# SIZES OF FARMLAND NECESSARY FOR EARNING MINIMUM INCOME AND INVESTMENT REQUIRED FOR FARMS OF VARIOUS SPECIALIZATIONS IN LATVIA

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**Abstract.** The aim of the research is to evaluate the required investments, taking into account the sizes of farmland necessary for earning a minimum income in the context of different farm specialization. Most agricultural sectors need agricultural land to earn revenues. A farmland area needed to provide a certain income depends on the farm specializations. The present research assumes that the individuals employed on agricultural holdings seek to earn an income equivalent to at least the average income earned by employed individuals in the country. The average income may be earned exploiting a certain agricultural land area. Using a specially developed methodology, the sizes of land area for providing a minimum income level on farms of various specializations in Latvia were identified. To earn an income equivalent to the average income earned by employed individuals in Latvia, on average, 65.5 ha in field crop farming, 48.3 ha in dairy farming and 53.7 ha in grazing livestock farming are needed per individual, while per two individuals 108.9 ha in field crop farming, 84.4 ha in dairy farming and 100.8 ha in grazing livestock farming are necessary. In Latvia, in the sectors of field crop, dairy and grazing livestock farming, more than 90 % of the total number of farms belong to a group of farms exploiting an area being less than the area needed for ensuring a minimum income. In order to that a land area needed to provide a minimum income is exploited, farms have to make long-term investments in farm buildings, machinery, equipment and other fixed assets. The size of long-term investment (investment in land excluded) varies from 532 EUR·ha$^{-1}$ for dairy farming to 1 110 EUR·ha$^{-1}$ for field crop farms, which requires to make a long-term investment of from approximately 26 000 EUR for dairy farms up to about 73 000 EUR for field crop farms.

**Keywords:** farms, income, specialization, agricultural land, long term investment.

## Introduction

Land is the key resource in agricultural production. As stressed by R.D. Singh and V.K. Singh, (2009) it is necessary to examine the land use and the resource use efficiencies in the agricultural areas in regional and temporal framework. Land use and resource use efficiencies have been measured to evaluate the ecologic and economic efficiency and growth in agriculture [1]. Currently, the agricultural sector in general and prime agricultural land in particular receive more attention from the policy forming community, because agricultural land in Europe is faced with various pressures. These include demands for increased food and biomass production for a growing world population and the need to adapt to climate changes. At the same time, societies become aware of the need to conserve or restore biodiversity, and soil and water resources. Finally, most evident to citizens in Europe, urban development, bioenergy cropping and nature development set claims on the available land resources [2].

Factor markets are a central issue in analyses of farm development and of agricultural sector vitality. Among the different production factors, land is one of the most studied [3]. It is well understandable that gaining income depends on the size of a farm's agricultural area (AA), the quality and location of this area, the kind of a crop grown, the price of it and the cost of producing it, labour management on the farm and other factors. The income level plays the leading role in farm development sustainability, as the agricultural sector continues to lag behind the rest of the economy in terms of income. As a matter of fact the gap between agricultural and non-agricultural income has widened in the European Union (EU) EU-15 in the last decade (from about 70 % to 60 % of average wages). In the EU-12, the gap has narrowed, mainly thanks to the introduction of the Common Agricultural Policy, yet it still stands at about 30 % of average wages [4].

But one of the EU sustainable agriculture aims is to ensure economic viability. This means that farms generate enough income to keep going [5]. N. Cepaitiene and V. Vinciuniene (2009) stress that income is the mix of reward for the fixed factors of production used in production, assessing the personal income of a farmer, a full assessment of the personal income could take a very broad view [6].

Theoretically, agricultural holdings can be viable with their owners earning even a low income. If agriculture is not the key economic activity, a farm (or an enterprise) can still function, providing its owner with the smaller part of the income. Yet, the present research assumes that agriculture is a farm owner's key economic activity and thus the owner seeks to provide himself and his family with an income equivalent to at least the average income earned by employed individuals in the country. Otherwise, one can regard the mentioned way of earning one's living as unsustainable. And, to do business in rural areas relatively large investments are needed, which is determined by the specifics of agricultural industry [7].

Therefore, the overall aim of this research is to identify the farmland sizes needed to earn a minimum income and the amounts of long-term investment for farms of various specializations, as well as to identify the number of such farms in Latvia.

To achieve the aim, the following specific research tasks are defined.

1. To identify the minimum farmland sizes needed to earn a minimum income level for the key agricultural sectors in Latvia.
2. To identify the number of farms providing a minimum income in Latvia in the key agricultural sectors.
3. To calculate the amount of long-term investments required for earning a minimum income on farms.

The research results are useful for state institutions, for example, the Ministry of Agriculture in order to provide long-term and sustainable land use in Latvia, as well as for designing government support policies.

**Methods**

To execute the research tasks, analysis and synthesis methods were employed. To identify the strength of correlations between the various indicators of agricultural land and incomes in Latvia, the correlation analysis was used.

A methodology was developed for identifying the minimum farmland sizes needed to earn a minimum income in the key agricultural sectors in Latvia.

The research assumes that individuals employed on agricultural holdings can provide themselves with an income equivalent to at least the average wage in the national economy. It is assumed that in order an agricultural holding is viable, at least one individual has to gain an income from agricultural activity that is equivalent to the average wage in Latvia (with labour taxes paid). A widespread model of agricultural holdings in Latvia is a family farm in which two adults work [8]. Therefore, calculations are performed also for an assumption that in order an agricultural holding is viable, at least two individuals could gain an income from agricultural activity that is equivalent to the average wage in Latvia (with labour taxes paid). The average wage in the country is calculated based on the CSB data for 2013, and the calculations employ the minimum income level (MIL): 10 619 EUR per employee and 21 238 EUR per two fulltime employees [9].

The functional dependence of the minimum land area on the total area of a farm is as follows:

$$ha_{\min} = \pi_{\min} / (b \cdot \ln(ha + a) + c) \quad (1)$$

where $ha_{\min}$ – minimum land area for sustainable farm management;
$\pi_{\min}$ – minimum revenue for sustainable farm management;
$\pi$ – revenue;
$ha$ – land area of the farm;
$a$, $b$, $c$ – equation coefficients.

The present research employed the FADN data. 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 [10].

Based on the FADN data, the minimum income level is calculated as revenue made up of the value of products, financial support for production and investment support minus the cost of goods and services, depreciation of fixed assets, interest payments, rent and production taxes. Accordingly, the revenue used in the analysis is calculated by the following formula:

$$\pi = q + sp + si - ic - d - i - r - t \quad (2)$$

where $\pi$ – revenue of the farm;
$q$ – total output of the farm;
$sp$ – financial support for production received by the farm;
$si$ – investment support received by the farm;
$ic$ – intermediate consumption by the farm;
$d$ – depreciation of the farm fixed assets;
$i$ – interest payments made by the farm;
$r$ – rent paid by the farm;
$t$ – production taxes paid by the farm.

In the present research, to identify the key crops, the data provided by the Rural Support Service (RSS) were used, as the absolute majority of market-oriented producers receive payments under the Single Area Payment Scheme (SAPS) and other area payments, and it partially allows setting apart nonmarket-oriented micro-producers that produce agricultural products in small quantities and only for their own needs. In 2012, according to the RSS, 1.64 mln ha were declared for SAPS; of the total declared area, 689 ths ha were under field crops, of which more than half – 350 ths ha or 51 % – were under winter and spring wheat, while rapeseed, barley and oats occupied 17, 13 and 9 %, respectively, of the total area under field crops. The greatest share of the area sown with feed crops, 836 ths ha, was occupied by green forage crops used in dairy farming and in grazing livestock farming. In this group of crops, permanent meadows and pastures, and grasses sown in arable land were in a quite equal proportion (459 ths ha and 341 ths ha or 55 % and 41 %, respectively). Among the other green forage and silage crops, maize was the most significant with 19.4 ths ha of the area of 35.9 ths ha [11]. So, the crop areas analysed in the present research occupied 93 % of the area declared for SAPS and comprised the basis for expanding field crop, dairy and grazing livestock farming in Latvia. The calculation methodology provides that in livestock farming, dairy and grazing livestock farming is associated with the areas of permanent grassland and permanent meadows, and pastures as these areas are the basis for milk and meat production.

## Results and discussion

### 1. Farmland sizes needed to earn a minimum income in the key agricultural sectors in Latvia

After analysing return on land indicators for the period 2008-2012, one can find that exploiting a farmland area of 65.5 ha can provide a minimum income level (MIL 1) for one employed individual in field crop farming in Latvia, while 108.9 ha are needed for two employed individuals (MIL 2). Farms, the key economic activity of which is dairy farming and on which one individual is employed, need to exploit an area of 48.3 ha to achieve a minimum income level of 10 619 EUR a year; however, to ensure a two times greater income, an area of 84.4 ha is necessary. For dairy farms, a minimum land area is smaller than for the farms specialising in field crops, which indicates a higher income per AA hectare earned in dairy farming.

After analysing return on land indicators for a five-year period, one can conclude that in Latvia in grazing livestock farming, on average, an area of 53.7 ha is needed to provide a minimum income per employed individual, while an area of 100.8 ha is necessary per two employed individuals (Table 1) [8; 12-15].

According to the calculations, in case of MIL 2, a minimum area is not two times greater than in case of MIL 1, which is associated with an increase in land use efficiency. Farms that employ two individuals provide higher performance and efficiency due to economies of scale, as their total cost per ha is lower, while their total revenue is greater. Overall, on MIL 2 farms, compared with MIL 1 farms, an income per ha is 6 % (grazing livestock), 14 % (dairy farming) or 20 % (the field crop sector) higher (Table 1).

Table 1

**Average minimum land areas for selected agricultural sectors in Latvia in the period 2008-2012**

| Indicators | Equivalent income level | | | | | |
|---|---|---|---|---|---|---|
| | Field crops | | Dairy | | Grazing livestock | |
| | MIL 1 | MIL 2 | MIL 1 | MIL 2 | MIL 1 | MIL 2 |
| Total output per ha, EUR | 486.5 | 473.7 | 563.8 | 655.7 | 318.0 | 324.1 |
| Variable cost per ha, EUR | 213.6 | 206.1 | 291.6 | 325.6 | 178.5 | 177.9 |
| Gross margin per ha, EUR | 272.9 | 267.5 | 272.2 | 330.1 | 139.4 | 146.2 |
| Total support per ha, EUR | 177.1 | 215.3 | 236.6 | 265.0 | 287.4 | 297.1 |
| Total cost per ha, EUR | 501.4 | 493.9 | 580.6 | 669.1 | 407.4 | 410.4 |
| Income per ha, EUR | 162.2 | 195.0 | 219.8 | 251.6 | 197.9 | 210.7 |
| Minimum area needed, ha | 65.5 | 108.9 | 48.3 | 84.4 | 53.7 | 100.8 |

The strengths of correlations for the land use indicators analysed are presented in Table 2 [8, 12-15].

Table 2

**Correlation strengths and significance for the land use indicators in Latvia in the period 2008-2012**

| Indicators | | AA and income | MIL and income | AA and MIL |
|---|---|---|---|---|
| Field crops | correlation coefficient | 0.914 | 0.877 | 0.963 |
| | significance level | $p = 0.01$ | $p = 0.01$ | $p = 0.01$ |
| Dairy | correlation coefficient | 0.967 | 0.968 | 0.992 |
| | significance level | $p = 0.01$ | $p = 0.01$ | $p = 0.01$ |
| Grazing livestock | correlation coefficient | 0.921 | 0.119 | -0.155 |
| | significance level | $p = 0.01$ | no | no |

So, for all the sectors, with the exception of grazing livestock (MIL and income and AA and MIL), there are strong linear correlations between the indicators analysed, as their correlation coefficients exceed 0.8 with a probability of 99 % [16].

## 2. Identification of the number of farms providing a minimum income in the key agricultural sectors in Latvia

Different information on land use in agriculture in Latvia is available in various information sources. Three key information sources used are as follows: the State Land Service (SLS), the RSS and the Central Statistical Bureau (CSB). In 2012 in Latvia, according to the RSS, the total AA declared for SAPS was equal to 1.64 mln ha [11]. For comparison, the Agricultural Census 2010 conducted by the CSB established that the utilised agricultural area (UAA) was equal to 1.8 mln ha [17], while the total AA reached 1.93 mln ha. The difference between the RSS and CSB data on the UAA may be explained by mainly small land plots used for growing crop products for one's own needs or for maintaining beautiful landscapes, while a small part is the land that is engaged in agricultural production but it is not possible to declare it for support payments or its owners do not want to do it. However, the SLS does not provide information on the UAA, while the total AA, in this data source, amounted to 2.365 mln ha. A great deal of the difference between the RSS and CSB data is the land that is overgrown with shrubs and does not meet the requirements for good agriculture and environmental conditions [11].

By using information on the AA declared for SAPS and the farms that applied for SAPS available in the RSS Integrated Administration and Control System, the data were grouped to get to know the distribution of farms by their size (Table 3) [18].

The absolute majority of farms belonged to the group of farms with an area of less than 20 ha – 50.2 ths or 80 % of their total number. Yet, the area exploited by these farms was equal to only 0.37 mln ha or 23 % of the total area of 1.64 mln ha. In Latvia, 92 % of the total number of farms exploited an area of less than 50 ha, while 96 % – an area of less than 100 ha (Table 3). In Latvia, the average area declared for SAPS was equal to 25.9 ha in 2012 (Table 3)

Table 3

**Distribution of farms by their UAA in Latvia in 2012**

| Groups of farms by UAA, ha | Number of farms in the group | Accrued number of farms | Total area in the group, ha | Accrued area in the groups, ha |
|---|---|---|---|---|
| (0 - 2] | 4 444 | 4 444 | 6 422 | 6 422 |
| (2 - 5] | 15 433 | 19 877 | 54 013 | 60 435 |
| (5 - 10] | 16 921 | 36 798 | 122 256 | 182 691 |
| (10 - 20] | 13 371 | 50 169 | 187 293 | 369 985 |
| (20 - 30] | 4 452 | 54 621 | 108 117 | 478 101 |
| (30 - 40] | 2 064 | 56 685 | 71 227 | 549 329 |
| (40 - 50] | 1 226 | 57 911 | 54 720 | 604 049 |
| (50 - 70] | 1 458 | 59 369 | 85 926 | 689 975 |
| (70 - 100] | 1 081 | 60 450 | 90 666 | 780 641 |
| (100 - 150] | 900 | 61 350 | 109 449 | 890 090 |
| (150 - 300] | 929 | 62 279 | 192 560 | 1 082 650 |
| (300 - 500] | 391 | 62 670 | 150 473 | 1 233 123 |
| (500 - 1000] | 262 | 62 932 | 180 008 | 1 413 131 |
| (1000 -...) | 134 | 63 066 | 223 102 | 1 636 233 |

After analysing the use of the entire farmland area, one can find that the greatest proportion of the total area (14 %) was exploited by a group of farms with an area of more than 1000 ha, which accounted for only 0.2 % of the total number of farms. In terms of proportion, large areas were also exploited by the groups of farms with areas of 150-300 ha, 300-500 ha and 500-1000 ha (12 %, 9 % and 11 %, respectively, of the total land area).

A similar situation in land management is observed for the entire EU – with the restructuring of the sector, the average physical size of the farm increased from 17 ha in 1995 to 22 ha in 2007 for the EU-15. However, due to the high share of small farms in most EU-12 Member States, the average farm size only reaches 6.0 ha for the EU-12 and 12.6 ha for the EU-27. The average farm size varies from more than 50 ha in five Member States (the Czech Republic, Denmark, Luxembourg, the United Kingdom and France) to less than 5 ha in four others (Malta, Romania, Cyprus and Greece) [4]. Fragmentation of agricultural land is widespread around the world and results from various institutional, political, historical and sociological factors, such as inheritance laws, collectivisation and consolidation processes, transaction costs in land markets, urban development policies, and personal valuation of land ownership [19].

Within the present research, the total number of farms was analysed for the farmland sizes, calculated for the selected sectors, needed for providing a minimum income level per one and two individuals employed in agriculture (Tables 4 and 5) [18].

Table 4

**Distribution of farms by land area needed to earn a minimum income by an employed individual for groups of farms of selected specializations in Latvia in 2012**

| Number of farms with a total UAA less than the minimum area | Minimum sizes of farmland for selected sectors, ha | Number of farms with a total UAA more than the minimum area |
|---|---|---|
| 59 119 | 65.5 (field crops) | 3 947 |
| 57 730 | 48.3 (dairy) | 5 336 |
| 58 276 | 53.7 (grazing livestock) | 4 790 |

In the sectors of field crops, dairy and grazing livestock, more than 90 % of the total number of farms belonged to the group of farms exploiting an area less than the area needed to provide a minimum income. For instance, only less than 4 ths farms or 6.3 % of their total number had a minimum land area to provide a MIL 1 in field crop farming. So, most of the farms had an area which, in terms of size (according to the calculations performed in the present research), could not ensure a minimum income level per individual employed in agriculture.

Table 5

**Distribution of farms by land area needed to earn a minimum income by two employed individuals for groups of farms of selected specializations in Latvia in 2012**

| Number of farms with a total UAA less than the minimum area | Minimum sizes of farmland for selected sectors, ha | Number of farms with a total UAA more than the minimum area |
|---|---|---|
| 60 669 | 108.9 (field crops) | 2 397 |
| 59 948 | 84.4 (dairy) | 3 118 |
| 60 477 | 100.8 (grazing livestock) | 2 589 |

A situation analysis shows that of 63 066 farms (RSS data), only 2 397 farms or 4 % of their total number had a minimum area needed for providing a minimum income level per two employed individuals in case of field crops (Table 5). A similar situation was observed for the sector of grazing livestock, while in dairy farming only 5 % of the total number of farms had a minimum land area calculated for MIL 2.

## 3. Amounts of long-term investment to provide a minimum income on farms of selected specializations

To identify an amount of long-term investment (in buildings, constructions, machinery, equipment and other fixed assets; land is excluded) for farms to provide a minimum income level, based on the FADN data for the period 2008-2012 [8; 12-15], an average amount of long-term investment per ha, as of the end of the year, was calculated for farms of a particular specialization. The amount was adjusted for the depreciation of fixed assets during the period of their exploitation; it was assumed that to get back the initial investment, the depreciation period of buildings and constructions was 20 years, while that of the other assets it was 5 years (Table 6).

Table 6

**Investment by farms in Latvia in the period 2008-2012**

| Indicators | Average investment per 1 ha in 2008-2012, EUR | | | Adjusted investment per 1 ha, EUR | | |
|---|---|---|---|---|---|---|
| | Field crops | Dairy | Grazing livestock | Field crops | Dairy | Grazing livestock |
| Long-term investment as of the end of the year: | 609 | 217 | 265 | 1110 | 532 | 644 |
| buildings, constructions | 143 | 88 | 104 | 309 | 184 | 229 |
| machinery, equipment | 384 | 111 | 138 | 570 | 239 | 291 |
| other fixed assets | 83 | 18 | 23 | 231 | 109 | 124 |

So, in the period 2008-2012, the greatest real amount of long-term investment for FADN farms, as of the end of the year, (land was excluded) was needed in field crop farming, 609 EUR·ha$^{-1}$, which was 2.8 times more than in dairy farming and 2.3 times more than in grazing livestock farming. If adjusted for the depreciation of fixed assets, the difference decreased, yet, the differences for the selected sectors were still considerable: the greatest amount of long-term investment (land was excluded) per ha was required for field crops, whereas the smallest – in dairy farming. Of the total investment, 45 % in livestock farming and 51 % in field crop farming were needed for purchasing machinery and equipment.

The calculation results for the amounts of long-term investment (land is excluded) necessary to provide a minimum income level on farms of selected specializations, given the adjusted amounts of investment presented in Table 6, are shown in Table 7.

Table 7

**Investments needed to earn a minimum income for farms of selected specializations in Latvia**

| Indicators | MIL 1 farms, EUR | | | MIL 2 farms, EUR | | |
|---|---|---|---|---|---|---|
| | Field crops | Dairy | Grazing livestock | Field crops | Dairy | Grazing livestock |
| Long-term investment needed: | 72 728 | 25 702 | 34 599 | 120 917 | 44 911 | 64 945 |
| buildings, constructions | 20 221 | 8 891 | 12 289 | 33 620 | 15 537 | 23 067 |
| machinery, equipment | 37 363 | 11 541 | 15 641 | 62 120 | 20 166 | 29 360 |
| other fixed assets | 15 144 | 5 270 | 6 669 | 25 178 | 9 208 | 12 518 |
| Maintenance of buildings and machinery | 2 480 | 993 | 1 052 | 4 123 | 1 736 | 1 975 |
| Investment subsidies | 2 781 | 697 | 1 101 | 4 624 | 1 218 | 2 066 |

So, to provide a minimum income, dairy farms have to make a long-term investment of approximately EUR 26 000, grazing livestock farms – 35 000 EUR, while field crop farms – 73 000 EUR (land is excluded). In addition, the maintenance of buildings and constructions requires, on average, 993-2480 EUR per year. To make long-term investments a subsidy of 697-2781 EUR per year will be needed.

## Conclusions

1. Land areas needed to provide a minimum income level per individual in Latvia are as follows: 65.5 ha in field crop farming, 48.3 ha in dairy farming and 53.7 ha in grazing livestock farming, while per two individuals the needed farmland sizes are 108.9 ha, 84.4 ha and 100.8 ha, respectively.
2. For all the key agricultural sectors, with the exception of grazing livestock farming (MIL and income and AA and MIL), there were strong linear correlations between the indicators analysed, as their correlation coefficients exceeded 0.8.
3. In the sectors of field crops, dairy and grazing livestock, more than 90 % of the total number of farms belonged to the group of farms exploiting an area less than the area needed to provide a minimum income. Only less than 4 ths farms or 6.3 % of their total number had a minimum land area to provide a minimum income in field crop farming, while in dairy farming it was 5.3 ths or 8.5 % and in grazing livestock farming it was 4.8 ths or 7.6 %.
4. To manage a farmland area needed to provide a minimum income, farms have to make long-term investments in buildings, constructions, machinery, equipment and other fixed assets. The size of long-term investment (investment in land excluded) varies from 532 EUR·ha$^{-1}$ for dairy farming to 1110 EUR·ha$^{-1}$ for field crop farms. So, to provide a minimum income on farms, the total long-term investment per farm employee stands at approximately 26 000 EUR for dairy farms, 35 000 EUR for grazing livestock farms and 73 000 EUR for field crop farms; per two farm employees it is approximately 45 000 EUR, 65 000 and 121 000, respectively.

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