

## ECONOMIC ASSESSMENT FOR THE PRODUCTION OF STARCH POTATOES ON FARMS IN LATVIA

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**Abstract.** Growing potatoes has long traditions in Latvia; yet, potato production is fragmented due to the traditional pattern of consumption of potatoes, as the crop is used as food and feed. Uses of potatoes in industrial processing change with the development of science. The most important component of potato is starch, the composition of which depends on variety and growth conditions.

The area cropped with starch potatoes totalled 494 ha in Latvia in 2014, which accounted for only 1.8% of the total potato area in the country. The organic starch potato area considerably increased, reaching almost 50% of the total starch potato area in 2014.

The production of starch potatoes by farms in Latvia is economically efficient under stable and correct farm management, reaching a margin of safety of more than 80%. However, farm size does not determine the economic efficiency of starch potato production.

The research *aim* is to examine economic indicators for the production of starch potatoes by farms in Latvia. To achieve the aim, the present research analysed the economic indicators of three starch potato farms: Aloja Agro Ltd, Burtnieku Grauds Ltd and the farm Piekalnes, which are located in the region of the only starch potato processing company in the Baltics – Aloja Starkelsen Ltd.

**Keywords:** starch potato, farms, area cropped with potato, contribution margin, profit.

**JEL code:** D24; M21; Q12

### Introduction

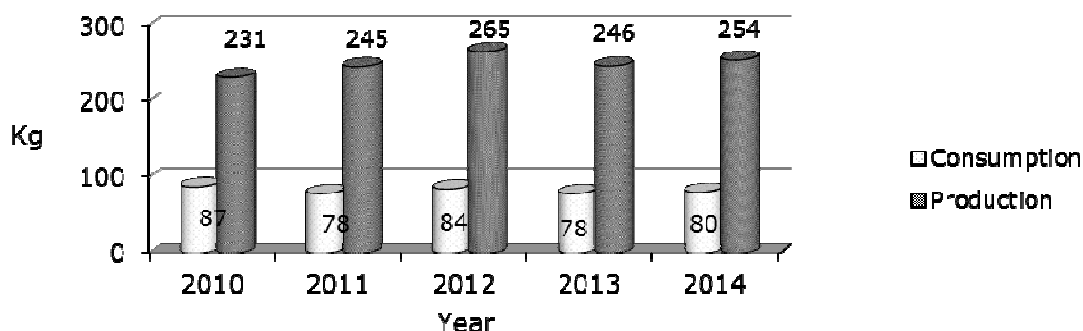
In 2014 in Latvia, the total output of agricultural products at constant prices (agricultural subsidies included) reached EUR 1105 mln, which was a 5% decrease compared with the previous year. Crop farming accounted for 55.60% and livestock farming comprised 44.40% of the total value. According to statistics for recent years, farms returned to a more balanced production structure (Ministry of Agriculture, 2015).

The proportion of final products in the distribution of agricultural products for potatoes increased from 4.30% in 2012 to 5.80% in 2014, which was determined by an increase in the value of potatoes, even though the potato area decreased in Latvia not only in absolute terms (from 30.1 thou. ha in 2010 to 26.80 thou. ha in 2014) but also in relative terms – of the total sown area, the area under potato accounted for 27.30% in 2010 and 23.20% in 2014. This may be explained by the fact that potato production is more labour-intensive and costlier, if expressed as a percentage of total revenue earned, than grain production. The economic role of potato increased and the kinds of use of potato diversified with the

development of science and processing industry. In Latvia, only 9.5 thou. tonnes or 20.1% of the total quantity of potatoes consumed are industrially processed, which provides great opportunities for potato production for this purpose in particular.

According to Figure 1, the consumption of potatoes as food comprised only approximately a third of the quantity produced, and there are great opportunities to increase the output of potatoes for industrial processing, thereby reducing consumption of potatoes as feed.

Potato production is fragmented in Latvia. According to the Central Statistical Bureau (CSB), in 2014, 96.4% farms had a potato area of less than 1 ha, accounting for 69.3% of the total potato area. In Latvia, only 12 farms had a potato area of more than 75 ha, farming 5.45% of the total area cropped with potato. On these farms, the average potato yield reached 26.2 t ha<sup>-1</sup>, which was 1.43 times higher than the average in Latvia (18.3 t ha<sup>-1</sup>). By concentrating the production of potatoes, it is possible to considerably increase the total output of the crop and to focus on the industrial processing of potatoes.



**Source: authors' calculations based on the CSB data**

Fig.1. Per capita production and consumption of potato in Latvia in the period 2010-2014, kg

The most important component of potato is starch, the composition of which depends on variety and growth conditions. The content of starch in a naturally moist product ranges from 10 to 20%.

The food industry mainly exploits the capability of a component of starch – amylopectin – to form paste or jelly (Munck L., 1994; Alexander R.I., 1995; Peerenboom E., 1997). However, the second component of starch – amylase – is used in the manufacture of plastics, in the chemical industry and in the production of seeds, pesticides and fertiliser coatings (Soest J.J.G., 1996; Wang T.L. et al., 1998).

On the whole, 80% of the total quantity of potato starch produced is now used in the non-food industry (Wang T.L. et al., 1998).

Lots of starch is used in the textile industry, metallurgy (to produce precise castings), the oil industry to stabilise oil wells and in the production of medicines, matches and glue. Modified starch has a broad range of uses – in the production of sausages, ice-cream, yogurt, mayonnaise and ketchup (Ivanova A., 1999; Spogis K., 1999; Skrabule I., 2003).

The research puts forward a *hypothesis* – the production of starch potatoes is economically efficient in Latvia. The research *aim* is to examine economic indicators for the production of starch potatoes by farms in Latvia. To achieve the aim, the following specific research *tasks* were set: 1) to examine preconditions for and the situation in the production of starch potatoes in Latvia; 2) to analyse the economic indicators for the production of starch potatoes.

To achieve the aim set, the present research analysed the economic indicators of three starch potato farms: Aloja Agro Ltd, Burtnieku Grauds Ltd and the farm Piekalnes, which were located in the region of the

only starch potato processing company in the Baltics – Aloja Starkelsen Ltd.

Statistical analysis was employed to process data. The present research analysed indicators of the mentioned farms and other farms in Latvia for the period 2006-2014 based on the availability of data.

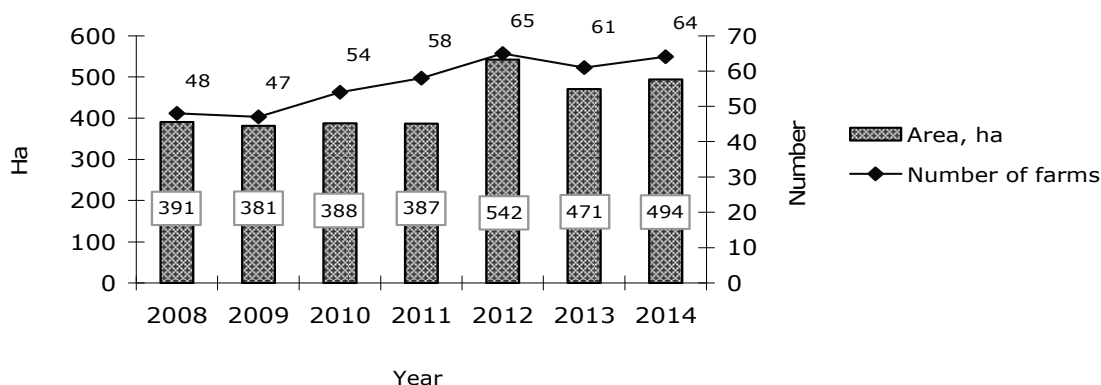
## Research results and discussion

The industrial production of starch from potatoes began in Germany in the 18<sup>th</sup> century. Nowadays, too, Germany together with the Netherlands is the key producer and exporter of food starch in the world (Willard M., 1993). Compared with other crops such as maize (*Zeamays*) and wheat (*Triticum*) that are also used for starch production, potatoes provide higher starch output per land area unit. Besides, starch produced from potatoes, in terms of properties, is more valuable than that from maize or wheat. Potato starch features higher viscosity, its particles are greater in size and it contains natural phosphate groups, while an admixture of protein and lipids is relatively small. Potato starch is white in colour and unlike, for example, starch from maize or wheat lacks any specific taste (Munck L., 1994; Alexander R.I., 1995; Ellis R.P. et al., 1998).

To produce starch from potatoes, the **following indicators are important:**

- the minimum content of starch has to be 17% (the higher the content, the greater premiums are paid) (Ivanova A., 1999);
- the extent of grime is not more than 7%;
- the content of protein is low;
- the proportion of small tubers (with a diameter of 30 mm) has to be less than 25% (Ivanova A., 1999);

- starch particles are evener and greater. However, given the further use of starch, some enterprises might prefer fine-grained starch (Peerenboom E., 1997; Wang T.L. et al., 1998);
- a specific ratio of amylase to amylopectin in starch, depending on the further use of it (Munck L., 1994; Alexander R.I., 1995; Soest J.J.G., 1996; Ellis R.P. et al., 1998; Wang T.L. et al., 1998).



Source: authors' calculations based on the MoA data

Fig.2. Starch potato area and the number of starch potato farms in Latvia in the period 2008-2014

Table 1

Production of starch potato in Latvia in the period 2012-2014

Indicator	2012		2013		2014	
	quantity	%	quantity	%	quantity	%
<b>Area, ha</b>	542	100.0	471	100.0	494	100.0
<b>incl. organic</b>	161	29.7	159	33.8	224	45.3
<b>integrated</b>	381	70.3	312	66.2	270	54.7
<b>Average yield, t ha-1</b>	23.4	100.0	20.0	100.0	26.4	100.0
<b>incl. organic</b>	16.0	68.4	13.8	69.0	11.6	43.9
<b>integrated</b>	28.5	121.8	23.3	116.5	38.7	146.6
<b>Number of farms</b>	65	100.0	61	100.0	64	100.0
<b>incl. organic</b>	35	53.8	34	55.7	37	57.8
<b>integrated</b>	30	46.2	27	44.3	27	42.2
<b>Average area cropped with starch potato per farm, ha</b>	8.3	100.0	7.7	100.0	7.7	100.0
<b>incl. organic</b>	4.6	63.0	4.7	61.0	6.1	79.2
<b>integrated</b>	12.7	174.0	11.6	150.6	10.0	129.9

Source: authors' calculations based on the MoA data

As once found by scientist and economist K.Spogis (1999), growing more potatoes for starch production by farmers in Northern Vidzeme could considerably contribute to Latvia's national economy. Geographically, particularly this region of Latvia should produce starch potatoes because of appropriate soils and the short distance to the processing company.

To examine trends in the production of starch potatoes in Latvia, the further analysis focuses on the sown area, the number of farms and yields.

A summary of the data presented in Figure 2 leads to a finding that over the analysed period, two periods may be distinguished in Latvia: 1) from 2008 to 2011 the sown area was relatively unchanged; yet, the

number of potato farms tended to increase; 2) in 2012, a sharp increase in the sown area and the number of farms took place, which was determined by an increase in the output of organic starch in line with change in consumer demand in the entire world.

The data and calculation results in Table 1 show that the agrotechnological situation and trends in producing starch potatoes are diverse:

the area cropped with starch potatoes was the greatest in 2012, which, compared with 2011, increased by 40%. This change was due to starting producing starch potatoes by the organic method. The area of potatoes grown organically tended to increase and reached 45.3% of the total area in 2014;

starch potato yields were volatile due to weather conditions. Organic potato yields were lower in 2014 (only 43.9% of the average potato yield and 3.3 times lower than on integrated farms);

the number of farms producing starch potatoes organically rose. In 2014, the number of organic farms exceeded that of integrated farms by 15.6%;

the average area under starch potato per farm tended to decline, which was affected by an increase in

the number of relatively small organic farms. The starch potato area on organic farms rose over the analysed period, which indicated development opportunities for organic farming.

To achieve the research aim, three farms – limited liability companies (Ltd) Aloja Agro and Burtnieku Grauds and the farm Piekalnes – which were different both by legal status and by area cropped with potato were selected for the present research.

Burtnieku Grauds Ltd with 480 ha was the greatest farm in terms of size. Aloja Agro Ltd had the largest area sown with starch potatoes; yet, this farm needed a greater rented area to ensure crop rotation, which contributed to the production risk. On the whole, the analysed farms had larger areas under starch potatoes than the average in Latvia (Table 1).

In assessing economic performance, an important indicator is not only a farm's land area but also its economic size, which, according to the methodology of the Farm Accountancy Data Network (FADN) of Latvia, is expressed in terms of total standard output (Table 3).

Table 2

**Characteristics of the analysed potato farms in 2014, ha**

Indicator	Aloja Agro Ltd	Burtnieku Grauds Ltd	Farm Piekalnes
<b>Total land area</b>	150.00	480.00	250.00
<b>incl. utilised agricultural area</b>	150.00	478.00	245.00
<b>potato area</b>	150.00	48.20	38.00
<b>starch potato area</b>	96.00	20.00	15.00

Source: authors' calculations based on Aloja Agro Ltd, Burtnieku Grauds Ltd and farm Piekalnes data

Table 3

**Economic sizes of the potato farms in 2014, EUR**

Crop	SO of the crop	Aloja Agro Ltd		Burtnieku Grauds Ltd		Farm Piekalnes	
		ha	SO	ha	SO	ha	SO
Potato	2 321	150.00	348150	48.20	111 872	38.00	88198
Rapeseed (winter)	747	-	-	45.40	33 914	30.00	22410
Wheat (spring)	587	-	-	150.00	88 050	68.00	39916
Grass	113	-	-	30.40	3 435	-	-
Oats	246	-	-	29.00	7 134	22.00	5412
Wheat (winter)	587	-	-	100.00	58 700	35.00	20545
Faba bean	459	-	-	22.00	10 098	12.00	5508
Fallow area	-	-	-	55.00	0	15.00	0
Rye (winter)	379	-	-	-	-	25.00	9475
<b>Total standard output</b>	X	<b>348 150</b>		<b>313 203</b>		<b>191 464</b>	

SO – standard output

Source: authors' calculations based on farm and the FADN data

All the analysed farms are located in Vidzeme region. In 2013 in **Vidzeme region**, the economic size of FADN farms was equal to **EUR 35 767**. According to the calculations, the standard output of Aloja Agro Ltd was the highest at EUR 348 150, that of Burtnieku

Grauds totalled EUR 313 203, while the standard output of the farm Piekalnes was the lowest at EUR 191 464. Compared with the average for Vidzeme region, the enterprises had great standard outputs. If measuring the farms' sizes by standard output, one can conclude

that all the analysed farms were large ones, as all the three farms belonged to size class 5, the SO of which ranged within EUR 100 000-500 000.

To assess the economic efficiency of producing starch potatoes, the following economic indicators were employed: contribution margin, profit and margin of safety.

The *contribution margin* is an indicator that is used for analyses and planning of an enterprise's economic performance and that reveals a surplus of the market value of the enterprise's products sold over proportionally changing variable costs.

Table 4

**Contribution margins of the starch potato farms, EUR ha<sup>-1</sup>**

	<b>Indicator</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
<b>Burtnieku Grauds Ltd</b>	revenue	948.72	1 174.36	1 364.16	1 335.92	1 602.94
	variable costs	536.00	616.00	565.00	1 312.04	432.61
	contribution margin	412.72	558.36	799.16	23.88	1 170.33
<b>Aloja Agro Ltd</b>	revenue	2 293.34	2 052.92	1 982.58	2 092.05	1 590.77
	variable costs	753.90	958.98	1 148.90	1 304.27	891.42
	contribution margin	1 539.44	1 093.94	833.68	787.78	699.35
<b>Farm Piekalnes</b>	revenue	1 529.75	1 626.55	1 625.77	1 734.40	2 010.80
	variable costs	416.60	503.55	515.70	639.30	495.00
	contribution margin	1 113.15	1 123.00	1 110.07	1 095.10	1 515.80

**Source: authors' calculations based on farm data**

The contribution margin shows the economic efficiency of farming a crop or some group of livestock. The starch potato farms examined in the present research did all field works by their machinery and did not outsource services. The cost of exploiting the farm's machinery belongs to fixed costs in the form of fixed asset depreciation, repairs, maintenance and fuel consumption. Variable costs involve seeds, fertilisers and plant protection products.

Table 4 reveals that the value of products produced per ha of starch potato for the farm Piekalnes and Burtnieku Grauds Ltd tended to increase, whereas that for Aloja Agro Ltd was volatile and tended to decrease. This situation was due to persistent changes in the rented area. However, the farm Piekalnes featured stable business management.

Seeds make up the highest proportion of variable costs, and periodic purchases of the seeds contributed to the volatility of variable costs for Aloja Agro Ltd and Burtnieku Grauds Ltd.

The mentioned farming preconditions determined the greatest and most stable contribution margin for the farm Piekalnes. On the whole, one can conclude that particularly farm management rather than the size

of cropped area determines the economic efficiency of production of starch potatoes. The contribution margin is a sum of revenue that covers fixed costs and contributes to an enterprise's profit.

Profit is determined by two factors: sales price and production cost. The sales price of starch potatoes consists of the basic price and a premium. The ratio of the two variables changed over the analysed period (Table 5), as the proportion of the premium increased. A premium is a stimulus for producing products of high quality. The sales price for the analysed farms did not significantly differ; yet, the farms' production costs were different. It was affected by both variable and fixed costs. The relatively low profits made and even losses suffered by Burtnieku Grauds Ltd and Aloja Agro Ltd were determined by the size of fixed costs, as the farms purchased expensive machinery for potato production. Nevertheless, under optimum farm management (on the farm Piekalnes), the profit per tonne of starch potatoes sold exceeded EUR 30, reaching a profit margin of 61.3% in 2014.

Table 5

**Profit or loss from the production of starch potato in the period 2010-2014, EUR t<sup>-1</sup>**

Indicator		2010	2011	2012	2013	2014	
<b>Burtnieku Grauds Ltd</b>	sales price	total	53.70	61.16	68.20	88.05	51.88
		basic	36.00	32.00	35.30	48.36	27.05
		premium	17.70	19.16	32.90	39.69	24.83
	production cost		40.15	41.87	37.95	99.19	20.96
	profit or loss		13.55	19.29	30.25	-11.14	30.92
<b>Aloja Agro Ltd</b>	sales price	total	65.51	63.93	63.03	66.27	54.66
		basic	38.00	36.00	35.00	39.06	27.34
		premium	27.51	27.93	28.03	27.21	27.32
	production cost		47.10	54.23	60.13	65.28	62.53
	profit or loss		18.41	9.70	2.90	0.99	-7.87
<b>Farm Piekalnes</b>	sales price	total	55.57	58.50	52.26	55.95	52.00
		basic	31.00	27.00	30.00	28.00	27.09
		premium	24.57	31.50	22.26	27.95	24.91
	production cost		22.58	24.71	23.45	27.59	20.12
	profit or loss		32.99	33.79	28.81	28.36	31.88

**Source: authors' calculations based on farm data**

In economic analysis theory, financial safety is a complex term characterised by the extent of use of not only financial but also all the other resources available to an enterprise. Financial safety is an enterprise's economic condition that involves the preconditions for a steady surplus of the enterprise's revenue over its expenditure, efficient use of resources and a continuous production process that are influenced by endogenous and exogenous factors (Koleda N., 2011).

The margin of safety is calculated by Equation 1 employing the break-even point:

$$MS = \frac{SR - BP}{SR} * 100 \quad (1)$$

where MS – margin of safety;

SR – sales revenue;

BP – break-even sales revenue.

According to Table 6, the following conclusions may be drawn: 1) starch potato production by farms in Latvia provides a sufficiently high margin of safety. In 2014, Burtnieku Grauds Ltd and the farm Piekalnes reached a break-even point by selling less than 20% of their products produced; 2) the margin of safety does not depend on the quantity produced.

## Conclusions

- 1) The area cropped with starch potatoes totalled 494 ha in Latvia in 2014, which accounted for only 1.8% of the total potato area in the country. The organic starch potato area considerably increased, reaching almost 50% of the total starch potato area in 2014.
- 2) The enterprises analysed have to put a special focus on gradually restoring their seed resources, as the situation of Burtnieku Grauds Ltd in 2013 showed that in case seeds are repeatedly purchased for the entire area to be sown, the seed cost makes up 67% of the total cost. In case seeds are produced by the farms themselves, the seed cost accounts for 25-40% of the total cost.
- 3) The production of starch potatoes by farms in Latvia is economically efficient under stable and correct farm management, reaching a margin of safety of more than 80%. However, the size of the farms does not determine the economic efficiency of production of starch potatoes.

**Margins of safety for the starch potato farms in the period 2010-2014**

Indicator		2010	2011	2012	2013	2014
<b>Burtnieku Grauds Ltd</b>	output, t	530	480	500	437	618
	break-even output, t	223	162	121	3 519	114
	margin of safety, %	57.9	66.3	75.8	-705.3	81.6
<b>Aloja Agro Ltd</b>	output, t	3 151	3 051	2 988	3 134	2 794
	break-even output, t	1 832	2 182	2 662	3 011	3 710
	margin of safety, %	41.9	28.5	10.9	3.9	-32.8
<b>Farm Piekalnes</b>	output, t	551	695	560	620	580
	break-even output, t	102	114	108	122	106
	margin of safety, %	81.5	83.6	80.7	80.3	84.6

Source: author's calculations based on farm data

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