Agronomy Research **3**(1), 81–90, 2005

Profitability of grain and rapeseed production in Estonia: future prospects

V. Loko, E. Koik and K. Tamm

Department of Mechanisation, Estonian Research Institute of Agriculture, Teaduse 13, 75501 Saku, Estonia; e-mail: valdek.loko@mail.ee, enno.koik@mail.ee, kalvi.tamm@neti.ee

Abstract. The accession of Estonia to the EU and the introduction of the Common Agricultural Policy (CAP) will increase the country's agricultural income substantially. Nevertheless, because of the northern climatic conditions, profitability of grain and rapeseed production in Estonia may have more problems than in other EU member states. The future impact of the CAP reform on grain production is being discussed. Results of different research projects are compared and the Estonian situation is analysed. It seems that there will be incentives for producers to decrease grain area in Estonia. Economic comparison was made about three tillage and sowing technologies: direct drilling, minimum and conventional tillage. Calculation results show that direct drilling and minimum tillage give better results than conventional tillage. However, the impact of direct drilling on yield and profit is more questionable and needs further research and farming experience. During last years, rapeseed production has increased because of its higher profitability than grain production.

Possible future WTO negotiation results may also create problems in Estonian agriculture because of the northern climatic conditions.

Key words: profitability of grain and rapeseed production, CAP reform impact on grain production, direct drilling, minimum tillage, conventional tillage, WTO negotiations

INTRODUCTION

In 2001 grain (without rape) was grown on 274,126 ha and the number of producers was over 20 thousand in Estonia. In 2003 the area of grain was 263,166 ha and the number of grain producers having at least 1 ha of arable land was 14.1 thousand. At the same time, there were 8.7 thousand producers with an area of up to 5 ha and their average area size was only 1.5 ha. The number of large-scale producers with a grain area of over 100 ha was 493, the average size of their grain area was 333 ha, whereas 63.6% of the total area of grain was under their exploitation. The number of small farmers has rapidly decreased in Estonia, thus quite a rapid production concentration takes place in crop growing.

In 2001–2003, the average grain yield varied between 1.9–2.0 t ha^{-1}. Winter wheat gave the highest yield in 2002 – 2.7 t ha^{-1}. The average spring barley yield was 1.9–2.0 t ha^{-1} in that period. In 2003, 8% of the grain sowing area was fertilised by organic fertiliser, whereas mineral fertilisers were applied on 82% of the sown area of grain. The amounts of the applied mineral fertilisers are not large: in 2001–2003 mineral fertilisers were applied on the fertilised area by applying 78–117 kg of active ingredient per ha (Statistical Office of Estonia, 2004). Considering what was mentioned above, the standard variant of 350 ha of sown area and the yield level of 2.4 t ha^{-1} were taken for comparing the technological variants of grain growing.

In 2003 the sown area of spring rape was 45,461 ha or 17.3% of the grain sowing area. The average yield of spring rape was 1.5–1.9 t ha^{-1} in 2001–2003. On growing technical crops where spring rape has the biggest share, 105–179 kg ha^{-1} of mineral fertilisers were applied in the active ingredient on the fertilised area. It also guaranteed a relatively high spring rape yield compared to the yield of cereals. For calculating the production cost of rape, the standard variant of the yield of 1.6 t ha^{-1} was taken.

MATERIALS AND METHODS

The present article analyses how the future profitability of grain and rape production is influenced by the following factors:

1. Production intensity (the yield)
2. The size of the sown area
3. Co-operative use of machinery
4. Conventional technology or replacement of ploughing-based technology by minimum cultivation (i.e. either surface tillage or direct drilling)
5. Measures of Common Agricultural Policy
6. Possible results of WTO negotiations

For producing grain, several machines are used and different fertilisers and plant protection chemicals are applied, whereas natural production conditions (soil texture and stones, the size and form of plots, etc.) are rather different. Thus, the number of possible technological variants in the grain production is very large. For bringing out the impact of pre-chosen factors influencing the amount of production conditions, only one variant with certain production conditions was chosen, which is permanent in comparing the variants of different soil cultivation and sowing works.

Production costs of each work were calculated by input elements. Such methods are often used (Enroth, 2002; Jäneda…, 2003; KTBL, 2003). In calculating the costs, algorithms composed by the researchers of ERIA (Koik et al., 2004; ERIA, 2004) were used. The cost of the applied mineral fertilisers, plant protection products and seed was calculated according to the price lists of Kemira Grow How AS from 2004. All costs in the tables do not include VAT. The overhead of 7% of the enterprise are being added to the costs formed in every operation.

Calculating the depreciation of melioration buildings is a specific problem in finding the profitability of grain and rape production. Melioration work has been carried out at the expense of the state, and drainage system and field roads have been transferred to producers free of charge, whereas a producer does not consider any depreciation in his bookkeeping. From the point of view of the state on calculating the costs and competitiveness of our producers, these costs should also be considered. The depreciation of melioration buildings on the drained land is about 1,000 EEK ha^{-1} (1 Euro=15.6466 kroons). This depreciation has not been considered in the following calculations.

RESULTS AND DISCUSSION

At present, one of the most widespread technologies is the so-called conventional technology, based on deep ploughing (23–25 cm).
For studying the yield impact, the economic efficiency was calculated on the level of three yields: 2.4 t ha^{-1} is the reference yield of the EU, on the basis of which the size of direct subsidies is now calculated (Table 1).

Table 1. Production costs and profitability of grain in the case of different yields, sown area 350 ha and conventional technology.

Yield t ha^{-1}	2.4	3.5	4.5
1. Variable costs (seed, mineral fertilisers and pesticides) EEK ha^{-1}	1,954	2,417	2,795
2. Soil cultivation EEK ha^{-1}	1,375	1,375	1,375
3.Sowing, plant protection and harvest EEK ha^{-1}	2,317	2,481	2,722
Total costs EEK ha^{-1}	5,646	6,273	6,892
Costs EEK t^{-1}	2,352	1,792	1,532
Price EEK t^{-1}	1,600	1,600	1,600
Profit EEK t^{-1}	-752	-192	+68

In the case of average and close to it yields it is not possible to produce grain profitably without subsidies. We can talk about profitable production only with the best soils where also additional fertilisers and pesticides are applied according to agronomic recommendations (Teraviljakasvataja…, 1999). So it is assumed that in the case of better soils it is optimum to use more fertilisers and pesticides per hectare.

On a smaller harvest area, soil tillage and harvest are more expensive (Table 2).

Table 2. Production costs of grain and profitability in the case of different sizes of the sown area (yield 2.4 t ha^{-1}).

Sown area ha	50	200	350
1. Variable costs (seed, mineral fertiliser and pesticides) EEK ha^{-1}	1,954	1,954	1,954
2. Soil tillage EEK ha^{-1}	1,880	1,445	1,375
3. Sowing, plant protection and harvest EEK ha^{-1}	2,681	2,454	2,317
Total inputs EEK ha^{-1}	6,515	5,853	5,646
Costs EEK t^{-1}	2,715	2,438	2,352
Price 1600 EEK t^{-1}	1,600	1,600	1,600
Profit EEK t^{-1}	-1,115	-838	-752

Although it is possible to use here cheaper and less powerful tractors and machines with a smaller working width, their work is still more expensive, due to their low hourly productivity, than using more powerful tractors and machines on a bigger sown area. Also in the case of a little amount of work (50 ha), the depreciation of machines per ha is great as the machines do not wear out physically, instead, they wear out morally in 12 years and the amount of depreciation per year of utilisation increases. In the case of a harvest area of 350 ha compared to 200 ha, the costs are smaller mainly at combine harvesting and drying. Due to the bigger amount of work, a more effective combine harvester and dryer can be used here. Although, due to more distant transport, the transport costs may increase a little, the total costs are smaller in the case of 350 ha than in the case of a sowing area of 200 ha.

In smaller farms there is an option to use more productive machinery available outside the farm: the neighbours' help, services of machinery co-operatives or contractors. Those costs are registered in the farm accountancy system as costs of contract work (CIRCA; Jäneda…, 2003). In 2002 in Estonia costs of contract works in the smaller size class of sample farmsteads were 107 EEK ha^{-1}, in the average size class 144 EEK ha^{-1}, in the bigger size class 113 EEK ha^{-1}. In 2001 the costs of contract work in the EU were 1,128 EEK ha^{-1} on the average. Regarding the production costs in 2002 in Estonia, the costs of contract work were 2.5% in the smaller size class, 2.7% in the average size class, and 1.1% in the bigger size class: 1.6% of production costs on the average. In 2001 the costs of contract work in different size classes in the EU were 4.3–5.5% of production costs, no tendency due to the size occurred. So we can say that more contract work is being used in other countries than in Estonia.

During the last years, the grain production technology without ploughing has spread more. Economic comparison was made about three tillage and sowing technologies: conventional tillage, minimum tillage, and direct drilling.

By using conventional technology, the costs on soil tillage and sowing work are 1,375 EEK ha^{-1} in the case of a sown area of 350 ha and the yield 2.4 t ha^{-1}, of which stone clearing work makes up approximately 268 EEK ha^{-1}. Total inputs – 5,646 EEK ha^{-1}.

In the variant of minimum tillage, instead of ploughing the stubble field is being cultivated twice with a disc harrow with integrated roller. The disc harrow does not bring stones to the surface, there is no stone clearing. The sowing is carried out by a combined sowing machine; in a soil with a loose tilth there may occur a need for after-sowing rolling. Compared to conventional technology, the costs will decrease 834 EEK ha^{-1} or by 15%. In German farms, the costs have decreased 684–1,684 EEK ha^{-1} (Uppenkamp, 2003), by German calculation 587 EEK ha^{-1} (KTBL, 2003), by Finnish calculation 588 EEK ha^{-1} (Nikula, 2005).

In the variant of direct drilling, no soil tillage is carried out in a stubble field, the sprouted weed is damaged by spraying with glyphosate (Roundup). The sowing (seed + fertiliser) is carried out by a direct drilling machine. The direct drilling machines are more expensive than the combined sowing machines, they also need a more powerful tractor. Therefore, sowing with a direct drilling machine is more expensive than with a combined sowing machine. Spraying with glyphosate is also an additional cost. Due to cancelling the soil tillage and stone clearing work, the costs will decrease 826 EEK ha^{-1} or by 15%. Considerable decrease of costs in the case of direct drilling was also achieved in Finnish calculations (Lankoski et al., 2004; Lätti & Peltonen, 2004).

The saving of the above-mentioned costs has been calculated on the soils where, in the case of conventional technology, stone clearing has to be carried out. In stonier fields, the minimum tillage can save more expenses.

The yield of grain calculated in the case of different soil tillage variants is equal provided that, in the case of minimum soil tillage, the yield is somewhat lower at the same sowing time. There are long-term experiments in Estonia for surface tillage research; for direct drilling short time data and production experience are available

(Viil & Võsa, 2004). Under the production conditions, it will be compensated by carrying out the sowing work faster and therefore there will be less yield decrease caused by the work delay.

Earlier mainly the linear formula was used in Estonia to express relations between working time and crop yield, and it was quite handy to use and there was a possibility to deduce the so-called fist rule: how great is loss per delayed sowing day for this or that crop (e.g. barley – appr0x 1.4% per day (Table 3).

In the early 1990s, when the spread and performance of PCs started to grow increasingly, which gave the possibility to perform statistical analyses faster and easier as before, data about yield and working time, collected from earlier decades, were reprocessed (Möller, 1981; Tamm, 1999). The result of a statistical analysis gave us regression coefficients for parabola relations. Parabola equations are preferred as they describe decay of yield depending on sowing time more naturally than linear equations. Linear relation has unnaturally sudden transition from early to late establishment – actual defection is smooth and takes some days. Another reason to prefer parabola is that yield after optimum date does not fall with constant speed but starts with a slow decline and then drops faster and faster – as we can see it by arch parabola function. So we cannot so easily say how great is yield loss per day as we can by using the linear function, instead we should use formula 1 to calculate average yield for a defined sowing duration.

$$h = h_{\max}\left(1 - \frac{bt^2}{3}\right)$$

where h - average grain yield from area, seeded during t days, kg/ha;
b - regression coefficients (see Table 3);
t - number of sowing days, counting from optimum day;
h_{max} - yield in optimum day, kg/ha.

Table 3. Values of regression factors for relations predicting cereals yield depending on sowing time in Estonia.

Cereal	Linear function		Parabola function	
	Average	95 % level confidence limits	Average	95 % level confidence limits
Barley	1.39	1.31…1.47	0.00117	0.00105…0.00129
Oats	1.70	1.51…1.89	0.00107	0.00080…0.00134
Spring wheat	2.00	1.87…2.31	0.00120	0.00095…0.00145
Winter wheat	1.21	0.80…1.62	0.00170	0.00125…0.00215
Rye	1.35	1.20…1.50	0.00203	0.00164…0.00242

Single area payment is taken 1,000 kroons per hectare, which is approximately 60 percent from the full amount of EU direct support and will be achieved in 2009. In addition, the new member states have the right to make additional payments of 30% from their own budget, but Estonia has used this right only partly and its decreasing use may be foreseen in the future.

The variants of minimum soil tillage and direct drilling enable to decrease production costs compared to conventional technology and can make production giving profit also on the level of average yield (Table 4). The impact of direct drilling on yield is more questionable and needs further research.

Rape growing has been more profitable in recent years, which is the reason for a rapid increase of the growth area.

The most influencing factor of the CAP reform is the application of a single area payment where the support does not depend on the crop grown and the support is also given to such grassland where no yield is being harvested but only cut and chopped. Thus, the grain producers may have the inducement of replacing grain with the grassland. At first, let us analyse the results received on investigating this problem at other research institutions.

Table 4. Comparison of profitability of technological variants of grain, rape and the upkeep of grassland (EEK ha^{-1}).

(350 ha, prices: grain 1,600 EEK t^{-1}, rape 3,400 EEK t^{-1}, single area payment 1,000 EEK ha^{-1}, without melioration)

	Grain					
	Conventional technology		Surface tillage	Direct drilling	Rape	Grassland
Yield t ha^{-1}	2.4	3.6	2.4	2.4	1.6	
Total production	4,840	6,760	4,840	4,840	6,440	1,000
Total costs	5,646	6,286	4,812	4,820	5,588	300
depreciation	1,300	1,500	1,200	1,300	1,300	100
Profit	-806	474	28	20	852	700
Profit without depreciation	494	1974	1228	1320	2152	800

To estimate the CAP reform impact on the agriculture, the European Commission Directorate-General for Agriculture has prepared Prospects for Agricultural Markets 2004–2011 Update for EU-25 (European…, 2004).

"These projections and analyses have been carried out on the basis of the two models currently available in the Directorate-General for Agriculture of the European Commission. These modelling tools were already used to produce the impact assessment of reform proposals. This report is based on the information available at the end of June 2004 and constitutes an update of the medium-term projections for EU markets published in March 2004. The analysis covers the period between 2004 and 2011.

These projections are established under a specific set of assumptions. The most important assumptions cover agricultural and trade policies, as well as the outlook for their agro-economic environment and for world agricultural commodity markets.
The medium-term projections depict an outlook for the EU cereal markets that would continue to appear rather favourable for most EU cereals, with the noticeable exception of barley".

As the historic trend before the reform was growing, some production decreasing impact of the reform seems to exist by these models.

In Finland two approaches were used: farm level production decision methods and a mathematical regional sector model. Grain production will decrease 20% (Lehtonen et al., 2004).

For Estonia, the farm level production decision model is used (Table 4). Grain production and keeping grassland in good order are compared. It is assumed that grain and grassland are produced according to Good Farming Practice as determined by the Estonian Rural Development Plan (Estonian…, 2004). Grassland should be mowed at least once or grazed before July 31. By July 31 at the latest, the mown grass should be removed or chopped.

The largest profit will be received when grassland is used but the difference with higher yield grain will be small.

From the viewpoint of a farmer, it is very important to take into account that depreciation costs are in large part with a constant character as it was emphasised in the Finnish research. If the farmer assumes that depreciation costs are constant in full amount in short term, there is no reason to decrease the grain area in short term. But in middle and long term, larger part of depreciation costs becomes variable, which creates incentives to decrease the grain area. Changes in labour costs have also to be taken into account. It is important that there are alternative options for using surplus labour time. In a calculation made in Germany, it was assumed that in addition to depreciation approximately one third of labour costs had a constant character and in this case grassland was not a profitable option (Lopotz et al., 2004).

It was assumed that the used land needed no melioration. The price of new melioration is approximately 40,000 kroons per hectare and depreciation costs are 1,000 kroons per hectare, which makes the economic efficiency of larger melioration restoration works questionable.

To sum it up, when the single area payment is equal for grain and grassland, there will be incentives to substitute grain production with grassland. To decrease this trend, a single area payment level for grassland should be lower than for grain as it will be used in Denmark, Germany and Sweden and for national supports in Finland.

In addition to the single area payment, crop production is also receiving support from the specified resources for rural development, which can essentially influence the profitability of production.

In the years of 2004–2006, the development of agriculture and rural life is proceeding according to the two programme documents: the Estonian National Development Plan for the Implementation of the EU Structural Funds – Single Programming Document 2004–2006 and the Estonian Rural Development Plan 2004–2006. In the next programming period (2007–2013), it is provided to use the programme document which, in principle, would join the measures of the both existing programme documents. The corresponding legislation should be elaborated in the years of 2005–2006. "The following three major objectives for RD policy have been set in the Communication on the Financial Perspectives for the period 2007–2013:

Increasing the competitiveness of the agricultural sector through support for restructuring;

Enhancing the environment and countryside through support for land management (including RD actions related to Natura 2000 sites);

Enhancing the quality of life in rural areas and promoting diversification of economic activities through measures targeting the farm sector and other rural actors.

To ensure a balanced strategy a minimum funding for axis 1 (competitiveness) and axis 3 (wider rural development) of at least 15% of total EU programme funding will be required and of at least 25% for axis 2 (land management) (Commission…, 2004).

Thus the European Commission regulates 55% of the distribution of finances of the whole programme budget on the goals level.

When, in the future years, the amount of predicted means for 2004–2006 is kept almost the same, it will be almost as big as the amount of direct subsidies in the near years. Grain producers have eagerly employed the possibilities of SAPARD and State Development Programme for receiving investment subsidies and, from the viewpoint of grain production profitability, it would be most useful if there would be maximum support for investments in the next programming period of 2007–2013.

The application of environment measures increases production costs and may decrease production and, therefore, the impact of these measures on the profitability of grain production depends on the profitability of each specific measure. Grain producers have had problems with the requirements for crop rotation, the share of clover, etc. At the same time, there are no such claims in Finland, for example. Since there is a possibility for reorganising measures by the next programming period, it is in the interests of grain producers that such situations be avoided where producers of other countries gain competition advantages due to environment measures. It should also be considered that due to the sparse settlement, the pollution load in Estonia is considerably lower than in the most of the EU member states and, therefore, the role of environment measures should be less important.

Middle and long-term prospects of Estonian agriculture depend on which agreements will be made at WTO negotiations. Surprisingly for European Farmers, the EU agreed at the Geneva meeting to several points of trade liberalisation, of which the most important ones for agriculture are: “The following will be eliminated by the end date to be agreed: Export subsidies as scheduled. Export credits, export credit guarantees or insurance programmes with repayment periods beyond 180 days” (WTO, 2004).

Elimination of export subsidies may decrease production and farm income, which, in first order, may happen in Estonia because of the northern climatic conditions.

CONCLUSIONS

The accession of Estonia to the EU and the introduction of Common Agricultural Policy will increase the country’s agricultural income substantially. It seems that the implementation of the single farm payment scheme as a part of the CAP reform in cases when the single area payment is equal for grain and grassland, there will be incentives to substitute grain production with grassland in Estonia. To decrease this trend, the single area payment level for grassland should be lower than for grain as it will be used in Denmark, Germany and Sweden and for national supports in Finland.

Important factors influencing future profitability of grain production will be new technology options. Economic comparison was made about three tillage and sowing technologies: direct drilling, minimum, and conventional tillage. The variants of minimum soil tillage and direct drilling enable to decrease production costs compared to conventional technology.

The yield of grain calculated in the case of different soil tillage variants is assumed to be equal provided that, in the case of minimum soil tillage, the yield is somewhat lower at the same sowing time. Under the production conditions, it will be compensated by carrying out the sowing work faster and, therefore, there will be less yield decrease caused by the work delay. Values of regression factors for relations predicting cereal yields, depending on the sowing time, are discussed in Estonia.

There are long-term experiments in Estonia for surface tillage research. For direct drilling there are available short time data and some production experience. Calculation results show that direct drilling and minimum tillage give better profit than conventional tillage. The impact of direct drilling on yield and profit is more questionable and needs further research and farming experience.

In recent years, rapeseed production has increased because of its higher profitability.

Middle- and long-term prospects of Estonian agriculture depend on which agreements will be made on WTO negotiations. Elimination of export subsidies may decrease production and farm income, which may first happen in Estonia because of the northern climatic conditions.

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