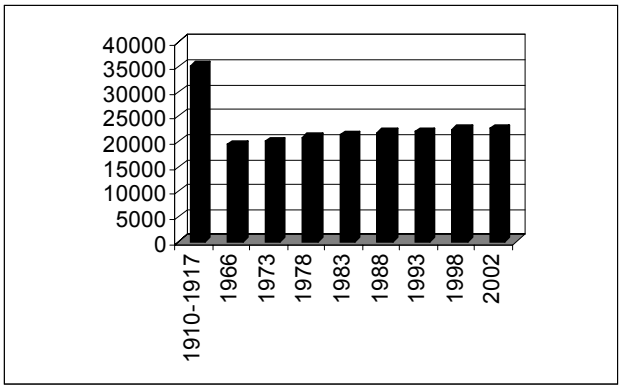

Fig. 8 Dynamics of forest area (thousands ha) of Amur Oblast for a period of 1910-2003.

COMPARATIVE CHARACTERISTICS OF THE BASIC INDICES OF LAND USE IN THE RUSSIAN AND CHINESE PARTS OF AMUR RIVER BASIN AT THE CURRENT STAGE OF LAND USE

The forest area of the southern Far East (according to the account data for 1998) has exceeded the similar index for province Heilongjiang (2000) 4.6 times (Table 6). In so doing, it should be noted that the forest area in both regions compared has increased. In province Heilongjiang, this took place due to active policy of the forest recreation (average annual increase for a period of 1995-2000 was1.078 mil ha). In the southern Far East, the major contribution is made by natural growing-over of unused lands and forest recreation (in 2001, the forest recreation works were carried out on 189 thousands ha). For 1993-2000, the forest area has increased by 15.9 miln ha in Khabarovsk Krai, by 70 thousands ha in the Jewish Autonomous Region, by 801 thousands ha in Amur Oblast. In Primorsky Krai, from 1993 to this day, the forest area has increased by 342 thousands ha. On the whole, the percentage of forest land for the southern Far East exceeds that of province Heilongjiang by 22%. A total stock of timber in 2000 in the southern Far East was 9 billions m^3. A level of using the design cutting area in the southern Far East is not high and varies from 8.4% in Jewish Autonomous Region to 26.8% in Khabarovsk Krai. In recent years, a not great increase in using the design cutting area is observed in connection with increased export volume to China. In 2000, in province Heilongjiang, 6.9 mil m^3 of timber and 314 thousands m^3 of saw-timber were produced. In the southern Far East, 8.7 mil m^3 of timber and 443.8 thousands m^3 of saw-timber were produced.

In Fig. 9, data of the population density in the districts of province Heilongjiang located along a border and local administrative districts of the southern Far East are given.

The farming industry in province Heilongjiang exceeds essentially that of the southern Far East in indices. It should be noted that the priority importance is attached to the agriculture development. It is interesting that the area of agricultural lands in the districts located along a border reduces in the last few years (see section “Dynamics of the farming industry in province Heilongjiang”). However, if a change of the province Heilongjiang agricultural land structure is analyzed for a period of 1995-2000, it should be noted that an increase in the sown areas of all crops by 682 thousands ha took place.

In the southern Far East, this index has decreased by 588 thousands ha for this period of time. As of 2000, the sown area of crops in province Heilongjiang exceeds those in the southern Far East by 8 millions ha. The area of arable lands in province Heilongjiang has increased by 622 thousands ha while that of pastures by 1.02 mil ha. In the Krais and Oblasts of the southern Far East, negative tendencies of changing indices are noted for the same period. So, for example, the area of arable land in Primosky Krai has reduced by 141.2 thousands ha while pastures by 180.1 thousands ha. The indices in Jewish Autonomous Region have decreased by 48.7 and 129.2 thousands ha respectively.

The efficiency of the sown areas using in province Heilongjiang and in the southern Far East one could judge from the crop capacity. In 2000, the productivity of soybean in province Heilongjiang was 15.7 centers/ha while that in the southern Far East 9.7 centers/ha. The wheat capacity is 16.2 centers/ha in province Heilongjiang and 9.7 centers/ha in the southern Far East. The productivity of rice in Primorsky Krai was 18.6 centers/ha while in the neighboring group of districts Jixi it was 81.4 centers/ha. On the Russian territory, the productivity of potatoes was 110.2 centers/ha and it was 5.3 times higher than in province Heilongjiang (20.7 centers/ha).

The higher productivity of crops in province Heilongjiang is explained by not only high farming standards and skill of the Chinese farmers but also by the high level of fertilizer application. If total volumes of fertilizer application (214.7 kg/ha in Primorsky Krai, 315 kg/ha in Jewish Autonomous Region) in the Far East are close to those in province Heilongjiang (301 kg/ha) then, as to application of mineral fertilizers, a gap is very great.

In province Heilongjiang, 130.3 kg/ha of mineral fertilizers, on the average, are applied while in Primorsky Krai 6.0 kg/ha, in Amur Oblast 6.4 kg/ha and in Jewish Autonomous Region 15 kg/ha. It should be noted that, as for the number of tractors used per 1000 ha of sown areas, Krais and Oblasts of the southern Far East exceed an average index of province Heilongjiang. This index in Primorsky Krai is equal to 12.3 tractors per 1000 ha, in Khabarovsk Krai – 16.4 and in Amur Oblast 9.8 tractors per 1000 ha. This index in province Heilongjiang is 8.1 tractors/1000 ha.

The main tendencies of land-use dynamics in Amur River basin are shown in table 7.

Table 6 Ratio of indices of province Heilongjiang and subject of the southern Far East of Russia in 2000

	Sout-hern Far East	province Heilong-jiang	Sout-hern Far East / province Heilong-jiang	Primorsky Krai/ province Heilong-jiang	Khabarovsky Krai/ province Heilong-iang	Amur Oblast/ province Heilong-jiang	Jewish Autonomous Region/ province Heilong-jiang
Area, thousands km^2	1354,2	454	3,0 ratio 3,0 : 1	0,37 ratio 1 : 2,7	1,74 ratio 1,7 : 1	0,80 ratio 1 : 1,2	0,08 ratio 1 : 12,6
Population (thousands people)	4897,4	38070	0,13 ratio 1 : 7,7	0,06 ratio 1 : 17,5	0,04 ratio 1 : 25,1	0,03 ratio 1 : 37,8	0,01 ratio 1 : 191,3
Population density, people/ km^2	3,6	83,9	0,04 ratio 1 : 21,5	0,16 ratio 1 : 6,4	0,02 ratio 1 : 44,2	0,03 ratio 1 : 30,0	0,07 ratio 1 : 15,3
GRP, $ billions*	5,91	39,33	0,15 ratio 1 : 6,6	0,06 ratio 1 : 16,5	0,06 ratio 1 : 15,9	0,02 ratio 1 : 40,2	0,004 ratio 1 : 278,6
Forest area**, thous. ha	87829	19190	4,58 ratio 4,6 : 1	0,59 ratio 1 : 1,69	2,74 ratio 2,7 : 1	1,17 ratio 1,2 : 1	0,08 ratio 1 : 12,5
Sown areas, thous. ha	1289,9	9329,0	0,14 ratio 1 : 7,2	0,05 ratio 1 : 20,8	0,01 ratio 1 : 90,9	0,07 ratio 1 : 14,1	0.01 ratio 1 : 117,1
Motor road density,*** km/1000 km^2	28,3	106,9	0,26 ratio 1 : 3,8	0,40 ratio 1 : 2,5	0,06 ratio 1 : 17,0	0,18 ratio 1 : 5,6	0,42 ratio 1 : 2,4
Railroad density, km/10000 km^2	73	159,2	0,46 ratio 1 : 2,2	0,59 ratio 1 : 1,7	0,18 ratio 1 : 5,5	0,52 ratio 1 : 1,9	0,54 ratio 1 : 1,9

- * - rates of exchange in 2000: $ 1 = 28,05 rubles; $ 1 = 8,27 Yuan; 1 Yuan = 3,364 rubles

** - forest area for the southern Far East is based on 1998 inventory

*** - motor roads with hard surface

Data source: RF State Statistical Committee, 2002 a, b; RF Ministry of Natural Resources, 2003; Amur Oblast Statistical Committee, 2002; Primorsky Krai Statistical Committee, 2001; Khabarovsky Krai Statistical Committee, 2001; China statistics press, 2001.

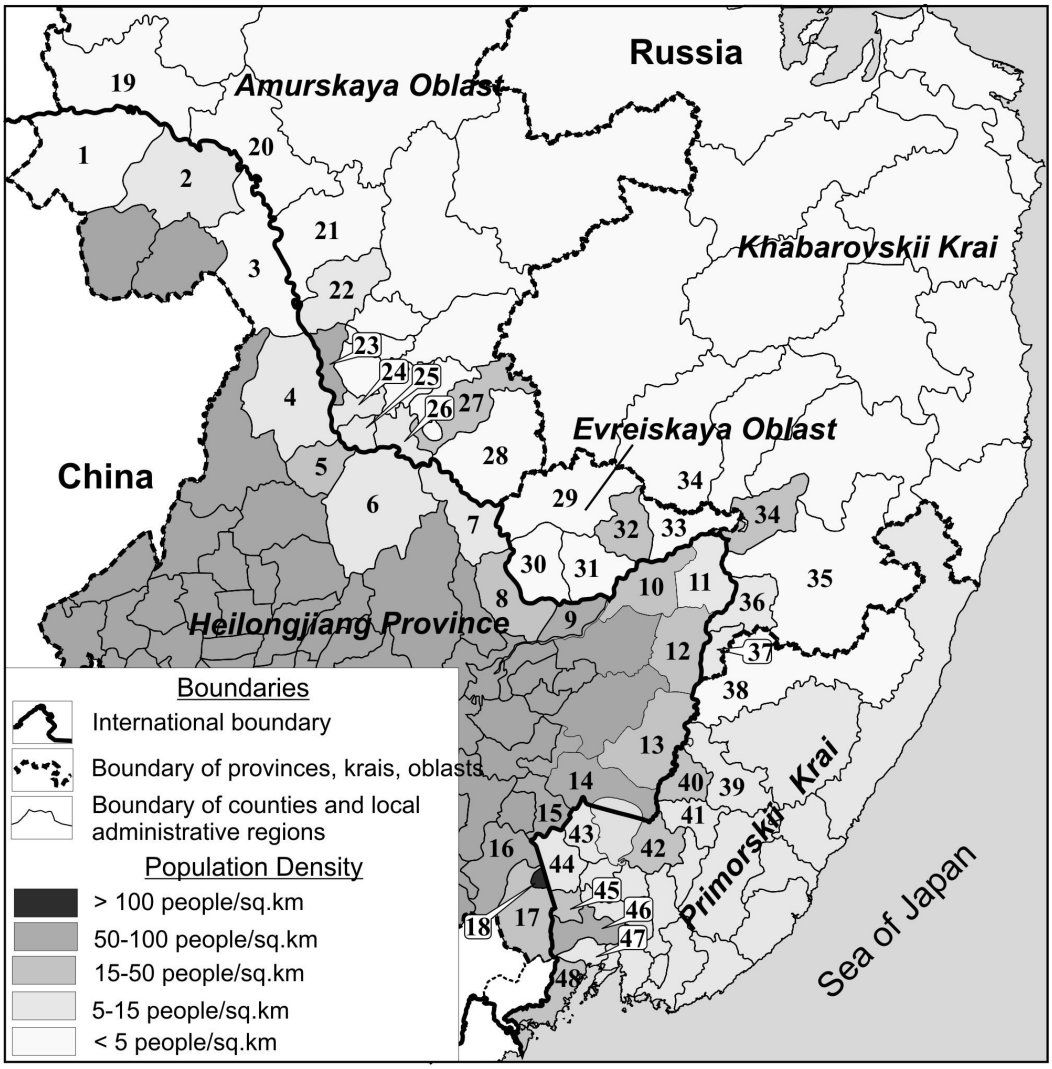

Fig. 9 Population density in the districts of province Heilongjiang located along a border and local administrative districts of the southern Far East in 2000

Table 7. The main tendencies of land-use dynamics in Amur River Basin (Russian and Chinese sides)

Land-use type	The main tendencies of changes in the long term
Agriculture	Small growth of the areas in the Chinese and Russian regions. Growth of intensification, including usage of fertilizers
Forest management	Small increasing of timber harvest of natural forests in the Russian regions and timber harvest of planted forests in Chinese regions. Planted forests increasing in the Chinese and Russian regions. Growth of another forest resources usage - in the Russian regions.
Transport	Increase of areas, which will be retracted under transport communications: oil pipelines, gas pipelines, highways.
Industry	Considerable growth will not expect. Modernization of modern enterprises will be more active in both regions.
Cities and Rural settlements	The growth due to reconstruction of housing and increasing of individual building construction in Chinese and in the Russian regions.

CONCLUSIONS

Thus, the major types of land use in the Russian and Chinese parts of Amur River basin are agricultural and forestry ones. The same kinds of land use are basic factors transforming the natural and natural-resources systems in the Amur River basin. In the analysis of these transformations, we proceed from the assumption that the Amur River basin, on the whole, is the greatest integrated geographical system (geosystem, ecosystem). The natural and ecological processes being in its individual parts (territories) are closely interconnected. In this case, the technogenic effects and changes in some parts cause changes in other parts of geosystem. In this connection, the integrated natural geosystems crossed by the frontier are considered by us as the specific transboundary geosystems perceiving different technogenic pulses of dynamics in different countries and suffering their interference throughout the geosystem. In the similar transboundary geosystems, the asymmetric (different on each side of the frontier) and asynchronous (with different dynamics tendencies) changes, structural transformations take place.

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