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## THE SWAPPING APPROACH IN THE COURSE OF LAND CONSOLIDATION: CASE STUDY OF UKRAINE

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**Abstract.** The paper is concerned with the issues of the voluntary land consolidation using the exchange method at land relations reforming. The objective of the article is the substantiation of the exchange method aiming at the large and small land owners (land users) land tenure optimization and the formation of approaches with the help of which the mutual alignment of their interests can be achieved. Land plot ownership and tenure rights exchange by the relative value has been substantiated. It is suggested to define the relative value based on the principle of juxtaposition of land plots by their qualitative, spatial and technological characteristics. The land plots exchange modelling has been improved according to the relative value application and due to the existing land plots boundaries retaining at the exchange. The effectiveness of the suggested land plots exchange method has been demonstrated at the land tenure optimization of an agricultural enterprise and some households in Kyiv Region. Alternative land consolidation projects based on the land plots exchange have been developed, the results of which demonstrate the advantages of the voluntary land consolidation based on the suggested methodology.

**Keywords:** land consolidation, land reallocation, land mass, land exchange, relative value, agricultural land.

### Introduction

The importance of land consolidation for the rural areas sustainable development is currently acknowledged worldwide (Giovarelli & Bledsoe, 2001; Vitikainen, 2004; Hartvigsen, 2014; Food and Agriculture Organization of the United Nations [FAO], 2003). The search of the most effective mechanisms of its implementation is an urgent issue. In this context, the issue of the alignment to the conditions and objectives of land consolidation is singled out (FAO, 2012, 2003). It is substantiated by the diversity of land consolidation approaches and mechanisms of their implementation (Vitikainen, 2004; Thomas, 2006; Hartvigsen, 2016).

At land consolidation, land plots exchange is recognized to be one of key tools (Sonnenberg, 2002), ownership rights exchange is recognized to be the key principle (Louwsma et al., 2014). The effectiveness of the swapping approach is proven as a constituent of land consolidation (Yimer, 2014). Land exchange is the most elaborately treated at the voluntary land consolidation and individual

land owners initiatives (Gedefaw et al., 2019; Sulonena et al., 2017; Bavarian Ministry of Agriculture and Forestry, 2006).

The article concentrates on the issues of the effective exchange method implementation at land consolidation in the context of land relations development. In Ukraine, an attempt at the regulation of the issues of land exchange of all forms of property within the agricultural land masses was made as the first stage of the land consolidation legislation development (Verkhovna Rada of Ukraine, 1998, 2001). However, there is no technical support of such initiatives, recommended by Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (FAO, 2012).

Currently, significant power has been accredited to the local authorities; land users motivation concerning the optimal land tenure through land consolidation is increased due to the land market establishment. Ukrainian legislation favours land users using more than 75% of land plots of an agricultural land mass concerning land

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consolidation issues (Verkhovna Rada of Ukraine, 1998, 2001). Such land user is considered to be an individual (company, or other entity) enjoying the usage right of the predominant agricultural land mass share (hereafter referred to as a large land user). According to the existing social and economic conditions, there is a request for the development of a so called user manual reflecting the clear and transparent land plots reallocation criteria.

The objective of the article is the substantiation of the exchange method aiming at the large and small land owners (land users) land tenure optimization and the formation of approaches with the help of which the mutual alignment of their interests can be achieved.

## 1. Materials and methods

Normative monetary value is defined as the key agricultural land exchange tool in Ukraine. Arable land plot normative monetary value is calculated by the formula (Cabinet of Ministers of Ukraine, 2006):

$$V = \frac{N_r}{Bg_r} \sum_{i=1}^n S_i Bg_i, \quad (1)$$

where  $V$  – is the land plot normative monetary value;  $N_r$  – is the capitalized rental income norm (uniform for a region), UAH/ha;  $Bg_r$  – is the soil fertility ball by a 100-ball scale (ball-bonitet), average for the region;  $Bg_i$  – is the soil ball-bonitet of the soil suitability group;  $S_i$  – is the soil suitability group area of the  $i$ -th soil of the land plot;  $n$  – is the number of soil suitability groups of the land plot.

According to the legislation of Ukraine (Verkhovna Rada of Ukraine, 1998, 2001), land plots exchange should be carried out by the following rules:

- Land plots to be exchanged should be placed within the same land mass;
- Land exchange is carried out for the striped land plots, provided their placement impedes the rational land use;
- Normative monetary value of the exchanged land plots should vary by no more than 10%.

The set exchange conditions do not guarantee the effective land plots reallocation for several reasons. First of all, the majority of land masses consists of land plots with almost the same normative monetary value (within 10%), excluding some land plots, formed by the division at inheritance. However, such land plots significantly differ in terms of configuration and placement.

Close normative monetary value of land plots within a land mass is predefined by the peculiarities of the distribution of the state and collective agricultural enterprises property and privatisation of land plots by private persons. According to the conditions, secured by legislation, there is a great number of land plots exchange options and in order to choose the optimal one the development of an additional methodology is needed. The abovementioned facts pose a threat (FAO, 2017) in terms of the involvement in the exchange through a court proceeding without the consent of the land owner.

On the other hand, as we can see from formula (1), the arable land plots normative monetary value within a region varies depending on ball-bonitet exclusively as the soil fertility characteristics. At calculating the normative monetary value according to the existing methodology, important for agricultural activity land plots characteristics are not considered, particularly, configuration, relief, ground water depth level, need for irrigation, placement of household buildings and target markets, etc. If a land tenure includes a number of land plots, it is reasonable to consider their mutual placement.

Respectively, it is recommended to apply relative value to substantiate the exchange (FAO, 2003), which is suggested to be defined by spatial, technological and qualitative characteristics. Land reallocation modelling approaches based on the minimization of distances between land plots of a certain land owner or user have been introduced (Kik, 1980; Mihajlovic et al., 2011). It is suggested to improve the optimization model based on the peer exchange by qualitative and spatial and technological conditions (Bugaienko, 2019) taking into consideration land exchange with retaining the existing land plots boundaries.

Land plots exchange with retaining the existing land plots boundaries has a set of advantages connected with the simplification of the transactions approval and legal description. It is worth mentioning, at the optimization of the rented land tenure the exchange is carried out by land sublease agreement. In such cases, land sublease agreement provisions are restricted by the land lease agreement terms and conditions, in particular, in terms of area and placement.

We scrutinize  $k$  land plots, the placement of which poses inconvenience for the economic activity, and  $j$  land plots, suitable for exchange. Herewith,  $k \leq j$ . Key reallocation precondition is exchange by relative value which can vary for the land plots to be exchanged within the range of 10%. Considering the abovementioned, it is suggested to adhere to the condition:

$$0.9 \leq \frac{K_{ji} B_{ji} S_{ji}}{K_{ki} B_{ki} S_{ki}} \leq 1.1, \quad i = 1, 2, \dots, n, \quad (2)$$

where  $S_j, S_k$  – are the areas of the exchanged land plots;  $B_j, B_k$  – is the average ball-bonitet of the exchanged land plots;  $K_j, K_k$  – is the spatial and technological characteristics coefficient of the exchanged land plots;  $n$  – is the number of the executed exchanges.

Striped land plots, land plots with a placement causing the development of point row areas at cultivating, broken boundaries causing the impaired transport accessibility, tillage, impaired plowing and crop cultivation technology violations, etc. are involved into the process of exchange. Peer land plots are chosen among land plots situated at the land mass boundary.

The exchange has been executed in an agricultural enterprise situated in Kyiv Region, formed from rented privately owned land plots and include eleven land masses (Figure 1).

There are preconditions for the spatial optimization due to the peculiarities of land plots placement, which are

not favourable for the agricultural enterprise economic activities and private land owners and users (Figures 2–9).

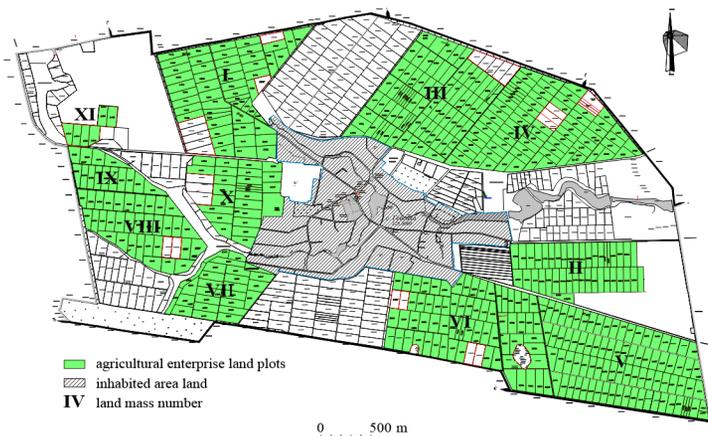


Figure 1. Agricultural enterprise land tenure



Figure 2. Land plots placement and usage within the fourth land mass (source: <https://map.land.gov.ua/>)



Figure 3. Land plots placement and usage within the eighth land mass (source: <https://map.land.gov.ua/>)



Figure 4. Land plots placement and usage within the eleventh land mass (source: <https://map.land.gov.ua/>)



Figure 5. Land plots placement and usage within the first land mass (source: <https://map.land.gov.ua/>)



Figure 6. Land plots placement and usage within the second land mass (source: <https://map.land.gov.ua/>)



Figure 7. Land plots placement and usage within the third land mass (source: <https://map.land.gov.ua/>)



Figure 8. Land plots placement and usage within the tenth land mass (source: <https://map.land.gov.ua/>)

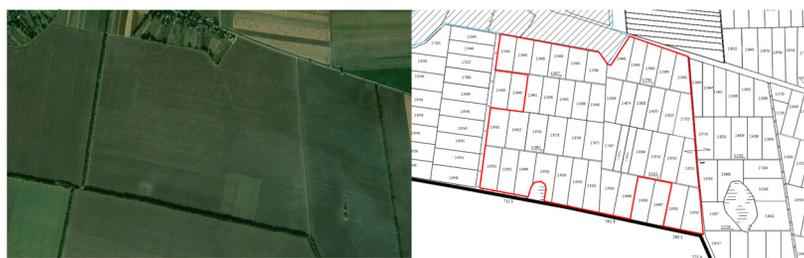


Figure 9. Land plots placement and usage within the sixth land mass (source: <https://map.land.gov.ua/>)

Land tenures have complicated technological conditions due to their placement towards natural and artificial boundaries like roads, tree belts, water-logged areas (the sixth, seventh and eighth land mass) and due to the use of land plots within the land mass by several land owners or users. The fourth and eighth land mass (Figure 2 and Figure 3) include the striped land plots of private land owners, which form interspersed contours with the total area of 70290 sq. m. and 58998 sq. m. within the land masses rented by the agricultural enterprise. Vehicle access to the land plots is provided by the auxiliary field roads 700 and 410 meters long respectively. The eleventh land mass (Figure 4) is close to the striped one by its spatial placement characteristics, because it is formed of two parts having

the common boundary of approximately 37 meters only.

According to the existing conditions, the exchange has typical aims of the agricultural land plots spatial characteristics improvement (Malashevskiy et al., 2018):

- Land tenure configuration improvement;
- Land plots vehicle access improvement;
- Strip farming removal;
- The reduction of distances from land plots to household buildings or other land plots of the same land owner.

Two land plots exchange options are suggested. In the first case, the exchange is carried out in accordance to legal restrictions for the case when land owners and users can be involved irrespective of their will, in particular,

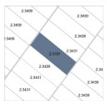
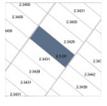
by decision of a court. The exchange of land plots placed within one land mass aiming at interspersed removal was stipulated. Accordingly, land plots reallocation within the ninth, eighth and eleventh land mass was carried out (Table 1).

Voluntary land owners participation was stipulated by option II. The exchange of fifteen land plots was carried out; possible land reallocation options without restrictions on the placement in the land mass were scrutinized

(Table 2). At the selection of peer land plots, land owners, for whom the exchange was rewarding from the point of view of the configuration and placement optimization of their own land plots (usually, towards other land plots and household buildings of these land owners), participated at the project.

As we can see from Table 1, 2, in both cases requirements on the land plots normative monetary value difference within the range of 10% were met at the reallocation.

Table 1. Land plots exchange in the land consolidation project (option I)

Land plots subject to exchange							Land plots chosen for exchange							Δ, %
Configuration	Land mass number	Soil suitability group			Normative monetary value V, UAH	Relative area SBK, sq.m.	Configuration	Land mass number	Soil suitability group			Normative monetary value V, UAH	Relative area SBK, sq. m.	
		Area, sq. m.	Code	Ball-bonitet, B					Area, sq. m.	Code	Ball-bonitet, B			
	IV	23428	53Д	63	101740.9	129.05		IV	23400	53Д	63	101628.0	125.28	+0.1
	IV	23431	53Д	63	101753.9	129.12		IV	23400	53Д	63	101619.3	128.86	+0.1
	IV	23431	53Д	63	101753.9	129.12		IV	23399	53Д	63	101614.9	129,04	+0.1
	VIII	29500	41Д	50	101674.4	133.34		VIII	21445	41Д	50	99394.7	131.72	+2.2
							9479		49Д	39				
	VIII	29498	41Д	50	101667.5	133.32		VIII	23092	41Д	50	107770.7	133.85	-6.0
							10483		49Д	39				
	XI	9187	41Д	50	106813.8	143.71		XI	9914	41Д	50	110974.3	146.55	+3.7
		7914	53Д	63										
		14699	49Д	39										
	XI	8310	41Д	50	97347.6	127.87		XI	30200	41Д	50	103990.5	139.95	+6.4
		7170	53Д	63										
		13434	49Д	39										

Note: Δ – is the difference of the land plots normative monetary values.

Table 2. Land plots exchange in the land consolidation project (option II)

Land plots subject to exchange						Land plots chosen for exchange						Δ*, %		
Configuration	Land mass number	Soil suitability group			Normative monetary value V, UAH	Relative area SBK, sq.m.	Configuration	Land mass number	Soil suitability group				Normative monetary value V, UAH	Relative area SBK, sq. m.
		Area, sq. m.	Code	Ball-bonitet, B					Area, sq. m.	Code	Ball-bonitet, B			
	XI	14 130	53Д	63	104 999.4	131.47		IV	23428	53Д	63	101 740.9	129.05	-3.2
		10 048	55Д	53										
		2010	41Д	50										

End of Table 2.

Land plots subject to exchange							Land plots chosen for exchange							Δ*, %			
Configuration	Land mass number	Soil suitability group			Normative monetary value V, UAH	Relative area SBK, sq.m.	Configuration	Land mass number	Soil suitability group			Normative monetary value V, UAH	Relative area SBK, sq. m.				
		Area, sq. m.	Code	Ball-bonitet, B					Area, sq. m.	Code	Ball-bonitet, B						
	XI	14 399	53Д	63	105 989.0	133.67		IV	23431	53Д	63	101 753.9	129.12	+4.2			
		7303	55Д	53					23431	53Д	63						
		4868	41Д	50					23431	53Д	63						
	XI	9762	53Д	63	107 262.2	141.10		IV	23431	53Д	63	101 753.9	129.12	-5.4			
		8577	209Д	60					23431	53Д	63						
		6127	49Д	39					23431	53Д	63						
		2451	41Д	50					23431	53Д	63						
		1225	55Д	53					23431	53Д	63						
	X	14 669	41Д	50	96 838.0	130.31		VIII	29500	41Д	50	101 674.4	133.34	+4.8			
		17 215	49Д	39					29500	41Д	50						
	X	28 401	49Д	39	103 095.1	124.94		VIII	29498	41Д	50	101 667.5	133.32	-1.4			
		2771	41Д	50					29498	41Д	50						
		4157	209Д	60					29498	41Д	50						
	XI	6381	53Д	63	102 447.8	126.25		I	4023	41Д	50	106 425.9	138.46	+3.7			
		18 887	55Д	53					21 314	53Д	63						
		1595	41Д	50					21 314	53Д	63						
	XI	9914	41Д	50	110 974.3	146.55		IV	22 442	55Д	53	102 690.8	134.32	-8.1			
		17 686	53Д	63					2210	53Д	63						
	XI	30172	41Д	50	103 990.5	139.95		IV	4273	53Д	63	32 190.5	125.12	-2.4			
									3732	55Д	53				3732	55Д	53
									7791	53Д	63				214	55Д	53
									8005	53Д	63				8005	53Д	63
	VI	29 499	41Д	50	101 664.9	133.33		VI	3999	41Д	50	103 292.4	134.66	+1.6			
		20 421	53Д	63					20 421	53Д	63						
	VI	26 333	41Д	50	92 942.7	97.24		VI	668	41Д	50	102 200.8	137.97	+9.1			
		3166	141	10					22 972	53Д	63						
	VI	29 501	41Д	50	101 677.9	135.12		VI	29 497	41Д	50	101 664.1	133.32	0.0			
	VI	29 501	41Д	50	101 677.9	131.61		VI	29 500	41Д	50	101 674.4	131.61	0.0			

Note: Δ – is the difference of the land plots normative monetary values.

## 2. Result and discussion

As the result of exchange by option I, the agricultural enterprise land tenure configuration was improved, the need for additional field roads disappeared (the fourth and eighth land mass) (Figure 10).

However, the potential capacity of the configuration optimization within land masses was not fully realized

and exploited due to restrictions on the involvement of land plots at the land mass boundaries and reallocation exclusively within the land mass. Land plots configuration was improved due to the interspersion removal (Table 3).

However, the exchange facilitated the net income increase due to the reduction of handling costs and the reduction of the uncultivated or cultivated with the technological process violation areas (Table 4).

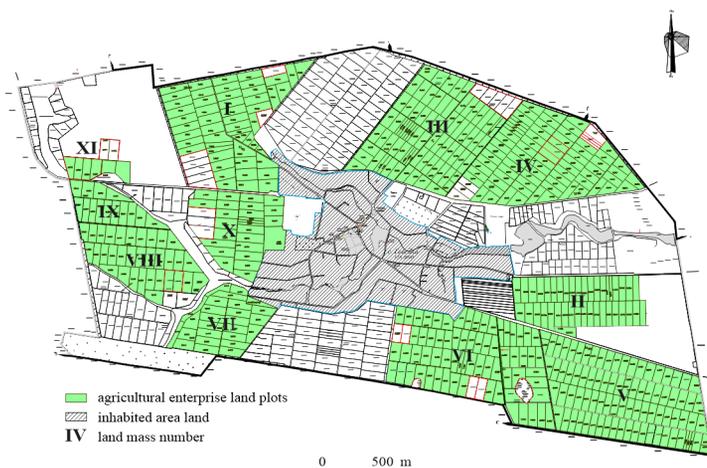


Figure 10. Land consolidation through land plots exchange (option I)

Table 3. Agricultural enterprise land tenure characteristics (option I)

Land mass number	The number of rented land plots	Before land consolidation				After land consolidation			
		Field area, ths. sq. m	Soil suitability groups		Average furrow length, m	Field area, ths. sq. m.	Soil suitability groups		Average furrow length, m
			Code	Area, ths. sq. m			Code	Area, ths. sq. m	
I	52	1593	41д	852	840.0	1593	41д	852	842.0
			49д	676			49д	676	
			53д	27			53д	27	
			209д	38			209д	38	
II	40	980	53д	620	1450.0	980	53д	620	1450.0
			55д	300			55д	300	
			56д	54			56д	54	
			210д	6			210д	6	
III	77	1708	41д	280	1439.1	1708	41д	280	1439.1
			53д	1382			53д	1382	
			55д	46			55д	46	
IV	73	1700	53д	1575	1083.5	1700	53д	1575	1189.4
			55д	110			55д	110	
			209д	15			209д	15	
V	86	2006	41д	153	1535.0	2006	41д	153	1535.0
			53д	1723			53д	1723	
			55д	130			55д	130	
VI	69	1853	41д	1066	1035.0	1853	41д	1066	1035.0
			53д	705			53д	705	
			55д	67			55д	67	
			209д	12			209д	12	
			141	3			141	3	

End of Table 3

Land mass number	The number of rented land plots	Before land consolidation				After land consolidation			
		Field area, ths. sq. m	Soil suitability groups		Average furrow length, m	Field area, ths. sq. m.	Soil suitability groups		Average furrow length, m
			Code	Area, ths. sq. m			Code	Area, ths. sq. m	
VII	26	505	53д	98	1125.0	505	53д	98	1125.0
			55д	351			55д	351	
			56д	50			56д	50	
			210д	6			210д	6	
VIII	33	971	41д	673	930.8	965	41д	687	1150.0
			49д	131			49д	111	
			53д	167			53д	167	
IX	14	382	41д	188	599.6	382	41д	188	599.6
			49д	3			49д	3	
			53д	185			53д	185	
			210д	6			210д	6	
X	30	858	41д	370	845.0	858	41д	370	845.0
			49д	410			49д	410	
			209д	63			209д	63	
			210д	15			210д	15	
XI	6	166	41д	66	337.2	169	41д	43	730.7
			55д	36			55д	36	
			53д	55			53д	52	
			209д	9			209д	9	
Total	506	12722	–	12722	–	12719	–	12719	–

Table 4. Agricultural enterprise land consolidation economic effectiveness (option I)

Agricultural crop	Cultivated area, ths. sq. m	Crop productivity, kg/ths. sq. m	Gross output, ths. kg	Gross income, ths. UAH	Total expenses, ths. UAH	Net income, ths. UAH
Actual values						
Corn	1951	890.1	1736.59	7177.84	3059.19	4118.65
Winter wheat	5204	627.0	3262.91	16 665.61	5578.69	11 086.92
Spring barley	1853	444.6	823.84	4100.35	3059.28	1041.07
Sunflower	2006	297.0	595.78	5287.58	1625.79	3661.79
Soya	1708	205.4	350.82	3121.76	1609.60	1512.16
Total	12 722	–	6769.94	36 353.14	14 932.55	21 420.59
Design target values						
Corn	1945	890.1	1731.29	7155.95	2006.74	5149.21
Winter wheat	5207	627.0	3264.53	16 673.91	3665.87	13 008.04
Spring barley	1853	444.6	823.78	4100.05	3059.28	1040.77
Sunflower	2006	297.0	595.78	5287.57	1625.79	3661.78
Soya	1708	205.4	350.82	3121.77	1052.77	2069.00
Total	12 719	–	6766.20	36 339.25	11 410.45	24 928.80

At the exchange by the option II, as compared with the option I, the number of reallocation options is increased due to a wider choice of land plots to be exchanged (Figure 11).

By exchange within the boundaries of the fourth and eighth land mass, not only are interspersions and the need for auxiliary field roads removed. Also, all

land plots of the respective land masses became the land tenure of an agricultural enterprise (Figure 11, Table 5). The eleventh land mass which had inconvenient configuration and placement (Figure 4), is withdrawn from the agricultural enterprise land tenure after the exchange; configuration of the tenth, first and sixth land mass is improved.

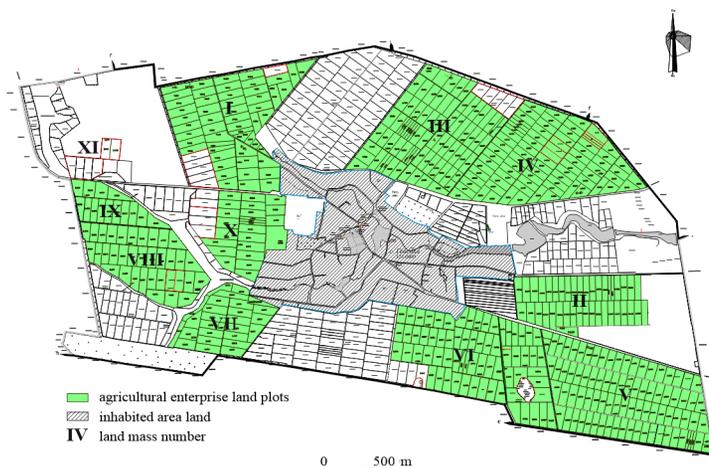


Figure 11. Land consolidation through land plots exchange (option II)

Table 5. Agricultural enterprise land tenure characteristics (option II)

Land mass number	Before land consolidation					After land consolidation				
	Rented land plots number	Field area, ths. sq. m	Soil suitability groups		Average furrow length, m	Rented land plots number	Field area, ths. sq. m	Soil suitability groups		Average furrow length, m
			Code	Area, ths. sq. m				Code	Area, ths. sq. m	
I	52	1593	41д	852	840.0	53	1618	41д	856	842.0
			49д	676				49д	676	
			53д	27				53д	48	
			209д	38				209д	38	
II	40	980	53д	620	1450.0	40	980	53д	620	1450.0
			55д	300				55д	300	
			56д	54				56д	54	
			210д	6				210д	6	
III	77	1708	41д	280	1439.1	77	1708	41д	280	1439.1
			53д	1382				53д	1382	
			55д	46				55д	46	
IV	73	1700	53д	1575	1083.5	80	1826	53д	1669	1410.0
			55д	110				55д	138	
			209д	15				209д	15	
								56д	4	
V	86	2006	41д	153	1535.0	86	2006	41д	153	1535.0
			53д	1723				53д	1723	
			55д	130				55д	130	
VI	69	1853	41д	1066	1035	69	1842	41д	1015	1062.0
			53д	705				53д	748	
			55д	67				55д	67	
			209д	12						
			141	3				209д	12	

End of Table 5

Land mass number	Before land consolidation					After land consolidation				
	Rented land plots number	Field area, ths. sq. m	Soil suitability groups		Average furrow length, m	Rented land plots number	Field area, ths. sq. m	Soil suitability groups		Average furrow length, m
			Code	Area, ths. sq. m				Code	Area, ths. sq. m	
VII	26	505	53д	98	1125.0	26	505	53д	98	1210.0
			55д	351				55д	351	
			56д	50				56д	50	
			210д	6				210д	6	
VIII	33	971	41д	673	930.8	35	1032	41д	734	1150.0
			49д	131				49д	131	
			53д	167				53д	167	
IX	14	382	41д	188	599.6	14	382	41д	188	599.6
			49д	3				49д	3	
			53д	185				53д	185	
			210д	6				210д	6	
X	30	858	41д	370	845.0	28	791	41д	353	846.0
			49д	410				49д	364	
			209д	63				209д	59	
			210д	15				210д	15	
XI	6	166	41д	66	337.2	0	0	–	–	–
			55д	36				–	–	
			53д	55				–	–	
			209д	9				–	–	
Total	506	12722	–	12722	–	508	12691	–	12691	–

Thus, as the result of the respective measures, the land tenure has acquired a compact form, the number of land masses in the land tenure has been reduced, their areas have been increased, their configuration has been improved (Table 6). As the result of land exchange by the

option II, agricultural enterprise net operating income has been increased by 3 997 750.25 UAH.

Exchange by the option II is more cost efficient. In both cases, the economic activity environment did not deteriorate for any of land owners and land users involved in

Table 6. Agricultural enterprise land consolidation economic effectiveness (option II)

Agricultural crop	Cultivated area, ths. sq. m	Crop productivity, kg/ths. sq. m	Gross output, ths. kg	Gross income, ths. UAH	Total expenses, ths. UAH	Net income, ths. UAH
Actual values						
Corn	1951	890.1	1736.59	7177.84	3059.19	4118.65
Winter wheat	5204	627.0	3262.91	16 665.61	5578.69	11 086.92
Spring barley	1853	444.6	823.84	4100.35	3059.28	1041.07
Sunflower	2006	297.0	595.78	5287.58	1625.79	3661.79
Soya	1708	205.4	350.82	3121.76	1609.60	1512.16
Total	12722	–	6769.94	36 353.14	14 932.55	21 420.59
Design target values						
Corn	2012	890.1	1790.97	7402.63	2070.99	5331.64
Winter wheat	5123	627.0	3211.56	16 403.35	2070.99	14332.36
Spring barley	1842	444.6	818.92	4075.83	3034.06	1041.77
Sunflower	2006	297.0	595.78	5287.57	1625.79	3661.78
Soya	1708	205.4	350.82	3121.77	2070.99	1050.78
Total	12691	–	6768.05	36291.15	10872.81	25418.34

the project after the reallocation implementation. Agricultural enterprise rented land area alteration resulted from land plots exchange and the lease of field roads used to access the striped land plots by the agricultural enterprise (such lease is prescribed by the legislation in effect).

The exchange calculation by the relative value using optimization models provides the necessary substantiation. The results of the research witness in favour of option II, which preconditioned voluntary land owners and users participation and excludes additional costs and the reallocation delay due to the exchange appeal.

## Conclusions

According to the research, the effectiveness of land plots exchange aiming at the configuration improvement, the reduction of the number of the striped land plots in the land tenure and the reduction of distances between the striped land plots has been substantiated. The complete substantiation is important for both comprehensive and voluntary land consolidation. The suggested methodology allows to choose the optimal land reallocation option and guarantee the absence of losses for a land owner involved in the project without the alteration of the legislation in effect.

The effectiveness of land exchange by the relative value defined by the collective estimate of the land plot soil quality, area, relief and configuration has been substantiated. The existing modeling approaches have been supplemented with the demands on the exchanged land plots relative value acceptable difference due to the existing land plots boundaries retaining at the exchange. For big land users, the demands on the formation of the most possible compact land tenure with the longest possible furrow and the avoiding of boundaries folding, cutting-in and excessive triangles have been defined. For small land users, demands on the placement of land plots which are situated on the project territory towards other land plots owned or used by the person have been specified.

The suggested reallocation options witness, the projects developed according to the restrictions on the land plots exchange and predefine the possibility of the compulsory land owners involvement have a relatively low effectiveness in terms of land tenure optimization of both big and small land owners. It is more effective to interest individual land owners to voluntarily participate in the project by the selection of the exchange options taking into consideration the spatial, technological and qualitative land plots characteristics.

It has been observed, in case of land exchange the resolving of reallocation issues in favour of individual small land owners (land users) is justified for big land users. It has been demonstrated with an example that irrespective of the fact the total rented area of a big land user (an agricultural enterprise) was decreased as the result of the exchange, the ultimate economic activities effectiveness was increased due to the reduction of expenses

for transportation, cultivation costs and field roads lease which were previously used to approach the interspersed land plots of small land users (households).

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