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The Analysis of Environmental and Anthropogenic Factors Influencing the Landscape Structure Formation of the Kuang Bin Province (Central Vietnam).

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ABSTRACT

Landscape formation of defined by geographical position of the territory, as well as local physiographic conditions. The modern landscape form on considerable territories is a result of natural influence, as well as anthropogenic factors. Anthropogenic landscapes can hold a dominant position. Studying of natural and territorial complexes change for the purpose of rational environmental management is timely due to conditions of the Vietnam provinces high economy development. Thus cartographic research techniques, GIS-technologies, prognosis become highly important. Research includes analysis of landscapes classifications depending on the different mapping scale. The the Kuang Bin province landscape classification hierarchy from system to types of landscapes in scale 1:500000 is made. Thus analysis the landscape forming factors like human environment and economic activity is carried out. The mathematical apparatus is applied to mark anthropogenic impact degree assessment, erosive processes intensity including provoked by agriculture. Initial data files are transferred to attribute tables and processed by means of ArcGIS GIS-product. Differentiation of landscapes depending on geological and geomorphology conditions change from the west to the east, from mid-mountain territories and uplands to low coastal plains is revealed. The highest anthropogenic impact is concentrated in the east of the province where the maximal concentration of population, city settlements with processing industry and arable lands is observed.

Keywords: landscape, environment, natural and anthropogenic factors, cartographic method, GIS technology

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INTRODUCTION

During historical process of nature and society interaction there is a continuous strengthening of anthropogenic factors influence on environment. In Vietnam, along with processes of industrialization, urbanization diversified growth of natural resources use. To avoid degradation and resource depletion, operation and use of natural resources always have to be carried out according to local ecological laws. Thus the tendency of social and economic development, management of public life has to remain effective.

Using taxonomical landscape systems developed by USSR geographers, proceeding from regional mapping 1:500000 scale, the following taxonomical landscape classification of the Quang Bin province is offered: main units are: system, class, type, configuration, as well as subsystem, subclass, subtype, subspecies - these are additional taxonomical units.

DATA AND METHODS

Landscape researches in Vietnam began in 1960 on regional and local levels. Till 1980th the classification system of territorial units according to natural geographical regions distribution was developed [1-5].

In work [4] classification of geographical landscape system for Northern Vietnam with 8 levels was given. Two pairs of factors were analyzed: geological conditions and relief type; relief – climate; climate – hydrological conditions; soils and vegetation.

In work of Fam Hoang Huy (1977) variations of anthropogenic impact on Vietnam natural landscapes were analyzed, review of territories landscape assessment methods, as well as resource use measures and environmental protection was made.

At the end of the XX century in Vietnam landscape approach was used in scientific researches for social and economic development of the country and certain regions. This area of research had great practical value, especially when studying rational use of resources and environmental protection.

In 1992 researchers made landscape classification system for assessment maps in structural branch of the Vietnam Geographical center for natural resources. This landscape systematization consists of 10 levels [6]. In work [7] the classification system of 7 levels is developed for the landscape map of Vietnam 1:1 000 000.

The Russian landscape science is based on genetic concept which defines landscape as the territory with the common development history, its heterogeneity explained by hierarchical structure organization. Its founders are L.S. Berg [8], N. A. Solntsevo [9], etc. They developed the fullest logical model of landscape including typological, space and hierarchical components. In compliance with the theory "Landscape (geographical) is such genetically homogeneous territory in which natural and typical repetition of the same interdependent combinations is observed: geological structure, relief forms, surface and underground water, micro-climates, soil differences, phyto- and zoocenosis".

For the environmental and anthropogenic factors influence analysis on landscape structure formation of the Quang Bin province (Central Vietnam) systematization of a large number input data characterizing geological structure, relief, climatic conditions, soils, vegetation, types of land use and data necessary for soil erosion assessment is carried out. For this purpose the following informational databases were used:

- Practice database GIS-64 (The GIS center of development – Publishing house resources – the Environment and Map of Vietnam - 2010).;
- DEM database (Digital Elevation Models);
- Database of soils and land use structure of the Quang Bin province Natural Resource and Environment Protection Administration;
- Database of vegetable cover of the Quang Bin province Natural Resource and Environment Protection Administration;
- Card of industrial parks of the Quang Bin province (scale 1:400000 Scheduling and Development of Industrial Parks Administration of the Quang Bin province).

Indicators of anthropogenic impact are received by means of mark assessment method. Landscape indexes, connected with anthropogenic impact in the form of specific soil and vegetable cover condition, are counted in percentage terms for all studied landscape unit area. In the territory (district, landscape) the point, which increases in process of economic influence increase, is appropriated to each group of anthropogenic land use, i.e. by estimating key parameters influence of the rating the scale was created. Social-economic indexes are determined by the techniques presented in percentage terms for all studied PTK area and constant criteria of anthropogenic and technological factor influence: the gross capacities having negative impact are estimated as follows: 1 point - weak, 5 points - catastrophic.

The map processing technique of soil erosion for the Kuang Bin province is carried out according to FAO recommendations, based on the four key elements: (1) district biases; (2) soil type; (3) vegetable cover; (4) amount of precipitation.

Classification of land groups with high and low anthropogenic impact is carried out according to the assessment points given in table 1.

Indexes of anthropogenic impact are considered given location landscape industry development. The increase in anthropogenic influence rendered in various morphological parts of landscape can intensify ecologically adverse denudation and accumulative processes, as well as affect of substance and energy flow in landscapes [11-13].

Table 1: The weight coefficients, appointed indicators of anthropogenic impact [10 with additions of the author]

Objects	Properties	Estimating state (point)
Building zone load	City	5
	Town	4
	Region	3
main category lands of land fund and ground types	Industrial lands	5
	Logistics:	
	- highway	5
	- railroad	3
	Recreation	
	Thermal sources, caves and beaches	4
	Historical places	2
	Other sights	
Vegetation	National parks, natural heritages	1
	Stony treeless spaces	3
	Tropical and subtropical evergreen seasonal coniferous and broad-leaved forest; tropical evergreen seasonal broad-leaved forest	1
	Rubber plantations, wooded areas	3
	Agronomic crops	5
	Secondary woods and shrubby vegetation	4
	Settlements	5
Soils	Red-yellow ferralitic soils	3
	Alluvial soils	5
	Sandy soil	3
	Sierozemic soils	5

Main issue of point assessment is comparison and analysis of natural and anthropogenic indexes. Total score method is used for this purpose. The total score method using points allows to define ecological strength of the research territory by result of human economic activity.

All issues of this research are solved with using ArcGIS - the geo-informational software product of the ESRI company. It found broad application for maintaining land registries, in land management, accounting of real estate objects, systems of engineering communications, geodesy, in subsurface use and other areas.

ArcGIS gives the chance to easily create data, maps and models in table software products, then to publish them and use in desktop applications, in web browsers and in the field, via mobile devices.

Around the world ArcGIS tools are used for working processes improvement in organization and solution of various tasks on the basis of geographical approach, including territories management, territorial scheduling and analysis, prognosis and risk assessment, environment monitoring, providing access to information, including cartographic.

RESULTS

The territory of the Kuang Bin province lies in monsoonal and tropical landscapes. By seasonal differentiation of rainfall, temperature schedule, and dryness degree the province territory falls into subsystem of monsoonal and tropical landscapes with poorly expressed cool and dry climatic year seasons.

By geomorphology features - division factors are morph-structure of the higher order (mega-relief form) - the following landscape classes are allocated: plain landscape class (low plains and heights); upland landscape class; mountain landscape class (low-hill terrain and middle altitude mountains).

The hydrothermal condition combination and dynamics of biocenoses defining natural and zonal features of territories is the cornerstone of landscape division into types. The tropical evergreen seasonal monsoonal forests landscape type is widespread in the Kuang Bin province. It is possible to carry landscapes of tropical evergreen seasonal monsoonal deciduous forests, plains and landscapes of tropical evergreen seasonal monsoonal coniferous and deciduous forests, uplands and mountains to subtypes.

The combination of soil types and modern vegetable associations allows to allocate 66 landscape types of the Kuang Bin province territories. These types reflect modern landscapes which were formed as a result of human-to-nature interaction.

By extent of impact on forest ecosystems one of the major places among anthropogenic factors is occupied by final cuttings. The final cutting within calculated cutting area with keeping to the wood and ecology requirements is one of the necessary conditions for forest biogeocenoses development. Kuang Bin is located amidst biological diversity of Northern Chyong Sean. The flora and fauna have are of great variety and has unique forms of genetic resources [1, 2, 5].

Deforestation represents process of complete elimination of closed and other types of forests. Area lessening of the woods in Vietnam as well as in the Kuang Bin province occurs intensively in due to rapid growth of population and need for construction wood as export fuel.

The forest area in the Kuang Bin province was reduced with a speed of 1,18% a year during the period since 1982 to 2002; during the period from 2002 to 2012 the forest area increased by 2,0%. According to the Ministry of Forestry the forest covering made 70% in 1982 and decreased to 59% in 2002; during the period from 2002 to 2012 forest covering increased to 68% of the territory (tab. 2).

Table 2: Change of the forest area in the Kuang Bin province [3]

Year	Forest area (hectare)	Covering of the territory (%)
1982	565486,9	70
1992	491981.47	61
2002	275850.93	59
2012	549590.0	68

Processes of forest degradation are influenced by its fast quality deterioration, as well as decrease in community types quantity; the covering increased, but generally these are man-made forests therefore value of biological diversity is not high. In the majority of areas the natural woods underwent serious transformation. The virgin forest areas which are not affected by degradation processes, well noticeable on space pictures, exist only in small forest areas, in high mountains in the western part of the Kuang Bin province. Natural landscapes are also preserved here.

In the Kuang Bin province drainage, flooding, salinization, acidifying, ferralitzation, formation of concretions and sand movement are the reasons of soil degradation. Soils in the cities degrade as a result of construction works and industrial wastage pollution. On plains soils degrade because of non-rational use of chemical fertilizers, pesticides, as well as agriculture misuse. The phenomenon of soil degradation is intimately bound to forest cover disappearance. The majority region areas with low risk of erosion are in areas with high timberland woodiness with a heavy-bodied forest cover and in regions of rice fields. Meanwhile the intensive erosion occurs generally in mountainous areas, on the free treeless lands and on agricultural grounds, arable lands. The most serious sites of erosion often occur on slopes, tops of the hilly lands.

Due to narrow topographical surface of the Kuang Bin territory, rivers are often short, steep, flow in the eastern direction. The water drain module averages $57 \text{ l/s}\cdot\text{km}^2$, which defines their high self-clearing ability [1, 5, 6]. In the Kuang Bin province polluters of surface waters generally are:

- Crude household sewage thrown into aqueous environment;
- Production sewage;
- Non-rational use and storage of chemical fertilizers, pesticides in river basins.

Currently in the Kuang Bin province salinization of underground waters takes place. Majority of the water bearing horizon in quaternary formations are polluted by compounds of iron, manganese, nitrogen, organic and inorganic substances. In coastal areas underground waters are often polluted by salty ocean waters.

Owing to slight influence of environment and anthropogenic factors the systems develop under natural laws and differ from their initial state. More fissile influences can change morphology, structure, functioning and dynamics of natural systems in landscapes. Humans will transform some natural systems and make them into stable anthropogenic systems such as rice fields, gardens or plantations of commercial crops and artificial landscape structure of the Kuang Bin province.

Argo-landscapes sharply differ from natural systems. Construction of terrace fields in mountains significantly transforms natural natural systems. Creation of ponds for shrimp cultivation changes mangrove landscapes. Deforestation and forest fires lead to formation of the secondary woods and bushes landscapes.

The industry radically changes natural systems. Mining destroys geological, geomorphology basis of landscapes and the state of underground waters in landscapes. The urbanization has caused change in natural systems near city landscapes. Transport branches cause the linear destruction of landscapes.

On the basis of vegetation maps, maps of soils, erosion, structures of land use in the Kuang Bin province and the database table of attributes were created layers, fields of anthropogenic influence level for each specific type of vegetation, soil, and land use of the Kuang Bin province, using the Feature to Raster (Conversion) function in the ArcGIS program. After calculation of all anthropogenic impact index coefficients, the Raster Calculator (Spatial Analyst) function in the ArcGIS program is used. As a result for anthropogenic impact assessment received sum of points allowed to range load of 5 gradation from low (0-4 points) to very high (> 96 points).

On the basis of the received results and anthropogenic impact rating scale the landscape influence map of the Kuang Bin province (fig. 2) was made.

The analysis of the landscape anthropogenic impact map shows that violations happen generally in regions of territories intended for building high concentration, agricultural production and industrial facilities.

Landscapes in river basin of Zhan in Bo Trach area and rivers Kien Zhang in Le Tui's region are most strongly changed. Here, ancient farming practices are observed; economic communes, craft private small enterprises and considerable population density which carry out mainly rural activity. Annually a large number of household wastage gets into environment; production wastage makes huge environmental impact.

In the field of river Kien Zhang the strong pollution takes place due to production activity of mineral water Bang park. This production park has inefficient system of sewage disposal which flow directly into the

river. Besides, coastal areas also are in a danger zone and serious environmental harm caused by production activity of aquaculture and tourist activity in seaside area of the Kuang Trach Region and city Dong Hui. The area of the least broken landscapes remained in mountainous areas, especially in national park Phong Nha-Ke Bang, where the rigorous policy of nature protection operating controls for the purpose of natural woods preservation is being enforced.

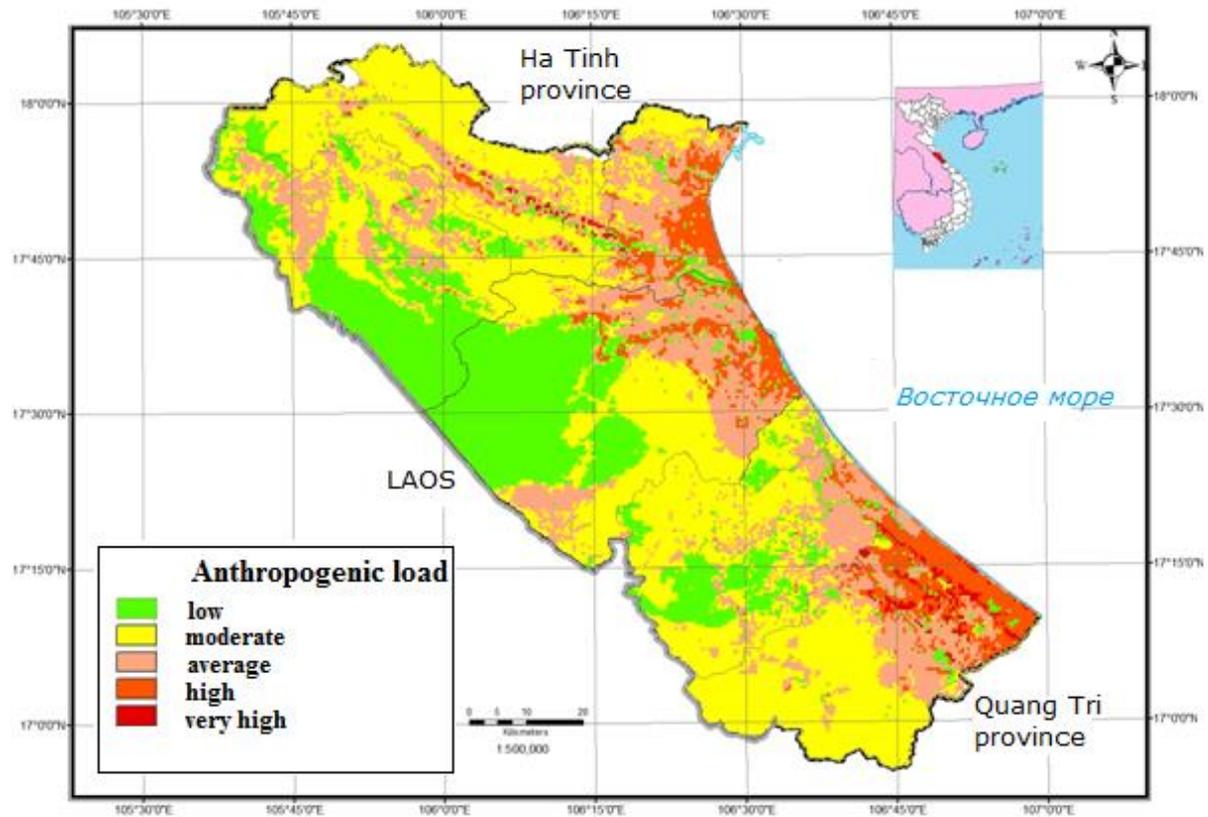


Figure 2: Anthropogenic impact map of Kuang Bin province landscapes

SUMMARY

Landscapes of the Kuang Bin province of the Central Vietnam are of large variety. In the western and central parts of the province landscapes develop mainly under the influence of natural factors. These are landscapes of mountains and uplands. East coastal part of the province is most convenient for development and is characterized by existence of anthropogenically changed landscapes. The nature of the province has high recreational potential, prerequisites for development of intensive agriculture, logging, mining and processing industry. Keeping of the nature protection legislation, rational use of natural resources is required.

CONCLUSION

The provided short characteristic and analysis of environment and anthropogenic factors influence on landscape structure formation of the Kuang Bin province show that the first are landscape-forming factors and actively influence all developments of landscapes, thus are subjected to anthropogenic influence breaking interrelations between all other components of nature.

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