THE GEOGRAPHICAL ANALYSIS OF THE TRANS-BOUNDARY TERRITORY (PRIMORSKII AND KHABAROVSKII KRAIS OF RUSSIA – HEILONGJIANG PROVINCE OF CHINA)

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The rational land use and coordination of the nature resources management are the important conditions for the ecological and economical safety of the near-boundary territories of neighboring countries. It has especial meaning when natural environment of such countries are ecologically connected, for example, in one trans-boundary watershed. The Amur River watershed including a significant portion of the southern part of the Russia Far East, northern and northeast regions of China is a very interesting and important object for geographical studies.

Wide complex researches of the Amur River basin were conducted on the national level in 1956 by joint forces of the Amur expedition of the USSR Academy of Sciences and the Heilongjiang expedition of the People's Republic of China (Nikol'skaya, Chichagov, 1957). The joint studies of the Russian-Chinese trans-boundary territories were proceeded only in the 1990s at regional and sub-regional level. The water basins of Lake Khanka (Kachur et al., 2001) and the Ussuri River (A sustainable land use., 1996) were the subjects of studies. These researches were directed to the transboundary diagnostic analysis of the study areas to organize the rational land use and to create its sustainable development programs.

Our work is directed towards the study of the trans-boundary territory at a local level. We analyzed the cartographic and literature materials characterizing the natural-territorial complexes and their separate components (relief, soils, vegetation, climate, hydrography) on the near-boundary territories of the Russian Far East and North-East China. It allowed us to identify 8 transboundary geo-systems of the regional level – physical-geographical provinces. They present the natural complexes integrated in the structural-dynamic and functional respects but separated by the state border (Ganzei, Mishina, 2002; Ganzei, 2004).

Since the parts of these geo-systems are situated in the countries with different social-economic, demographic, ecological indices, cultural and economic traditions, the natural environment on each side of the border changes in a different degree. Therefore, the main aim of our research is the geographical analysis of the trans-boundary geo-system's environment and landscapes transformations resulted from anthropogenic impact which is different on the Chinese and Russian territories.

The subject of our investigation is the Bikin-Vandashan trans-boundary geo-system. This geo-system is low-mountain block-folding with intrusive massifs, with broad-leaved and coniferous-broad-leaved forests on brown mountain-forest and brown mountain-forest podsolized soils. The area of the whole geosystem is about 19 thousands km^2. The Ussuri River divides the geosystem into two approximately equal parts.

The state of natural environment is in many respects determined by the dynamics of anthropogenic using of the land, forest, water and other natural resources in the course of economic development of the territory. The natural statistical data on resources are organized by the units of the administrative-territorial division. Therefore, we study the Bikin-Vandashan trans-boundary geosystem environmental impact within the local level administrative units, on the territory of which it is located. We consider these adjacent units as the Bikin-Vandashan trans-boundary territory or the integral natural-economic object. This transboundary territory includes Pozharskii raion of Primorskii Krai, Bikinskii and Vyazemskii raions of Khabarovskii Krai on the Russian side. The Zhaohe and Baoqing counties of the Shuangyashan region and Hulin county of Jixi region of Heilongjiang province form the Chinese part of the territory (Figure 1).

Figure 1. The Bikin-Vandashan Trans-boundary Geo-System and Territory

To study the economical utilization of the transboundary territory we use physical-geographical and economic thematic and complex maps, statistical materials, references and the remote sensing data (Ladsat-5 and Landsat-7 scenes). The comparing of various data of different years make it possible to carry out the comparative spatial-temporal analysis of land use development both in Russia and in China and to reveal peculiarities of resources use within border territories of each country.

The distinctive feature of land use development in the Ussuri River watershed is that until the middle of the last century its Russian part in the middle and low current has been more involved in economic activity and was more exploited than the Chinese one. Since the

mid-1950s the situation has changed for the opposite one and the present social and economic situation points to significant disbalance in intensive use of natural resources of trans-boundary territories.

The demographic situation is one of the main factors determining the scales of the anthropogenic action on the territory. In the middle current of the Ussuri River by the late 1930s the absolute population and its density in the Russian territory were much higher (Glushakov, 1948; Urban and rural population.., 1971; Urban and rural population.., 1976). By the late 1950s the Chinese part was already leading in the absolute population, and average indices of population density in districts and counties became almost equal. For a period of the next 50 years, the population on the Chinese territory increased about 7 times while on the Russian one only 1.5 times. It is resulted in the fact that by 2000 a difference in number and density of population has considerably increased (Table 1). During the last 10-15 years the dynamics of the population in the Russian boundary territory remains negative, in the Chinese one - positive.

Table 1

Population Dynamics of the Bikin-Vandashan Trans-boundary Territory

Administrative Formations	Area (km^2)	Population (thous. persosns)			Population Density (persons / km^2)		
Raions		1959	1995	2000	1959	1995	2000
Pozharskii	22570,4	13,0	37,9	36,6	0,6	1,7	1,6
Bikinskii	2500	21,5	29,1	27,4	8,6	11,6	11,2
Vyazemskii	4300	38,5	30,0	29,1	9,0	7,0	6,8
Counties		1955	1995	2000	1955	1995	2000
Hulin	9329	41,6	289,0	301,1	4,3	31	32,3
Baoqin	9968	72,3	405,0	424,2	7,2	40,6	42,5
Zhaohe	6613	11,4	130,0	137,8	1,9	19,6	20,8

Data: U Chuan-Tsjun et al., 1957; Primorskii Krai on the border.., 2001; Socio-economical situations.., 2001; Heilongjiang statistical yearbook, 1996, 2001; Helongjiang agricultural atlas, 1999.

In the second half of the 20^{th} century, the economic development of the transboundary territory became more intensive, especially, in the Chinese part. By 2000 in 5 of 6 administrative formations of the Bikin-Vandashan trans-boundary territory the agrarian specialization was retained. The industry prevails in production volume only in the economy of Pozharskii raion of Primorskii Krai. Industry of the Russian and Chinese territories have several common features such as the development of the same branches of manufacturing (food, light, wood and wood-working, building materials) and industries' orientation to the local raw and markets.

More intensive economic use of the Chinese part of the trans-boundary territory can be illustrated by such bigger indices like the cultivated lands, the crop capacity of all cultures excluding potatoes, consumption of chemical fertilizers, total number of live-stock, length and density of transport ways, gross output value, and other. On the Chinese territory these indices are more than in the Russian territory both in absolutely and relative calculations. Some of those social-economical indicators in calculating per area unit directly or indirectly characterize an environmental impact. The table 2 illustrates the differentiation of the

economic use intensity of the Chinese and Russian territories on each side of the boundary in 2000.

Table 2

Certain Socio-Economic Indicators for Bikin-Vandashan Trans-boundary Territory

Indicator	Counties			Raions		
	Hulin	Baoqin	Zhaohe	Bikinskii	Vyazemskii	Pozharskii
Population Density, people/km^2	32,2	42,5	20,8	11,2	6,8	1,6
Gross Output Value of Industry*, $1,000 / km^2	7,8	4,9	1,3	0,8	0,8	1,8
Highway Density, km / 1000 km^2	155	141	147	84,4	65	12
Gross Output Value of Forestry, $1,000 / km^2 non-arable lands	314	243,8	83	–	–	71
Gross Output Value of Agriculture, $1,000 / ha arable lands	1,1	0,8	0,5	0,7	1	0,5
Gross Output Value of Farming, USA doll. / ha arable lands	909	659	396	364	531	308
Gross Output Value of Animal Husbandry, USA doll. / ha arable lands	197	94	71	376	425	200
Number of Cattle, head / km^2	0,9	1,7	0,5	1,4	1	0,1
Chemical Fertilizer, kg / ha arable lands	86,8	111,4	94,2	49,4*	49,4**	7,7***

* - industrial GDP of the counties includes construction's income

** - average meaning of Khabarovskii Krai

*** - average meaning of Primorskii Krai

Data: Agriculture of the Primorskii Krai, 2003; Primorskii Krai on the border.., 2001; Socio-economical situations.., 2001; Heilongjiang statistical yearbook, 1996, 2001.

Land-use allocation maps of the Bikin-Vandashan trans-boundary territory were provided from deciphering satellite images Ladsat-5 (1989-1991) and Landsat-7 (1999-2001) at scale 1:1000,000. They show that Russian and Chinese parts of territory have the same types of land-use (agricultural, forest, industrial, settlement, transport). The main differences are connected with the more wide distribution of agricultural lands in the Chinese territory (Table 3). Arable lands occupy practically all flat territories here. The share of improvement lands is considerable. On the Russian territory the arable lands are also partly located on the improved soils. Here however the land-improvement systems are deserted and not used basically, while on the Chinese territory the changing of swamps and damp meadows continuous. Considerable territories were begun to be agriculturally used between 1990 and 2000 in watersheds of the Tsisinhe, Naolihe, Mulinhe, Abutsinhe, Tsihulinhe rivers. Cultivated areas occupy the clear-cutting slopes of different altitude if there are no virgin

lands. The large clear-cutting territories under croplands are in the old development regions with high population density such as southern and western parts of Baoqin county, north-west part of Jaohe county.

On the Russian territory forest exploitation and forestry are the most widespread types of land-use. Arable lands have small sizes and frequently are combined with other types of agricultural lands, meadows, bushes, forests. On the Chinese territory such land's complexes are located in the mountainous river valleys. During the last 10-15 years the agricultural land-use on the Russian territory has changed a little because of the difficult economical situation and demographic crisis.

Table 3

Land Use of the Bikin-Vandashan Trans-boundary Territory

Type of Land Use	1990				2000			
	Chinese part		Russian part*		Chinese part		Russian part*	
	km^2	%	km^2	%	km^2	%	km^2	%
Total Area	25910	100	14303	100	25910	100	14303	100
Forest (including sparse grows)	9450,4	36,5	10370	72,5	8053,7	31,1	10377	72,6
Bushes, grasses, wetlands	4236,7	16,4	2871,4	20,1	2455,2	9,5	2907,3	20,2
Wetlands and damp meadows in the begining of improvement	1008	3,8	–	–	359,8	1,4	–	–
Agricultural areas:								
arable lands	5248	20,3	927,6	6,5	6313	24,3	881	6,2
improvment arable lands	5915	22,8	50,6	0,4	7521,2	29,1	44,6	0,3
Clear-cutting areas (mainly using like arable lands)	27,4	0,1	–	–	1062,1	4,1	–	–
Mining lands	–	–	62,4	0,4	–	–	71,1	0,5
Areas for different use	24,5	0,1	21	0,1	145	0,5	22	0,2

* - including Bikinskii and Vyazemskii raions at hole, and the most settled and economically developed western part of Pozharskii raion (7503 km^2)

The Bikin-Vandashan trans-boundary geo-system mainly presents mountains of different altitude with forests cover. The development of timber industry causes transformation of vegetative formations as a result of forest felling. On the Chinese territory it happens in different type's forests and has clear-cutting character. On the Russian territory the selective felling of different intensity is mainly observed in coniferous-mixed and coniferous forests.

For the analysis of the Bikin-Vandashan trans-boundary geosystem's present land cover the more detail deciphering of the Landsat-7 satellite images was conducted at scale 1:500 000. In the figure 2 the map's fragments are presented. Its analysis allowed us to dedicate some features of vertical and horizontal distribution of the basic types of vegetation and lands on the latitudinal profiles**.**

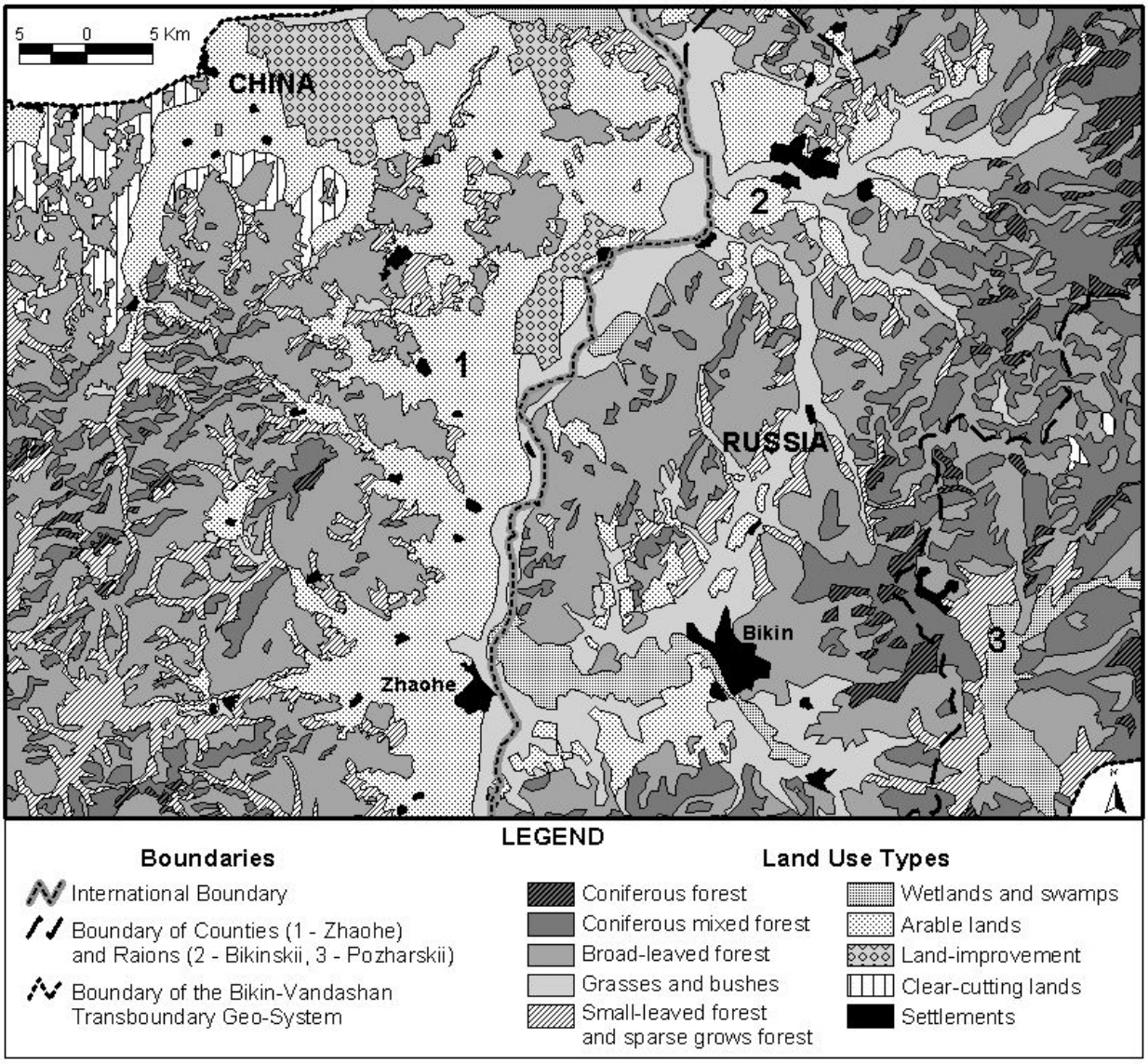

Figure 2. Land Use of the Bikin-Vandashan Trans-boundary Geo-System in 2000 (fragment)

On the Chinese territory, the deciduous forests and sparse grows forests with undergrowth are predominant types of vegetation. The coniferous-mixed forests and small patches of coniferous forests occupy here mainly the highest parts of northern and western slopes, and tops. On the Russian territory the wood vegetation – deciduous and coniferous-mixed – prevail, a share of coniferous forests remains quite high.

For the Chinese territory more considerable differentiation of the vegetation cover is characteristic. Small-sized land patches of different types are combined on small areas. The greater areas of similar sections and lesser mosaic structure of their combinations are typical on the Russian territory.

On the Russian territory, more regular distribution of vegetation and types of land use on altitude levels (for example, agricultural lands and meadows in plains up to 100 m above the sea level; undergrowth, sparse grows forests, deciduous forests in foothills, mainly, are observed at heights down to 200 m; coniferous-deciduous forests are usual on hill countries and low-mountain relief above 200 m etc.). On the Chinese territory some types of vegetation

and lands occupy the heights which are not typical of them. For example, the agricultural lands extend to 400 m above the sea level; sparse grows forests and bushes go up to 300 m while the coniferous-deciduous plantations are on the hills with heights up to 100 m etc.

As a whole vegetation of the Chinese territory has a significant likeness with the land cover of western part of the Russian territory, which is experiences anthropogenic action for a long time. The field researches have shown that here secondary small-leaved and broad-leaved forests dominate on the felling places aged of approximately 80-100 years.

CONCLUSIONS

The economic structures of Bikin-Vandashan trans-boundary territory on each side of the border have similar features; however the Chinese part of the territory experiences more significant economic actions. That is why the land cover and natural complexes as a whole are converted in the greater degree than those on the Russian side. On the Russian territory the degree of an anthropogenic impact and land cover transformation increase from east to west reaching their maximum in frontier plain regions.

The counties and raions of the trans-boundary territory are differentiated by the intensity of the environmental impact. Hulin county and Bikinskii raion are subjected to the most intensive economic effect while Jaohe county and Pozharskii raion – to the least one. Bikinskii raion and Jaohe county have the most similar indexes of an anthropogenic environmental impact.

On the Chinese territory, many ecological problems (water and wind erosion, contamination of waters by household and industrial wastes, chemicals etc.) are more manifested. The trans-boundary character of many of them requires developing cooperation between the Russian Federation and China at local level to provide the mutual ecological safety and to prevention from trans-boundary damages.

One of the components of such interaction should be program on the rational nature management of the trans-boundary territory based on the functional zonation, considering the degree of disturbance, transformation of natural complexes of territory, their vulnerability, potential economic capacity, ecological significance etc.

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