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## RESEARCH ON THE PHENOMENON OF SELF-AFFORESTATION OF AGRICULTURAL LANDS IN UKRAINE

**Abstract:** Extension of the forest area in Ukraine is one of the indicators confirming achievement of the goals of sustainable development. Therefore, the issue of protection, restoration and rational use of forest ecosystems is rather actual. The process of self-afforestation taking place on agricultural land, which are not used according to their intention because of their investment unattractiveness, due to lack of funds or other reasons, and thus, they are self-sown with forest plants, is one of the ways of the forest-covered area extension in Ukraine. There is no reliable information on the number of land plots with self-sown forests on agricultural land. Therefore, it is expedient to make inventory of them by using the tools of satellite remote sensing and field surveys. The author of the work suggests a conceptual model of planning the use of agricultural land with self-sown forests on the base of the inventory data. To make the best-possible decisions on the use of the land plots with self-sown forests, at the local level it is important to determine the rational direction of the self-sown forest use in the process of spatial planning on the base of the data of analysis of the soil and plant cover layer quality. Therefore, it is recommended to make zoning of the land by the kinds of land use (agricultural, forestry, recreational, nature protection). Basing on the zoning data and considering the potential ecosystem benefits from forests, it is necessary to develop measures on the self-sown forest use and protection.

**Keywords:** self-sown forest, agricultural land, ecosystem services, inventory, planning, zoning

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## Introduction

The ecological policy of Ukraine aims to promote sustainable development of nature management, to halt biological and landscape diversity loss, to improve conditions of damaged ecosystems, to achieve a neutral level of land degradation, to expand the natural preserved area, etc. In that context, one of the research tasks is to develop a strategy of land use within the rural territories considering the sustainable development concept. That concept suggests balancing between the current human needs and protection of the future generation interests, particularly their needs for a safe and healthy environment (Sustainable Development Goals: Ukraine, 2017).

A particular attention is paid to sustainability of natural ecosystems, which determine stability of the whole biosphere. Protection of the artificially made systems' capacity to self-restoration and dynamic adaptation of those systems to any changes in the surrounding is of great concern (Ecosystem restoration for people, nature and climate, 2021). Ecosystem self-restoration is a process of the ecosystem self-recovery to the conditions of dynamic balance, which has been destroyed under the impact of negative external and internal factors. The capacity of ecological systems to self-restoration is reduced along with degradation of natural resources, environmental pollution, loss of biological and landscape diversity of territories (Grodzinsky, 1995).

In Ukraine, agricultural development of the territory accounts for 70%, plowing – above 50%, and therefore, it is very important to create conditions for protection and restoration of agroecosystem productivity. Agroecosystem is considered as an ecosystem subsystem, in which cultivated crops dominate on the treated soil. The structure and regime of such system is supported and regulated by people, whereas lack of control gradually causes loss of its functions, properties and productivity (Schiere & Grasman, 1997). To support or improve the ecological services in agroecosystems, it is necessary to broaden the diversity of vegetation within and around the agroecosystem (Altieri, 1989). For that purpose, forests are of great importance, as under smart management, they provide for a great number of ecosystem services, namely air purification, soil formation, regulation of climate and water streams, reduction of the risks of natural disasters, broadening of the territory biological diversity, improvement of human living standards, and raise of community stability (Cunningham et al., 2015).

However, the anthropogenic activities have caused a large-scale destruction of lands and maximum simplified ecosystems in the form of artificial agrocoenosis. Therefore, it is of urgent importance to make regeneration of forests. Regeneration (natural restoration) can be fulfilled by different ways, i.e., secondary forest, passive restoration, shrubs growing, etc. (Holl & Aide, 2011).

In the recent decades, Ukraine has experienced the process of self-afforestation of agricultural lands because of the land plots being not used according to their intended purpose (Unaccounted forests of Ukraine, 2020). Such situation is forced by some factors, including the land-owners' lack of funds to run agricultural activities, investment unattractiveness of the land because of low soil fertility, or poor state support for animal breeding development, etc. According to the data (Land directory of Ukraine, 2020), the

country cultivates 2.9 mln ha (7%) of agricultural land. Those processes have both positive and negative effects. On one hand, it results in creating forest ecosystems of both ecological and forestry value, on the other hand, the land plots with young forests belong to the category of agricultural lands, and legally cannot exist as forest lands of the forest fund of Ukraine, therefore they should be uprooted. In that context, there are some legal, social and economic, ecological and organizational problems, which require a complex approach to their solution.

The goal of the article is to substantiate the expediency of protecting forests on agricultural lands as an important constituent of sustainable development of the territory in Ukraine. The authors propose a conceptual model of planning the use of agricultural land with self-sown forests referring to the inventory data. Inventory of agricultural lands with the self-sown forests involves studying the natural and spatial conditions and analyzing the factors causing appearance of abandoned lands. The article describes the tools, which are necessary to implement the model of planning the use of agricultural land with self-sown forest.

## Material and Methods

The methodological basis of the research is made by the concept of ecosystem services, which confirms the relationship between the human well-being and ecosystems stability. Reduction of the quality of ecosystem services causes significant economic losses and expenditures for healthcare (Millennium Ecosystem Assessment, 2005), whereas the ecosystem sustainability depends on the degree of its biological diversity, and in case of its loss, it negatively influences production of the essential vital services, provided by the ecosystem (Mehring et al., 2017).

In the research, forests are considered as social-ecological systems, which provide for a great variety of ecosystem services (Fig. 1). Therefore, one should concern fundamentals for the integrated ecosystem management (Izakovičová et al., 2018), which would integrate institutional norms, social practices, knowledge and technologies in the way to simplify the adaptive management and provides for sustainable use of ecosystem services by people (Hummel et al., 2011).

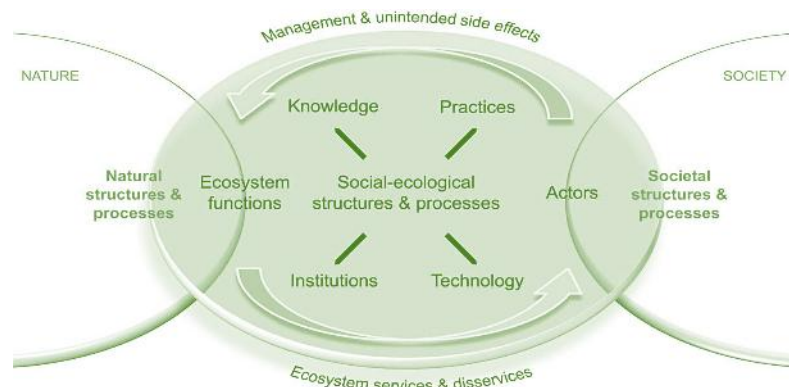


Fig. 1. Nature-society relations as a social-ecological system  
Source: Hummel et al., 2011; Mehring et al., 2017

The research was conducted on the examples of land plots within the Busk territorial community in Lviv region (Western Ukraine) (Fig. 2). The territory belongs to the zone of Small Polissia, where a significant share of area is taken by the landscapes of Polissia type (sand plains, grasslands, deciduous and pine forests, swamps) (Geographical Encyclopedia of Ukraine, 1993).

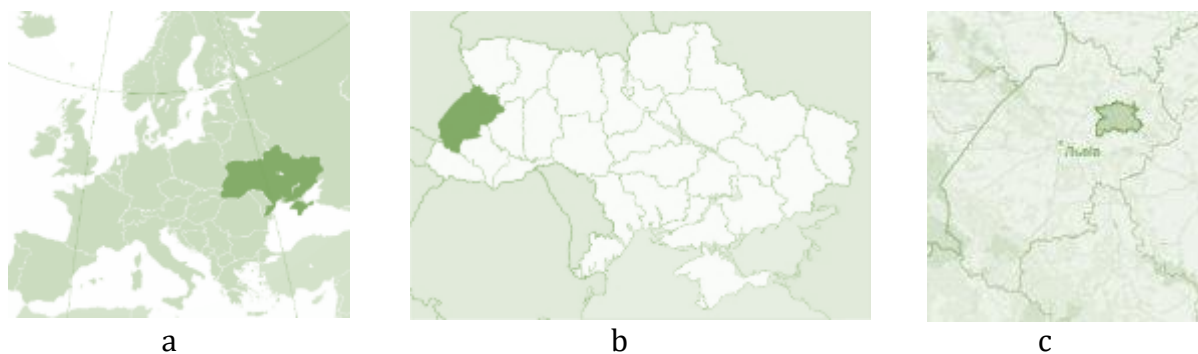


Fig. 2. Location of the study area: (a) in Europe – Ukraine, (b) in Ukraine – Lviv region, (c) in Lviv region – Busk territorial community

Source: author compilation

On the community territory, three agricultural areas with self-sown plants were marked near Baimaky, Hrabyna, and Sokolivka villages (Fig. 3).



Fig. 3. Location of the study area: (a) Busk territorial community; (b) Research arrays –(I) near the village of Baimaky, (II) near the village of Hrabyna, (III) near the village of Sokolivka

Source: author compilation

Within the area, 15 land plots of private ownership were chosen to study the processes of self-afforestation (Fig. 4). Comparison of orthophotos of the Public Cadastral Map of Ukraine 2009 (Fig. 4 I a, II a, III a) and satellite photos of the social

GEO-information service “GISFILE” 2021 (Fig. 4 I b, II b, III b), confirm that 12 years ago, self-afforestation processes did not happen on the studied area.

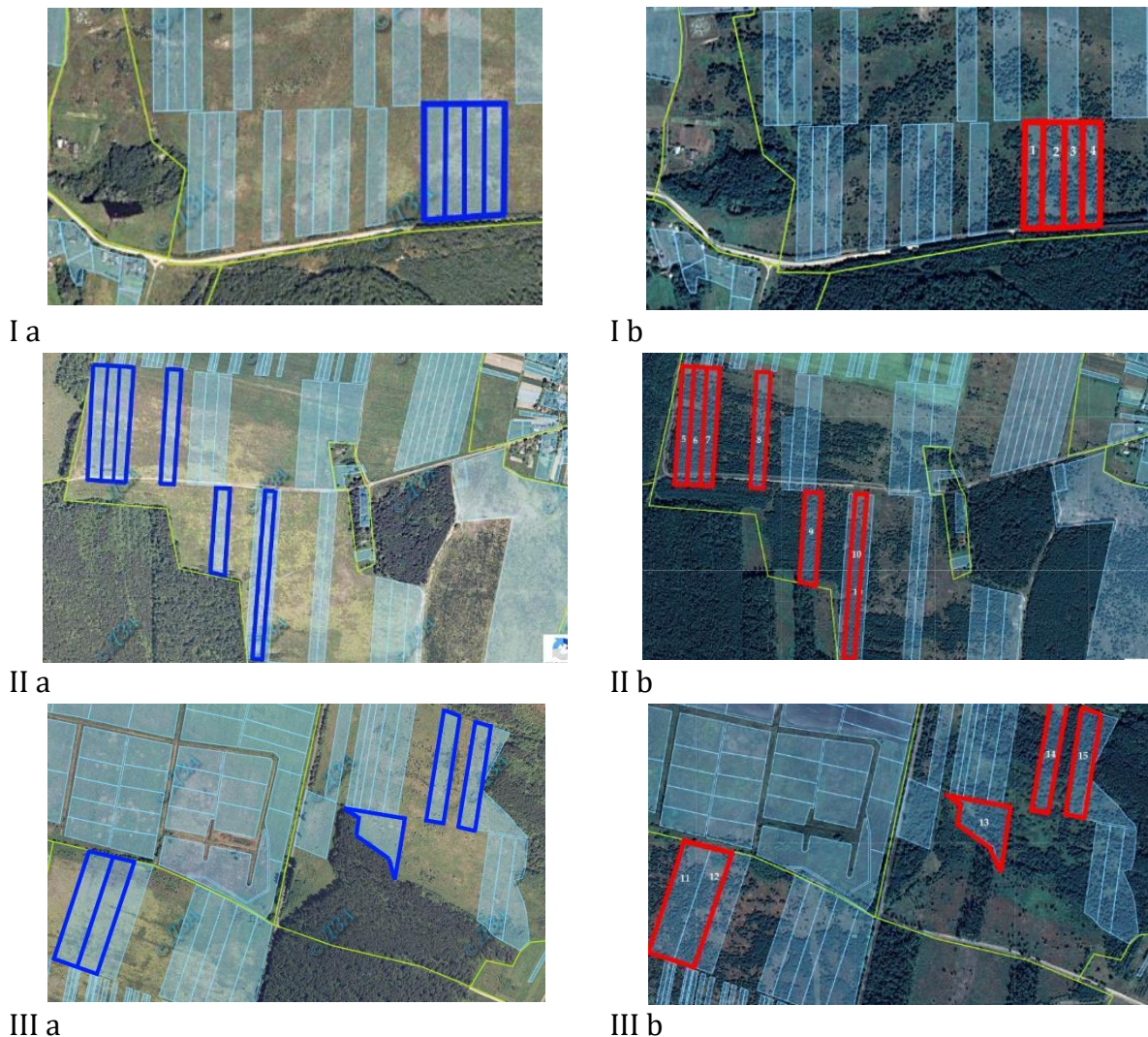


Fig. 4. Location of land plots with self-sown forests: (I) near the village of Baimaky, (II) near the village of Hrabyna, (III) near the village of Sokolivka

Source: author compilation from the Public Cadastral Map of Ukraine 2009 (a), from social GEO-information service “GISFILE” 2021 (b)

The method of analysis was used to select, to make quantitative assessment, to determine the legal status, to describe the topographic characteristics of land plots with the self-sown forest. The information on the forest cover on agricultural land was obtained from the social GEO-information service “GISFILE” (GISFile) and geo-portal “Public cadastral map of Ukraine” (Public cadastral map of Ukraine). The cartographic method was used for visualization of the processes of self-afforestation on the studied territories. The system approach was used to study the self-afforested plots as an integral set of elements in the complex of relations and dependences. The abstract-logical method was applied for consolidation of the research results and conclusions making.

## Results and Discussion

The initial phase of settling the situation with the self-sown forests on agricultural lands should involve inventory of lands, which aims to restore the quantitative and qualitative characteristics of land plots. Such information is required for the land cadaster, control for land use and protection, making managerial decisions by government and local authorities concerning the land use in the future. Inventory of land is conducted to determine the land plot location, its boundaries, size, legal status, kind of lands, use conditions, etc. (The order of land inventory, 2019). To obtain more information on the self-afforested agricultural lands, it is recommended to conduct soil and geobotanic observations (Mesquita et al., 2021). It will help assessing the ecosystem value of vegetation and soil suitability for agricultural use.

Referring to the inventory results and field surveys, the author of the research has got information about 15 land plots (Table 1). While choosing the land plots, the possibility to interview the owners was considered to get more detailed information on the use of self-afforested lands in the future.

All land plots are in private ownership. They include grasslands, which are intended for commercial agricultural production, e.g. cattle grazing.

The studied land plots are characterized by turf sand and clay-sand soils (Albeluvisols Umbric). Such soils are particular for Polissia zone and characterized by low fertility, weak humus horizon, small content of humus (0.6–0.9%), poor nutrition elements. However, under the adequate agricultural technologies, they provide for rather good yields of potato and winter rye (Soils and soil resources). The vegetation is represented by pine and grass that is also specific for Polissia zone. Pine is a dominating tree in local forests. The research confirms that open places of pine growing are the habitat for many animals and other kinds of plants, which are at risk of extinction (Nordman et al., 2021).

The interview results show that self-afforestation of agricultural lands has happened due to the following reasons, particularly 1) abandoned lands because of the land-owners' no interest to run any agricultural activity (cattle grazing, hay-making, cultivation of energy crops, etc.); 2) investment unattractiveness of land to be used for arable farming because of low soil fertility.

Therefore, legal aspects of the issue of self-sown forests on agricultural lands should be considered at the governmental level. The notion of "self-sown forest" should be legally approved and the procedure of transferring the agricultural land with self-sown forest to the category of the forest fund lands should be legislatively adopted.

Table 1. Results of the inventory of self-afforested land plots within the studied area

Land plot number	Area, ha	Soil/vegetation cover	Land use according to the cadaster	Afforest area
Area near the village of Baimaky				
1	0.7361	Turf sand and clay-sand / pine and grass	Grassland	0.3607
2	0.7022			0.3702
3	0.7021			0.3821
4	0.7167			0.4372
Area near the village of Hrabyna				
5	0.9823	Turf clay-sand / pine and grass	Grassland	0.7816
6	0.9823			0.7874
7	0.9823			0.8003
8	0.9823			0.6728
9	0.9448			0.8407
10	0.9455			0.7521
Area near the village of Sokolivka				
11	1.8615	Turf clay-sand / pine and grass	Grassland	1.4812
12	1.6009			0.9405
13	1.1137			0.8013
14	1.1337			0.5878
15	1.1275			0.8294

Source: author study from the Public Cadastral Map of Ukraine, field surveys and social GEO-information service "GISFILE"

Nevertheless, the final decision should be made at the local level while making spatial planning of the territorial communities. The authors of the research propose a conceptual model for planning the use of agricultural lands with self-sown forests (Fig. 6).

Referring to the inventory of lands, it is necessary to make managerial decisions concerning their future use, in particular, either change or not change their intended use, to include those land plots into the category of forest or environmental lands, or they should stay in the category of agricultural lands. According to the laws of Ukraine, the category of lands and their intended use are defined within the specific kind of the territory functional intention, identified in the complex plan of spatial development of the community area (On Amendments to Certain Legislative Acts of Ukraine Concerning Land Use Planning, 2020). It means the complex plan should include information about boundaries of the functional zones of the whole community area with the requirements to building and topographic organization. The territory functional zones should specify the permissible kinds of the land intended use with the list of restrictions.

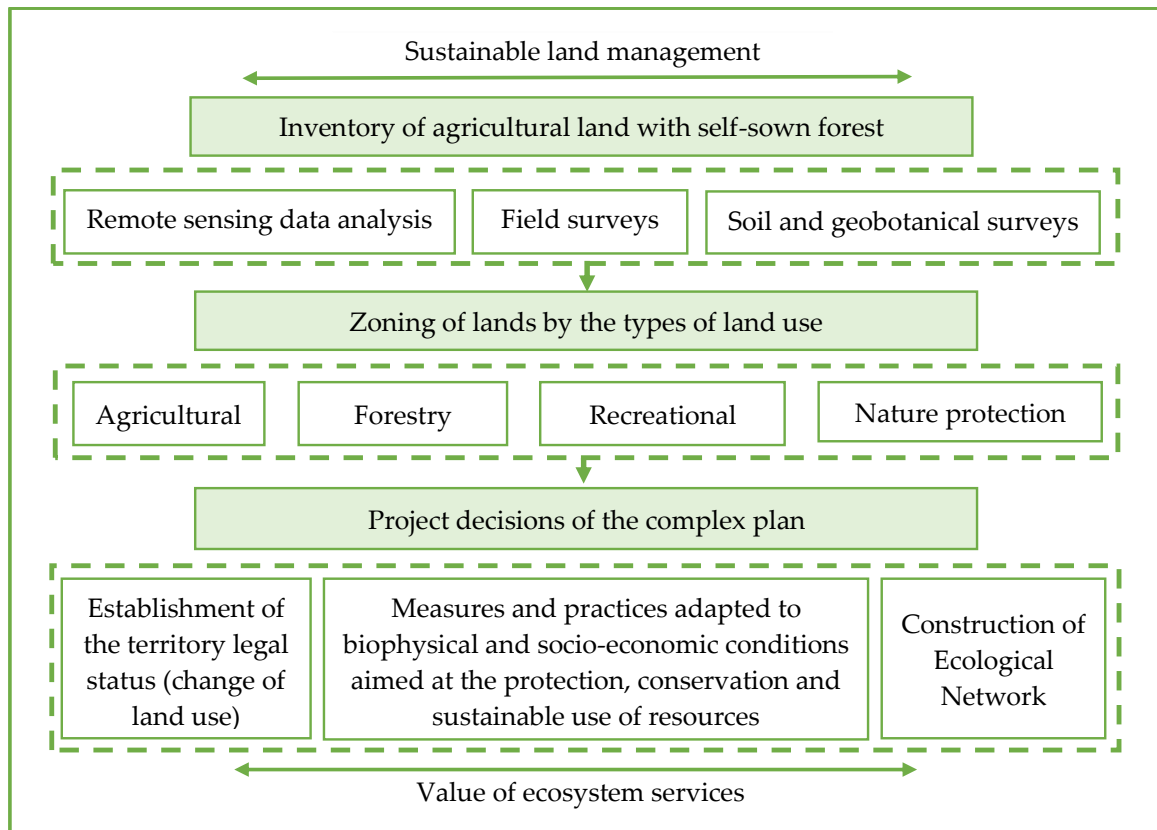


Fig. 6. Conceptual model of planning the use of agricultural land with self-sown forest  
Source: author compilation

In that context, while planning the land use it is necessary to make the territory zoning along with grouping agricultural lands by the types of use with consideration of their quality, assessment of sensitivity to anthropogenic burden, modern use and determination of target functions of the future community development. It will determine the land use conditions and regulations within the corresponding types. It is recommended to distinguish four types of land use:

- agricultural type – crops of different kinds of perennial fodder herbs for feeding animals with fresh green forage at pastures, or making hay and other green forage;
- forest type – growing forest plants to satisfy needs of population and production for timber, technical, medical and other forest products; another important additional use of forests is related with obtaining non-timber products of forest, particularly collecting wild fruits, nuts, mushrooms, berries, medical plants, oleoresin, wood sap, placement of apiaries, etc.;
- recreation type – lands of that type can be used for strolling, riding bikes and horses, camping, gathering berries, mushrooms, medical plants, photo hunting, resting by the river, fishing, etc.;
- environmental type – any activity, interfering natural processes in the ecosystems or making harmful effects on the natural complexes and objects, is forbidden; a specific environmental regime is settled on the territory to restore the ecosystem natural conditions, to protect and improve its sustainability, capability to self-regulation,



ecological potential; in the future, such territories should be included in the ecological network.

Determining the direction of use of the agricultural lands with self-sown forests, it is required to assess the ecosystem benefits, which can be obtained from such lands. To regulate the land relations of environmental use and to motivate land owners, it is recommended to introduce a conservation easement (Murray et al., 2021).

The issue of self-sown forests on agricultural lands is disputable and needs further studying. However, the authors of the research consider, that self-sown forests perform as one of the tools to restore the natural ecosystems and to improve the biological diversity of territories. Therefore, management of self-afforested lands in favor of their protection should be an important constituent of the state policy, spatial planning and land resources management at the local level (at the level of territorial communities).

Obviously, self-sown forests need human support, treatment and protection from different negative impacts (e.g. fires, pests, invasion kinds, etc.). But, since self-sown of forest plants happens in a natural way (passive forest restoration), such forest ecosystems will be more resistant to different natural phenomena in the future and more valuable for increase of the territory biological diversity than man-cultivated forests (active forest restoration) (Birch et al., 2010).

## **Conclusions**

1. It is important to protect self-sown forests in Polissia zone, where ecosystems have been important elements of the space, often dominating ones. The process of self-afforestation on agricultural lands should be considered as natural regeneration of forests, which provides for ecosystem benefits through restoration of natural ecosystems and increase of the territory biological diversity.

2. Inventory of agricultural lands with self-sown forests is an important constituent of sustainable management of lands and spatial planning, using the data of satellite remote sensing. A mandatory condition of the inventory of land plots with self-sown forests is to conduct soil and geobotanic observations of the land quality characteristics.

3. Solution of the problem of self-sown forests on agricultural lands needs a complex approach with consideration of legal, economic, social, and ecological aspects. However, the ecosystem value of forest ecosystems should be a primary criterion for determining the direction of use of the self-afforested agricultural lands.

4. Results of the research can be used for making a complex plan of spatial development of community territories in terms of topographic planning, as well as for project decisions concerning protection of land, water, forests, formation of ecological network, management of river basins, etc.

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