

# Agro-Recreational eco-Settlements Network Formation Under the Step-by-Step Service System Conditions



Tetiana Pavlenko, Olena Ovsiienko, Dmytro Ovsiienko, Yulia Kuznetsova

**Abstract:** *The algorithm of forming a network of agro-recreational eco-settlements in the step-by-step service system conditions is defined in the article. The peculiarities of agro-recreational eco-settlements network formation under the conditions of a step-by-step service system are given the case of certain administrative districts of Poltava region, Ukraine. Depending on the taxonomic structure of the agro-recreational eco-settlements territorial organization, the levels of their functional-planning organization have been formed: agro-recreational eco-locality, agro-recreational eco-center, agro-recreational eco-zone, agro-recreational eco-district, agro-recreational eco-region. On the basis of the algorithm of agro-recreational eco-settlements network formation, the landscape ecological integrity of the agro-recreational eco-settlements and their network was estimated using the landscape ecological integrity index and the dimensions of settlements greening were determined.*

**Keywords:** *agro-recreational eco-settlement, network, systemic approach, step-by-step service system, landscape ecological integrity index.*

## I. INTRODUCTION

Today, in the process of intensive urbanization, there is a tendency to create agro-recreational and recreational entities of different types in settlements. This, in turn, improves the economic situation of the settlement itself (the nomenclature of cultural and service facilities develops, the social infrastructure improves, etc.), and provides the opportunity for a full rest of the residents and visitors. However, in most cases, the creation and development of agro-recreational and recreational entities is not systematic without taking into account the necessary town planning standards.

Therefore, there is a need for research and favorable integration of the network of agro-recreational eco-settlements under the conditions of a step-by-step service system.

## II. RESEARCH TIMEFRAMES

Chronological timeframes – from the end of the XIX century. (beginning of more intensive introduction of recreational function in small settlements) till the beginning of the XXI century (present).

Territorial borders – analysis of the current state of eco-settlements and settlements having agro-recreational and recreational function of domestic and foreign experience, the solution of problems is worked out the case of Poltava region settlements, Ukraine.

## III. METHODOLOGY

Research methods are components of a general multilevel methodology, which includes the following levels: philosophical, general scientific, specific scientific (town planning), technological (agro-recreational).

The study uses: the basics of the systemic approach, comparative-historical method, method of terminological analysis, method of modeling, etc.

At the town planning level, the structural and functional approach is used. Methods of modeling architectural systems are used.

At the agro-recreational level (technological level), specific methods for the study of agro-recreational eco-settlements are used: the method of assessing the ecological stability of the agro-recreational eco-settlements landscape, the method of trial design by means of the criterion of the agro-recreational eco-settlements network efficiency under the conditions of a step-by-step service system.

## IV. RESULT AND DISCUSSION

The analysis of the existing state of settlements with the agro-recreational function in Poltava region [1] (Ukraine) showed that the development and structure level of the settlement infrastructure get behind the permanent population needs, does not meet current standards; the share of the housing stock is located in the sanitary-protection zones of the enterprises; the recreational potential of the settlements is insufficient.

**Revised Manuscript Received on April 30, 2020.**

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In domestic project design practice, the development of recreation facilities was mainly carried out according to typical projects designs, which reduces their attractiveness.

The dispersed planning scheme is dominated in project designs and, therefore, valuable territories are inefficiently used.

Also, together with negative factors, the following positive points were found out: a large production base contributes to the development of production, emerging and increase of jobs; availability of territorial resources within the settlements and possibility of existing buildings concentration; increasing the percentage of green areas in settlements, etc.

Based on the conducted research, it was determined that the Kotelva, Myrgorod and Shyshaky districts of Poltava region (Ukraine) are the most promising for the development of agro-recreational eco-settlements network (high percentage of recreational and agrarian resources, organic farming availability, etc.).

Agro-recreational eco-settlement as a system is divided into some components under conditions of a step-by-step service system (according to the main groups of human activity processes [2]):

- agro-industrial component;
- recreational component;
- component of the service sector (step-by-step service system);
- component of communications.

The algorithm of forming the agro-recreational eco-settlements network under the conditions of step-by-step service system consists of two main stages: assessment of the landscape ecological stability of the agro-recreational eco-settlement network (limitation of tasks) by the landscape ecological integrity index; and according to determining the areas of settlement greening; problem solving using the criterion of the agro-recreational eco-settlements network efficiency (trial design and determination of the effective variant on the communication criterion basis under the conditions of the step-by-step service system).

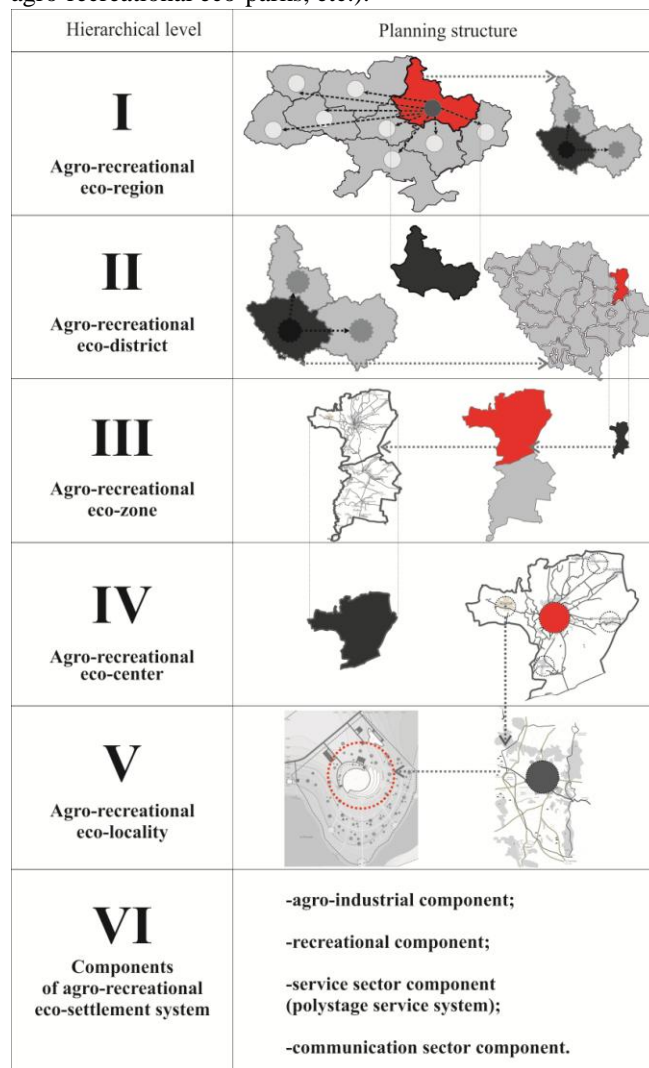
Using the example of certain administrative districts of the Poltava region (Ukraine), the peculiarities of the agro-recreational eco-settlements network formation under the conditions of a step-by-step service system are presented [3, 4].

Taking into account the available natural resources, the level of their preservation, as well as the agro-industrial development features, Kotelva and Shyshaky administrative districts of Poltava region (Ukraine) can be considered as the most characteristic.

According to the taxonomic structure of the agro-recreational eco-settlements territorial organization (fig. 1), [3, 4, 5] the basic levels of functional and planning organization of the agro-recreational eco-settlements network under the conditions of a step-by-step service system are defined.

Agro-recreational eco-localities (level V of the agro-recreational eco-settlements system) are defined as constituents of agro-recreational eco-settlements networks: certain small or medium-sized rural settlements - agro-recreational eco-settlements (agro-industrial, agro-recreational and recreational eco-settlements), and

separate eco-settlements, agro-recreational eco-establishments (eco-agro-cottages, farmsteads, agro-recreational eco-parks, etc.).



**Fig. 1. Hierarchical levels of agro-recreational eco-settlement systems.**

Agro-recreational eco-center (level IV of the agro-recreational eco-settlement system) is defined as a large settlement - agro-recreational eco-settlement (agro-industrial, agro-recreational and recreational eco-settlements), which is located near valuable agricultural and recreational resources, where the network of eco-farm stays and eco-agro-rest houses (agro-recreational eco-localities) were formed.

The agro-recreational eco-zone (level III of the agro-recreational eco-settlement system) is defined as the set of agro-recreational eco-centers grouped round about an agro-recreational eco-center within a certain compact area under the conditions of a step-by-step service system.

Agro-recreational eco-zones, differing in functional (typological) feature, can be polyfunctional (agro-recreational) and monofunctional (agro-industrial only or recreational only). In this case, there may be agro-recreational eco-zones, which have both agro-industrial, recreation, and agro-recreation, but one of these functions is predominant.

It has been determined [5] that there is the ecological equilibrium when the percentage ratio between the area of natural and transformed ecosystems is not less than 60: 40.

The variety of natural conditions determines a number of methods of functional and planning organization of agro-recreational eco-zones, providing the effect of the adaptability principle:

- linear which is characteristic for the territories along the anthropogenic or natural axis with flat terrain;
- linear-deep laid which is typical for riverine territories with complex relief;
- dissected-bushy which is characteristic for hilly territories with formed transport links;
- compact which is characteristic for territories of the local type situated on the terrain.

Agro-recreational eco-district (level II of the agro-recreational eco-settlements system) is defined as a homogeneous territory with a formed network of agro-recreational eco-settlements in terms of a step-by-step service system.

Agro-recreational eco-districts, differing in functional (typological) character, can be polyfunctional (agro-recreational) and monofunctional (only agro-industrial or only recreational). In this case there may be areas in which are both agro-industrial, recreational, and agro-recreational, but with the predominance of one of the functions.

Functional and planning structure of agro-recreational eco-districts (using the example of Kotelva and Shyshaky administrative districts) is determined by the type of natural and anthropogenic landscape:

- riverine with active relief; riverine plain;
- on the shores of lakes, reservoirs; on sand spits and islands;
- in hilly terrain; in urban settlements.

The riverine agro-recreational eco-districts with an active relief are characterized by the availability and location of beach areas, the narrow shape along the bank line of the reservoir, the inclusion of the territory in the area with an active relief.

The complexity of the reliefs of riverine and hilly territories determines the agro-recreational eco-districts zoning (using the example of Kotelva and Shyshaky administrative districts, Poltava region, Ukraine):

- the first zone and the coastal strip: the main recreational territory of the riverside agro-recreational eco-district;
- second zone: the territory of predominantly agro-recreational and recreational eco-settlements, recreational entities, the location of transport nodes;
- the third zone: the territory of agro-industrial development and mainly agro-industrial and agro-recreational eco-settlements;
- the fourth zone: the territory of forests, autonomous agro-recreational eco-complexes, tourist itineraries;
- the fifth zone: the territory of agro-recreational eco-parks, nature reserves, wildlife sanctuaries, tourist complexes.

Such deep zoning ensures the preservation of the coastal landscape. The planning structures of hilly agro-recreational eco-districts (using the example of Kotelva and Shyshaky districts, Poltava region, Ukraine) are interrelated with the

relief peculiarities:

- valley-growing in the form of a landscape amphitheater (site in the ring of slopes) or landscape corridor (gorges, river beds with adjacent slopes);
- slope in the form of a landscape stairs (slopes of different steep) or steep slopes covered with forests or deforestation.

The value of the hilly part of agro-recreational eco-districts (using the example of Kotelva and Shyshaky districts, Poltava region, Ukraine) consists in their year-round use. The planning organization of agro-recreation in lake-river areas with a network of agro-recreational eco-settlements is conditioned by the internal geographical structure and the external configuration of the waters [5].

The planning structure of agro-recreational eco-districts (using the example of Kotelva and Shyshaky districts) on the basis of a network of small water bodies (lakes in particular) is arranged due to the differentiation of recreational functions at each water body.

The diversity of natural conditions determines a number of methods of functional and planning organization of agro-recreational eco-districts providing the adaptability principle effect:

- linear which is characteristic for river basin areas with flat terrain (agro-recreational eco-districts with a network of agro-recreational eco-settlements on the Vorskla and Dnieper banks);
- linear-deep which is typical for riverine areas with complex relief (agro-recreational Kotelva eco-district: Kotelva - Bilsk);
- dissected-bushy which is characteristic for hilly areas with formed transport links (Shyshaky, Lubny, Zinkiv districts);
- compact, which is typical for the local type areas, located on the relief (Hadyach, Lokhvytsya districts).

Functional zoning is a decisive factor in the rational functional and planning organization of the agro-recreational eco-district.

Functional zoning of the agro-recreational eco-district is coordinated by:

- the principle of environmental friendliness (the relationship between the population and the environment is as balanced as possible and provides for self-reproduction of the environment, protection of aesthetically valuable landscapes, refusal to place agro-recreational objects in such natural areas);
- the principle of functional-planning structures density (creation of agro-recreational network on the basis of effective functional-planning interconnection of agro-recreational eco-settlements and recreational and / or agro-recreational entities - agro-recreational eco-parks, agro-parks, eco-complexes, landscapes, tourists itineraries in the terms of step-by-step service system);
- the adaptability principle (adaptation of space to changing environmental conditions, functional planning organization requirements, rapid urbanization development, the emergence of new socio-economic conditions,

which allows the most effective functional planning formation of agro-recreational eco-settlements, depending on the availability of the main factors of influence; - planning structure diversity and differentiation according to the functional profile of the agro-recreational settlements network).

The following functional and planning elements are defined as a part of the agro-recreational eco-district (using the example of the Kotelva administrative district, Poltava region, Ukraine):

- recreational environment is divided into the following components of the recreation environment: (long-term, short-term, mixed); tourism (cognitive, sports, mountain climbing, hunting, fishing, etc.); centers of the step-by-step service system; recreational natural landscape and protected landscapes; tourist attractions and routes; internal transport and pedestrian connections;

- rural environment has the following environmental components: environment of agro-industrial, agro-recreational and recreational eco-settlements (agro-recreational eco-localities, agro-recreational eco-centers);

- agro-industrial environment has the following components: agricultural production environment, industrial environment, municipal and household environment, reserve territory for expansion of municipal and household environment, etc.;

- agro-recreational environment has the following components: agro-recreational entities (agro-park, agro-recreational eco-park, summer residences, etc.):

- the ecological environment has the following components: ecological basis environment, ecological reserve environment, the ecological corridor environment [6].

The ecological base environment is defined by the massifs of forests, marshes, grasslands and other conditionally undisturbed and / or poorly disturbed ecosystems associated with other similar natural complexes where wild animals can move without obstruction. These territories do not have a special protection status and can be used for all types of economic activities which are not related to the destruction of natural ecosystems: hunting, sport fishing, forestry, recreation, traditional agricultural use.

The environment of the ecological reserve is defined by all existing and designed especially protected natural territories, as well as the sites that are promising for this type of natural resource use. Within their limits all types of economic activity are restricted. The entire environment of the ecological reserve is linked to all functional and planning elements through ecological corridors.

The environment of the ecological corridors is defined by the relatively narrow groups of forests, swamps, meadows, shrubs, strips of forest, etc. that connect the ecological base environment. Ecological corridors run between the territories, largely disturbed by anthropogenic activity. Ecological corridors consist of free transit zones, restricted wildlife runs and diffuse penetration areas [6].

The agro-industrial environment is separated from the recreational and rural areas by sanitary protection strips having a width of 200- 500 m depending on the forms of relief.

The peculiarities of agro-recreational eco-settlements network formation within the administrative districts can be accepted for the formation of such a network within the territorial districts (interior district, inter-district). For example, Shyshaky united territorial community combines about 80% of the area.

Agro-recreational eco-region (level I of the agro-recreational eco-settlements system) is defined as a large natural ethno-cultural administrative territorial unit, which consists of one or several administrative regions characterized by the similarity of natural-landscape structure, historical, cultural, socio-demographic and economic development, specific infrastructural links and other factors under the conditions of a step-by-step service system.

## **V. EFFICIENCY CRITERION FOR AGRICULTURAL ECO-SETTLEMENTS NETWORK**

As a result of the analysis, it was found that economic factors, together with the factors that create the environment of agro-recreational ecosystems, have a sufficient number of connections, that both manage and are managed, and may be basic in developing the forecast of the town planning system behavior.

Thus, it can be confirmed that the effective use of territories depends on economic and environmental factors.

The environment, as an influential factor, creates the rental value of the territories and determines their efficiency.

In the development of functional planning decisions, the main elements of the agro-recreational eco-settlements eco-structure formation are the free territories which are not involved into technological processes, and the system of green plantings.

It seems appropriate for agro-recreational eco-settlements to determine the size of free areas around territories proceeding from biological balance conditions.

The scheme of natural and transformed ecosystem area ratios proposed by N.F. Reimers is of interest [7].

According to his data, a sufficient state of biological balance is possible with the ratio of natural and transformed territories in the percentage of 60: 40.

When considering the problem of stable landscapes and optimizing their development, it is important to operate a system consisting of quantitative and qualitative assessments of the processes under study. Due to this, it becomes necessary to determine the ecological stability of the landscape, in particular its degree, using the index of ecological integrity (*IEI*) [5, 7].

The method of assessing the environmental stability of the landscape [5, 7] using the index of ecological integrity (*IEI*) is to identify and analyze areas which are occupied by various elements of environmental infrastructure:

$$IEI = \frac{\sum_{i=1}^n S_{st}}{\sum_{i=1}^n S_{ust}} \quad (1)$$

where:  $IEI$  is the index of ecological integrity of the landscape;

$S_{st}$  – green areas that have a positive impact on the landscape (parks, miniparks, boulevards, gardens, etc.);

$S_{ust}$  – the areas of the landscape unstable elements (land with unstable herbage, areas under construction and road network, which are overgrown and muddy reservoirs, other areas that have been anthropogenically devastated).

The assessment of the landscape is done according to a scale in Table 1.

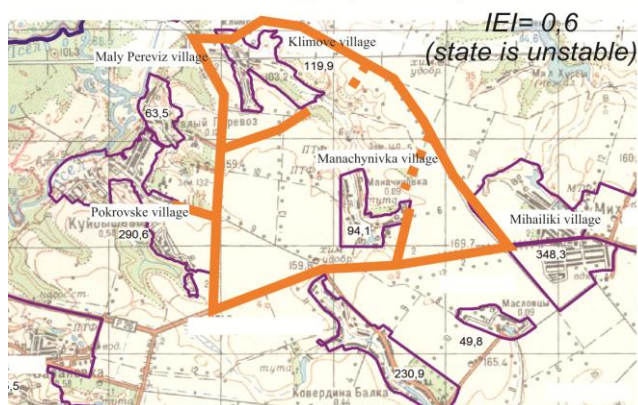
In order to achieve the required level of greening, it is necessary to increase this index to the full stability of the landscape.

This criterion of ecological integrity is considered as limiting the task of creating the network of agro-recreational eco-settlements.

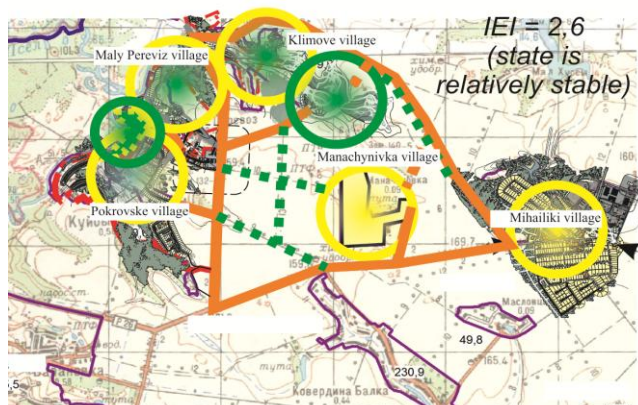
That is, the maximum stability of the landscape should be ensured to provide the network with ecological status.

Fig. 2. Assessment of ecological integrity of the agro-recreational eco-settlement landscape

Territory of settlements before reconstruction (using the example of Shyshaky district, Poltava region, Ukraine)



Territory of settlements after reconstruction with forming the agro-recreational eco-settlement network (using the example of Shyshaky district, Poltava region, Ukraine)



Legend:

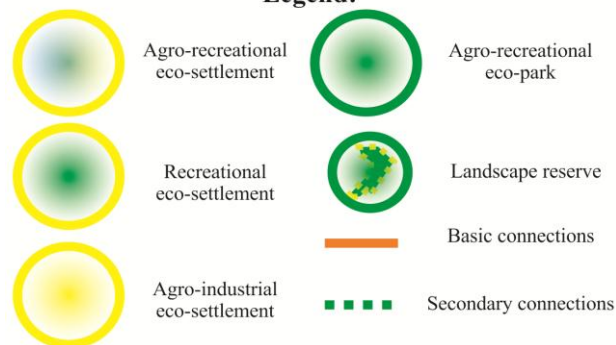
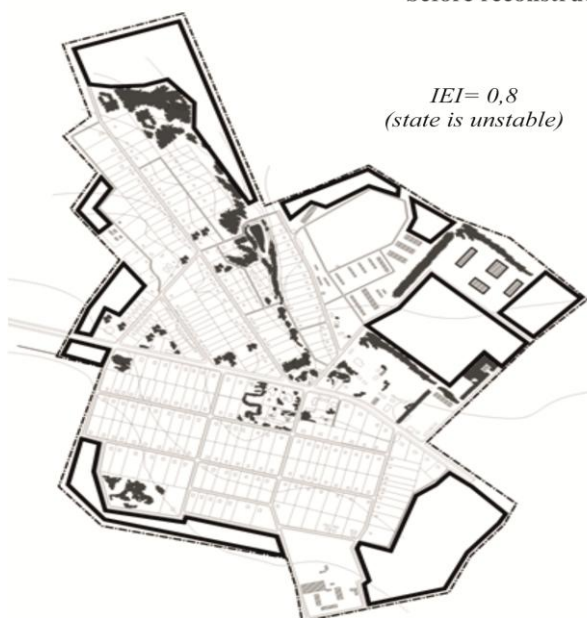


Fig. 3. Ecological integrity assessment of the landscape of the agro-recreational ecosystems network

Table- I: The index of ecological integrity ( $IEI$ )

Index Value	Landscape Characteristic
Less than 0.5	instability is well expressed
0,5 - 1,0	state is unstable
1,01 - 3,5	state is relatively stable
3,51 and above	stability is well expressed

Agro-recreational eco-settlement before reconstruction



Agro-recreational eco-settlement after reconstruction



If water resources are available, a network of agro-recreational eco-settlements can be developed both along the bank line and up to the bank line with the formation of beach areas.

If the area which is rich in forest resources, is not far from the settlement, the development of a settlement network may take place towards the forest with the possible formation of a sylvan park (fig. 2, 3).

### VI. CONCLUSION

The peculiarities of forming the network of agro-recreational eco-settlements, which depend on natural resources, the existing network of recreational establishments and the infrastructure necessary for their functioning under the conditions of a step-by-step service system are considered.

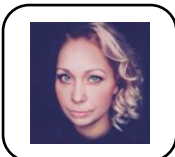
The hierarchical levels of the territorial organization of the agro-recreational eco-settlements network, which are an integral part of the general process of formation of agro-recreational territorial communities, which form important structural links of agro-recreational ecosystems of different type and scale, have been determined.

This criterion of ecological integrity is considered as limiting the task of forming a network of agro-recreational eco-settlements. That is, the maximum stability of the landscape should be ensured for architectural and urban planning of the settlement area greening.

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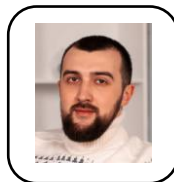


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