AGRICULTURAL LAND-USE POTENTIAL AND INVESTMENT REQUIRED IN LATVIA

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Abstract. Land as a resource of agricultural production is not fully exploited in Latvia, as approximately 400 thsd ha, according to the data in the identification system of agricultural parcels, were undeclared for the Single Area Payment Scheme in 2012 and, of the agricultural area, 10 % was uncultivated and 2% was overgrown. It creates unique opportunities and a potential for enhancing the management and use of land in the future to increase the output of agricultural products. Using expert forecasts and a specially developed methodology, calculations on the potential for crop yields and total crop output in Latvia for 2020 were performed based on the utilised agricultural area, composition of sown area, and type of farming in 2012. In the calculations the following indicators were taken into account: increases in crop yields in the current area and, the production of crops in the area that was not exploited in 2012. It was determined that in Latvia in 2020 compared with 2012, there would be good opportunities for enhancing the efficiency of use of land for all groups of agricultural crops. Yet, to ensure the exploitation of an additional area, long-term investments of LVL 120-156 mln are required, of which half is investment in machinery and equipment. The source of long-term investments will be support measures of the Rural Development Programme 2014-2020, yet, provisionally at least a fourth of the public funding intended for investment in agriculture has to be allocated to these measures.

Keywords: agricultural land, exploitation, investment.

Introduction

The Agricultural Census 2010 surveyed close to 12 million farms in the EU-27. These farms covered around 170 million hectares (1.7 million km^2) of utilized agricultural area (UAA). This means that the UAA occupied slightly over 40 % of the EU-27 territory [1]. The UAA is the key resource of agricultural production in any country. The main preconditions for the production of agricultural products are soil fertility, climate, and the location of land that, to a great extent, affect agricultural output and farm income. Land use has been emphasised in research by scientists of many countries, for instance, Richard Flavell (USA) [2] stresses that it is necessary to be overcome throughout the world to help increase the rate of improvements in food production and intensify production on less land. These decisions include putting optimal use of land at the top of the world agenda to sustain both, the planet and an adequate quality of life for mankind. As always it has been the case, more investments are urgently required into the dissemination of successful technologies in crop breeding and production, into teaching and training as well as into innovative research. The same opinion is expressed by the scientists T. Garnett and C. Godfray [3], J.N. Pretty, J. Thompson and F. Hinchcliffe [4], Hongxia Xue [5], Wirsenius et all [6], A. Dobermann, R. Nelson [7] and others.

In Latvia the production resource – land is not exploited efficiently as in many other western economies, and there is a large potential for land to be used in efficient agricultural production. A fact indicates that in 2012, the area of agricultural parcels totalled 2.039 million or 88 % of the UAA in Latvia, but the area declared for the Single Area Payment Scheme, which was maintained in good agricultural and environmental condition, was 1.639 million ha or 80 % of the agricultural parcels. In 2012 in Latvia, the cultivated agricultural area totalled 1.995 million ha or 87 % of the total UAA, the uncultivated agricultural area was 243 thousand ha or 10 %, besides, 2 % of the UAA was overgrown [8]. For this reason, a national task is set for the next years in Latvia (Presidential Decree No 5 of 10 October 2012 “On Proposals for the Efficient and Sustainable Exploitation of Agricultural Land”) that intends to retain agricultural land in or reclaim it for agricultural production in order to efficiently manage approximately 2 mln ha, while at the same time increasing the efficiency of agricultural holdings; it will produce a greater value added and generate higher incomes for farmers, which will lead to greater tax revenues, thus stimulating economic growth [9].

Therefore, the overall **aim of this research** is to identify possibilities for using an additional area of agricultural land for agricultural production and to calculate the amount of long-term investments required for achieving it. To achieve the aim, the following **specific research tasks are defined**: 1) to calculate the potential for the output and yields of the main crops in Latvia; 2) to calculate the amount of long-term investments required for the exploitation of an additional land area.

The research results are useful for state institutions, for example, the Ministry of Agriculture and the Ministry of Environmental Protection and Regional Development in order to provide long-term and sustainable land use in Latvia.

Materials and methods

To execute the research tasks, analysis, synthesis, the logical and constructive methods, induction and deduction were employed. To identify the strength of correlations between the various indicators of agricultural land and farm long-term investments in Latvia, the correlation analysis and descriptive statistics methods were employed using IBM SPSS Statistics 19 (Statistical Package for Social Sciences).

This study analyzed information and available data from the Rural Support Service (RSS), which administrates different support measures, and the Central Statistical Bureau (CSB) information. The study design process used special and general literatures, methodological materials on the land use etc.

To determine the agricultural land-use potential, the opinions of the following Latvian scientists representing the Latvia University of Agriculture, Faculty of Agriculture, the Latvia State Institute of Fruit-Growing, JSC Pure Horticultural Research Station and the following agricultural organisations: the Latvian Agricultural Organisation Cooperation Council, the association "Farmers Parliament" and the Latvian Agricultural Cooperatives Association were used. Also the expertise of experts was taken into account in regard of the trends in the yields, prices, and production cost of crops in the next 6-7 years, i.e., until 2020, the direct payment rates approved in Latvia [10], and the available information on the support payments under the Rural Development Programme 2014-2020 [9].

A methodology was developed for identifying crop yields and crop output to determine the land-use potential in Latvia. First, the experts were asked to forecast the average yield for several crops in the whole country, which was compared with the real yields of these crops in the country in 2012 [11], to subsequently use it to determine the potential yields in Latvian rural territories by the following formula:

$$PP_i = P_i \cdot \frac{PPen}{Pf} \quad (1)$$

where PP_i – potential yield of the corresponding crop in the *i*-th territorial unit;
P_i – yield of the corresponding crop in 2012 in the *i*-th territorial unit;
PPen – potential yield of the corresponding crop in the country, as forecasted by the experts;
P_f – yield of the corresponding crop in the country in 2012.

To calculate the additional land area to be exploited for growing the corresponding crop, the following formula was used:

$$PZ_i = ZN_i > 25 balles / melior \cdot c + ZN_i > 25 balles / nemelior \cdot c \quad (2)$$

where PZ_i – additional land area to be used for growing the corresponding crop in the *i*-th territorial unit;
ZN_i>25*balles*/*melior* – area of agricultural parcels undeclared for the SAPS in 2012, which is ameliorated and its qualitative estimate is less than 25 points, in the *i*-th territorial unit;
ZN_i>25*balles*/*nemelior* – area of agricultural parcels undeclared for the SAPS in 2012, which is unameliorated and its qualitative estimate is more than 25 points, in the *i*-th territorial unit;
c – proportion of the corresponding crop in the area declared for the SAPS in 2012.

To calculate the total output of crops a formula comprised of two parts was used: its first part calculates the potential output of crops from the land area as of 2012, while the second one determines an additional output of crops from the currently unexploited land area:

$$RP_i = PP_i \cdot Z_i + \left(PP_i \cdot ZN_i > 25 balles / melior \cdot c + PP_i \cdot ZN_i > 25 balles / nemelior \cdot c \cdot M\right) \quad (3)$$

where RP_i – potential output of the corresponding crop in the i-th territorial unit;

Z_i– area of the corresponding crop in 2012 in the i-th territorial unit;
M – difference in the yield between unameliorated and meliorated land.

To identify the effect of long-term investment on the economy of farms in Latvia, the FADN was used. The FADN is a survey carried out by the Member States of the EU. It was established in 1965 in accordance with the Regulation No 79/65 of the Council of 15 June 1965 setting up a network for the collection of data on the incomes and business operation of agricultural holdings in the European Economic Community. The target size of the sample for the FADN in Latvia is 1000 farms [12].

Results and discussion

1. Potential for the output and yields of the main crops in Latvia

Cereals. The expert forecasts on the potential output of crops were quite modest, compared with 2012 [11], and the average yield of grains was forecasted for the year 2020 at only 4.1 t·ha^{-1}, including wheat – 4.8, winter barley – 4.5, triticale – 4, and rye, spring wheat and barley – 3.4 t·ha^{-1}. In the calculations it was assumed that 5 % of the total area of grains would be used for organic farming, i.e., the yield would be on average 28.3 % lower, which also affected the total output of grains. The potential output of grains is as follows:

- from the current land area – totally 2465 thsd t, including 2260 thsd t produced in a conventional way and 204 thsd t produced organically;
- in addition, given the percentage distribution of the crops grown in 2012 and the farming techniques in rural territories, 87197 ha could be exploited for grain production, of which 16394 ha will be unameliorated; therefore, additionally 334 thsd t will be gained from the currently unfarmed area.

Rapeseed. The expert forecasts on the potential output of rapeseed were modest, compared with 2012 [11], and the average yield in 2020 was forecasted at only 2.8 t·ha^{-1}. Yet, the experts forecasted intensive farming in the entire area of rapeseed. The potential output of rapeseed might be as follows:

- from the current land area – totally 327 thsd t;
- given the percentage distribution of crops grown in 2012 and the farming techniques in rural territories, 17399 ha could be additionally exploited, of which 3268 ha will be unameliorated; it would provide an additional gain of 45.8 thsd t from the currently unfarmed area.

Potatoes. The expert forecasts on the potential output of potatoes were optimistic, compared with 2012 [11], and the average yield in 2020 was forecasted at 25 t·ha^{-1} in intensive farming and 15 t·ha^{-1} in organic farming. It was assumed that 5 % of the total area of grains would be used for organic farming. The potential output of potatoes might be as follows:

- from the current land area – totally 735 thsd t, including 712.5 thsd t produced conventionally and 22.5 thsd t grown organically;
- given the percentage distribution of crops grown in 2012 and the farming techniques, 6276 ha could be additionally exploited for growing potatoes, of which 1014 ha will be unameliorated; it would enable additional 145.7 thsd t to be gained from the currently unfarmed area.

Forage crops. The expert forecasts on the potential output of forage crops were more optimistic, compared with 2012 [11]. The experts forecasted the average yield of maize at 37 t·ha^{-1}; 25 t·ha^{-1} for green crops and silage crops as well as permanent grasses sown in arable land, and 12 ha^{-1} for fresh biomass harvested in permanent meadows and pastures in intensive farming. The potential output of maize might be as follows:

- from the current land area – totally 718 thsd t;
- given the percentage distribution of crops grown in 2012 and the farming techniques, 3769 ha could be additionally used for growing maize, of which 563 ha will be unameliorated; thereby, 131 thsd t would be additionally gained from the currently unfarmed area.

The potential output of green crops and silage crops as well as permanent grasses sown in arable land might be as follows:

- from the current land area – totally 7688 thsd t;

- given the percentage distribution of crops grown in 2012 and the farming techniques, 61756 ha could be additionally exploited for growing grasses and green crops, of which 11718 ha will be unameliorated; thus, 1292 thsd t would be additionally gained from the currently unfarmed area.

The potential output of fresh biomass gained from permanent meadows and pastures might be as follows:

- from the current land area – totally 3950 thsd t;
- given the percentage distribution of crops grown in 2012 and the farming techniques, permanent meadows and pastures could be established in an additional area of 98820 ha, of which 19098 ha will be unameliorated; in this way, 833 thsd t would be additionally gained from the currently unfarmed area.

Summary on the potential of the output of crops. Using the expert opinions on the potential yields of crops, the potential total output of the main crops was estimated at the level of rural territories for exploiting the current area of crops declared for the SAPS in 2012 more efficiently and intensively [13]. Besides, in 2012, the Rural Support Service had registered 400 thsd ha area of agricultural parcels that was not declared for the SAPS [13], of which 250 thsd ha were ameliorated and 300 thsd ha had a qualitative estimate of less than 25 points. However, the total unameliorated area, the qualitative estimate of which was greater than 25 points, in rural territories was equal to 56 thsd ha, and this area was used to calculate the potential area for growing crops in the future. Taking into account the percentage distribution of the crops grown in 2012 and the farming techniques, the possibility to exploit part of this agricultural area in intensive farming was considered. The calculation results are summarised in Table 1.

Table 1

Potential for the total output of crops in Latvia in 2020

Crop	Output if increasing yields in the current area, thsd t	Additional			Total output, thsd t
		ha	incl. unameliorated area, ha	output, thsd t	
Cereals	2465	87197	16394	334	2799
Rapeseed	327	17399	3268	46	373
Potatoes	735	6276	1014	146	881
Maize	718	3769	563	131	849
Grasses sown in arable land and green crops / silage crops (fresh biomass)	7688	61756	11718	1292	8980
Permanent pastures and meadows (fresh biomass)	3950	98820	19098	833	4783
Vegetables	195	0	0	0	195
Total	x	275217	52055	x	x

By exploiting the agricultural area that was not declared for the SAPS in 2012 in a more intensive and efficient way, an additional area of 275 thsd ha could be used in agricultural production, including 52 thsd ha of unameliorated land whose qualitative estimate exceeds 25 points. The additionally exploited area could increase the output of agricultural products within a range from 12 % (grains, rapeseed) up to 17 % (potatoes, fresh biomass harvested in permanent meadows and pastures), compared with 2012. A comparison of the potential total output of crops in 2020 and that in 2012 suggests that one can forecast the following increases: 32 % for grains, 23 % for potatoes, 53 % for maize, 88 % for green crops, silage crops, and permanent grasses, and 84 % for permanent meadows and pastures.

2. Amount of long-term investment for exploiting the additional agricultural area

To identify relationships between the indicators of the UAA and the required amount of long-term investment in Latvia in 2003-2012 [14-19], a correlation analysis was performed. However, a correlation analysis does not enable the causes of relationships to be justified, but it allows the intensity of correlations between economic variables to be measured. A correlation is strong if $r > 0.8$ [20]. The correlation analysis results are summarised in Table 2.

Table 2

Strong correlation coefficients (r) between the indicators for agricultural land and material and technological resources in Latvia in 2003-2012

Indicator	*r*	Indicator
Number of tractors in Latvia, thsd	0.85	Area of meadows and pastures, thsd ha
	0.80	RDP* long-term investment subsidies for FADN farms, LVL**
Number of combine harvesters in Latvia, thsd	0.89	UAA, thsd ha
	0.85	Arable land, thsd ha
	0.85	Agricultural output of FADN farms, LVL
	0.82	RDP long-term investment subsidies for FADN farms, LVL
Long-term investment in buildings and constructions on FADN farms, LVL	0.92	Long-term investment in machinery and equipment on FADN farms, LVL
	0.86	Agricultural output of FADN farms, LVL
Long-term investment in machinery and equipment on FADN farms, LVL	0.92	UAA, thsd ha
	0.92	Long-term investment in buildings and constructions on FADN farms, LVL
	0.91	Arable land, thsd ha
	0.86	Area of meadows and pastures, ths ha
	0.83	UAA of FADN farms, ha
Long-term investment in other fixed assets on FADN farms, LVL	0.89	UAA, thsd ha
	0.88	Area of meadows and pastures, thsd ha
	0.86	Agricultural output of FADN farms, LVL
	0.85	Arable land, thsd ha

*RDP- Rural Development Programme; ** 1 Latvian lats (LVL) = 0.702804 EUR

Barletta test shows the general significance of correlation for all the variables of less than 0.05 (in this example the significance level Sig=0.00); it indicates that a correlation analysis is adequate. The correlation calculation data presented in Table 2 lead to the following conclusions:

1. The number of combine harvesters in Latvia has the strongest correlation with the UAA indicators and the agricultural output, whereas the number of tractors strongly correlates with the area of meadows and pastures and the number of tractors and combine harvesters – with the RDP long-term investment subsidies for FADN farms.
2. The long-term investment in machinery and equipment on FADN farms mainly has a positive and strong correlation with the UAA of the entire country and of FADN farms as well as with the investment in buildings and constructions, which thus contributes to the agricultural output of FADN farms.
3. The long-term investment in other fixed assets on FADN farms, too, depends on the use of land in the country, which contributes to the output of agricultural products.

Based on the correlation analysis, it is possible to forecast the need for additional investment if the currently unfarmed agricultural area is exploited (Table 1). Given the fact that in the period of analysis from 2003 to 2012 the value of long-term investment on FADN farms has considerably increased – in buildings and constructions – 3.6 times, in machinery and equipment – 3.2 times, and in other fixed assets – 2.4 times – calculations were performed for two scenarios based on:

1. average value of long-term investment per UAA ha in the period 2003-2012;
2. average value of long-term investment per UAA ha in the period 2010-2012.

Besides, it was assumed that new investments would account for 70 % of the investment made in the previous period, as the existing constructions, machinery, and other fixed assets would be exploited more efficiently.

So, to exploit the additional area of more than 275 thsd UAA ha in 2020, a long-term investment within a range of LVL 120-156 mln is necessary, of which slightly more than half is investment in machinery and equipment. The analysis of the amount of public funding for the support measure "Investment in Material Assets" under the Rural Development Programme 2014-2020 [9], which is intended both for farmers and for processors of agricultural products, with a budget of EUR 478 mln as well as the measure "Development of Agricultural Holdings and Entrepreneurship", which provides assistance to new farmers and small agricultural holdings, with a budget of EUR 142 mln over a

seven-year period suggests that in order to intensively farm the additional agricultural area, approximately ¼ of the financial assistance intended for farm investments has to be allocated to these objectives, which is a significant amount of funds.

Table 3

Amount of long-term investment if exploiting the additional UAA in 2020 in Latvia

Indicators	On average in 2003-2012 per 1 UAA ha	Required amount in 2020, thsd LVL	On average in 2010-2012 per 1 UAA ha	Required amount in 2020, thsd LVL
Long-term investment in buildings and constructions	156.20	42989	221.93	61079
Long-term investment in machinery and equipment	224.99	61921	285.55	78588
Long-term investment in other fixed assets	56.55	15564	58.90	16210
Total	x	120473	x	155877

Conclusions

1. Land as a resource of agricultural production is not fully exploited in Latvia, as approximately 400 thsd ha of agricultural parcels were undeclared for the Single Area Payment Scheme in 2012 and, of the agricultural area, 10 % was uncultivated and 2 % was overgrown. It creates opportunities and a potential for enhancing the management and use of land in the future.
2. Using expert forecasts and a specially developed methodology, calculations on the potential for the crop yields and total crop output in Latvia for 2020 based on the utilised agricultural area, composition of sown area, and the type of farming in 2012 were performed. In the calculations, first, increases in crop yields in the current area and, second, the production of crops in the area that was not exploited in 2012 were taken into account.
3. By exploiting the agricultural area that was not declared for the SAPS in 2012 in a more intensive and efficient way, an additional area of 275 thsd ha could be used in agricultural production. It could increase the output of agricultural products within a range from 12 % (grains, rapeseed) up to 17 % (potatoes, fresh biomass harvested in permanent meadows and pastures), compared to 2012.
4. The potential total output of crops in 2020 compared to 2012 is expected to be significantly higher: 32 % more grains, 23 % more potatoes, 53 % more maize, 88 % more green crops, silage crops, and permanent grasses, and 84 % more fresh biomass harvested in permanent meadows and pastures.
5. The potential total output of forage crops is sufficient to feed not only the expected number of livestock, but also to be used in fresh biomass as alternative option, for instance, in producing biogas from fresh biomass.
6. To exploit the additional area of more than 275 thsd UAA ha in 2020, long-term investments of LVL 120-156 mln are necessary, of which slightly more than half is investments in machinery and equipment. The source of long-term investments will be the support measures of the Rural Development Programme 2014-2020, yet, according to provisional estimates, a fourth of the public funding intended for farm investments has to be allocated to these measures.

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