Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 4, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

PROSPECTS OF EMPLOYMENT OF DEGRADED ARABLE LANDS IN UKRAINE

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Abstract

Degradation of arable lands makes ecological and social-economic threats for sustainable development of rural territories in Ukraine. The most spread kinds of degradation of arable lands are water and wind erosion of soils. To solve the problems of land and soil degradation, the national ecological policy expects reduction of the area of degraded arable lands by conservation and improvement of the directions of economic activity on rural area. The present research gives argumentation of such alternative directions of employment of degraded arable lands as growing of energy willow and hazelnut, sowing of perennial herbs for production of forage and honey. Evaluation of the projects efficiency is made according such criteria as net present value, profitability index and payback period. Calculations prove reasonability of investments into alternative employment of degraded arable lands. Ecological benefits of the projects implementation include anchoring of the soil top layer with root systems of plants on erosion-dangerous land parcels; enrichment of soil cover layer with nutrients under perennial herbs; raise of biological diversity of the territory. To improve the directions of economic activity on rural area it is recommended to introduce grant-project form of development of territorial communities.

Key words**:** *degraded arable lands, alternative directions of activity, efficiency, sustainable development, rural territory*

INTRODUCTION

Reclamation of degraded lands and soils, as well as efforts of the whole world not to deteriorate land conditions, are the main tasks of sustainable development of society [26].

In the global context, solution of the problem of land degradation needs application of the approach, which is focused on synergy and interrelations of such tasks as stop of the processes of land degradation, protection of biological diversity and control for climate changes. It means that measures, intended to stop land degradation, should improve the situation with biodiversity of territory, climatic changes and vice versa. However, the problem should be solved at a local level, considering particular conditions and reasons of degradation progress. It is necessary to plan local solutions concerning land protection and improve local policy of land resources management [9].

Soil degradation is the main negative process of land degradation, which causes deterioration of its useful properties and fertility. It is a result of a complex effect of natural and anthropogenic factors. Soil degradation started its accelerated development in the 20th century due to intensification of agriculture, urbanization and cutting down of forests. The heaviest soil degradation is observed on arable lands in the form of water and wind erosion [13] [22].

According to the data of Food and Agriculture Organization of the United Nations (FAO), in Ukraine soil erosion causes annual loss of 300-600 million ton of soil. Total area of degraded and low-productive arable lands constitutes more than 6.5 million ha. It causes decrease of yield of agricultural crops and losses due to under-production in the amount of above 20 billion UAH (approximately USD 759 million annually) [7].

Conservation of arable lands, which is done by withdrawal of them out of economic use for a definite period or for permanent through grassing or forestation, is an important measure to protect agricultural landscapes and to stop degradation processes of soil [4]. Nowadays, in many countries, land

conservation is done to protect not only soils and agricultural lands, but also to increase biodiversity of the territory. In spite of the fact that conservation of arable lands excludes their intended use, landscape approaches to land protection still have not only ecological but also economic and social benefit in the form of ecosystem services, secured by the nature (food, fibre and fuel, natural medicine, fresh water, climate regulation, pollination, erosion control, recreation and tourism, aesthetic values, etc.) [8] [24].

In Ukraine, solution of the problem of land degradation and security of sustainable development of the territory also expects a set of tasks of ecosystem character, in particular, reduction of the area of degraded arable lands through conservation and improvement of the directions of economic activity on rural territory [2]. However, although intensive use of degraded arable lands is of poor efficiency, alternative kinds of activity on rural area of Ukraine are introduced at slow rates, and land grassing is an unfavourable way to employ erosion-dangerous land parcels.

The aim of the research is to argue alternative directions of employment of degraded arable lands, which will support sustainable development of rural territories in Ukraine.

MATERIALS AND METHODS

The research is based on one of the principles of the sustainable development concept, i.e. "to secure a sustainable and long-term character of development in order to meet needs of people, living now, along with the possibility of future generations to satisfy their needs" [12]. The work also employs the idea of ecosystem approach as a strategy of integrated management of natural resources, which secures preservation and sustainable use of the resources in a justified way [23].

Intensive employment of arable land is considered as an economic use of land parcels in the ways, causing deterioration of soil quality (system plowing of erosion-dangerous area, violation of soil-protective requirements of arable farming, employment of degraded lands).

Alternative directions of use of degraded arable lands include:

-growing of energy crops;

-growing of perennial plants;

-sowing of perennial herbs for forage production;

-sowing of perennial herbs for honey production.

Financial efficiency of the projects implementation is examined under conditions of the Western region of Ukraine for four enterprises in Lviv region, where arable lands suffer from the different kinds of degradation, i.e. water erosion on slopes, wind erosion on the land parcels with the soils of light mechanical content (deflation), water-logging of lands.

To estimate investment projects, the following dynamic indicators are calculated, particularly net present value, profitability index and discounted payback period [27]:

$$NPV = \sum_{t=1}^{T} \frac{CF_t}{(1+d)^t} \quad (1)$$

$$PI = \frac{\sum_{t=1}^{T} \frac{CF_t}{(1+d)^t}}{\sum_{t=1}^{T} \frac{I_{ut}}{(1+d)^t}} \quad (2)$$

$$DPP = \frac{\sum_{t=1}^{T} \frac{I_{ut}}{(1+d)^t}}{\sum_{t=1}^{T} \frac{CF_t}{(1+d)^t}} \quad (3)$$

where:

NPV – net present value, UAH;

PI – profitability index;

DPP – discounted payback period, years;

CF_t – cash flow in a year *t*, UAH;

d – discount rate per annum;

I_{ut} – investment expenditures in a year *t*, UAH;

t – serial number of each year;

T – period of the project implementation, years.

Financial efficiency of implementation of the projects was estimated under conditions of the western region of Ukraine (Lviv region), where one can widely observe such kinds of degradation of arable lands as water erosion on slopes, wind erosion on the land parcels

with the soils of light mechanic content, acidification of soils and waterlogging of lands.

Aggregate and order of the technological processes, which are necessary to be performed in the process of implementation of each project, are defined on the base of a detailed study of scientific works, regulatory documents and reference books in the mentioned field.

Production expenditures are determined by materials expenses, expenses for labor payment, depreciation costs and general production expenditures. Expenditures for payment and material expenses for fuel are calculated on the base of acting norms of production, time, and fuel consumption in agriculture of Ukraine [20]. Amount of other material expenditures is calculated on the base of acting market prices. General production expenditures are taken in the size of 30% of the amount of annual labor payment. Depreciation costs are calculated by production method. Income is determined at minimum values of the indicators of yield capacity and sale prices for each kind of products.

A rate of discounting of money flows is calculated by the method of cumulative construction by adding compensations for different risks to a risk-free basic rate (Table 1).

Table 1. Calculation of discounting rate

Rate and compensation	Value, %
Risk-free basic rate	4.2
Compensation for risks, particular for the branch	1.0
Compensation for differences in liquidity of investment	3.0
Compensation for the necessity of investment management and competent management of assets	1.0
Compensation for inflation processes	3.0
Total	12.2

Source: the author's personal calculations

A risk-free basic rate is defined as an average rate for currency deposits of ten commercial banks of Ukraine. Compensation for a branch risk is determined on the base of the norms of the Fund of State Property of Ukraine [1]. Compensation for risks of investment liquidity is set on the ground of the fact, that investments into purchase and development of a land parcel are relatively liquid within the qualification group of the estimated object, while having less liquidity, as comparing to bank deposits [5]. Value of compensation for the necessity of investment management considers available or absent competent management. Concerning a high rate of growth of the prices for goods and services, a correction for inflation processes has been made.

RESULTS AND DISCUSSIONS

Project 1. Growing of energy crops

The project is intended for a farming enterprise under administration of Rozvadiv village council in Mykolaiiv district, Lviv region, which employs 34.6 ha of arable lands with water-logged soils.

The project takes energy willow as its object, which is unpretentious to soil conditions, enriches soil with minerals, microelements and nutrients of natural origin, has a high yield capacity on well irrigated lands. Willow is also used as an anti-erosion means for anchoring of soil and as a natural filter for its purification. Degree of land exhaustion by willow is 3-5 times lower than by cereals. Besides, almost 60-80% of nutrients come back into the land with fallen leaves [10] [21].

Time horizon of the project is 28 years. It is planned to get yield of willow every three years, i.e. nine times during the period of the plantation existence. Expected yield capacity of energy willow is taken as 60 ton/ha in the first and ninth cycles, 70 ton/ha in the second and eighth ones, and 80 t/ha in other cycles.

Project 2. Growing of perennial plants

The project is intended for a farming enterprise under administration of Poharysko village council in Zhovkva district, Lviv region, which employs 12.0 ha of arable lands with deflated soils.

Hazelnut tree has been chosen as an object for the project. Comparing to other perennial plants, it is unpretentious to the quality of soil (but acidic, salinized and waterlogged ones) and microclimatic characteristics of territory.

Root system of nut crops has high anti-erosion properties, supplying conditions for the soil protection from degradation. Placing of a nut orchard on 3-6° slopes enables easy maintenance of the soil and simplifies shipping of nuts. Establishing an orchard on 7-20° slopes, it is necessary to keep to the requirements of anti-erosion protection. The project also considers a great demand for nuts at the domestic and foreign markets [14] [19].

A minimum time horizon of the project is 75 years. Every 25 years, i.e. three times during the period of the plantation existence, it is planned to make surgery with total cutting of a tree. A crop starts to bear fruits on the fifth years. Performing the total complex of measures concerning maintenance of the hazelnut plantation it is possible to obtain 5 kg of nuts from each tree starting from the 5th to the 10th year of fruit-bearing, 8 kg – from the 10th to the 20th year and 6 kg – from the 20th to the 25th [11].

Project 3. Sowing of perennial herbs for forage production

The project is intended for a farming enterprise under administration of Remezitsi village council in Zolochiv district, Lviv region, which employs 16.2 ha of arable lands with eroded soils.

Herbage and hay of perennial herbs are characterized with high feeding qualities. Nutritive value of 1 kg of hay constitutes approximately 0.52 feeding unit. Cubes and granules are not of less nutritive value than oats [3]. It can secure the branch of animal breeding with cheap and appropriate feeding base. At the same time, perennial herbs improve soil fertility, protect it from wind and water erosion, positively influence soil cultivation. According to the data of scientific and research institutions, after three-year growing of perennial herbs, amount of humus increases by 0.3-0.4%, a share of nitrogen in the soil by 150-200, sometimes 300 kg/ha. A share of calcium and other substances, contributing to intensification of structural soil aggregates, also increases [25].

Time horizon of the project is 8 years. It is recommended to sow multi-component legume and cereals herb mixtures: meadow clover, esparcet horned, meadow carmine, red chaff, with the sowing norms of 5 kg/ha, 8 kg/ha, 5 kg/ha and 9 kg/ha respectively. Such herb mixture is more resistant to unfavourable conditions, creates a dense turf, structuring the soil, and secures obtaining of forage with balanced nutrients. To reduce surface flow of melted and rainwaters, the soil is recommended to be cultivated across the slope or by contour. To support high productivity and durability of grass stand, it is necessary to apply mineral and organic fertilizers. Starting from the second year, it is recommended to make overgrazing on the places of grass stand destruction with the norm of 5-10% of the total area of cropping.

Preparation of hay should be done in the first year, making two mowing's in a season. Under performance of a complex of crop-engineering and agro-ameliorative works, cultivated hayfields can supply 10.0-13.0 ton/ha of dry weight of grass [18].

Project 4. Sowing of perennial herbs for honey production

The project is intended for a farming enterprise under administration of Nadychi village council in Zhovkva district, Lviv region, which employs 6.7 ha of arable lands with eroded soils.

Sowing bee plants with different period of flourishing and different productivity, it is possible to create a honey-producing conveyer, which will secure bee-families with honey yield during the whole season.

White sweet-clover is taken as a perennial and bee plant for the project. It is also good for vegetative reclamation. The plant is unpretentious to soil fertility. It grows well on light sandy, not deep carbonate, rocky soils and black alkali, on hilly area and washed-out slopes of ravines, where it is necessary to introduce anti-erosion measures. Sweet-clover also enriches the soil with organic substances and improves its structure [15] [17].

Time horizon of the project is 5 years. Sweet-clover starts to flourish on the second year after sowing. Thus, it is rationally to sow it along with phacelia, i.e. an annual bee plant in order to yield nectar in the first year. Sweet-clover does not need specific agro-technical measures. However, under application of mineral fertilizers, the plants grow higher,

increasing their honey yield. To regulate the period of honey yielding, vegetation is mowed twice a season. It is planned to pump honey three times a year. Maintenance of one hectare of sweet-clover plants needs two bee-families [6]. It is expected to gather 250-350 kg of honey from one hectare of phacelia, and 300-500 kg of honey from one hectare of sweet-clover.

Efficiency of the projects is measured at minimum indicators of production expenditures, expenses for labor payment, yield capacity and sale prices for products (Table 2).

Table 2. Main criteria of projects evaluation

Project	Index		
	Net Present Value, thousand UAH/hectare	Profi-tability Index	Payback Period, years
Project 1	35.11	1.08	5.9
Project 2	1460.83	21.8	4.6
Project 3	25.67	1.65	2.3
Project 4	36.79	9.8	1

Source: calculated by the author.

Analysing the obtained results, one should mark that each project is profitable for capital investments. Index of the net present value proves that revenues from investments are enough to meet the expenditures and to increase income within each project. In all variants, profitability index is above one, i.e. profitability rate of all projects exceeds the common rate of discounting, i.e. 12.2%. Evaluation of the project according to payback period of investments confirms that the most attractive is the variant of use of degraded arable lands for honey production, because in the first year of the project implementation, amount of income equals the amount of investments into the project.

To stimulate farmers to diversify their production, it is necessary to introduce a grant-project form of development for territorial communities [16]. Advantages of such approach are revealed in its multifunction (solution of some primary tasks), collectivity (consideration of the interests of the community majority), an opportunity to attract different sources of financing (funds of local, regional and state budgets, funds of private domestic and foreign investors, money of international organizations and funds) by means of transparent and open selection.

CONCLUSIONS

To sum up, introduction of alternative directions of use for degraded arable lands, which expect combination of environmental measures and ecologically focused commercial activity, will secure solution of both ecological and social-economic problems of a region.

The authors of the work have studied four variants of alternative use of degraded arable lands with different economic intention, but similar ecological target, i.e. to protect soil from degradation, first from erosion.

Although estimation of the investment projects is a little subjective one (for example, it does not concern conjuncture of the market, logistics), the authors of the research consider the projects are attractive for implementation within the policy of integrated management of rural territories. Planning development of the territories it is important to take alternative directions of use for degraded arable lands as one of possible ways to solve the tasks concerning stimulation of development of small and medium business on rural area, support for alternative power engineering, development of ecological network and protection of biological diversity.

ACKNOWLEDGEMENTS

The experiment is highly appraised by the Department of Ecology and Natural Resources in Lviv region, as well as partially considered in completing of a Program of social-economic and cultural development of Zhovkva district, Lviv region. We are thankful to our colleagues from the department of economic development and trade of Zhovkva district state administration for consulting and sufficient support for the research performing.

Particular thanks to anonymous readers for their comments to the previous version of the work.

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