FARM INCOME RISK ASSESSMENT FOR SELECTED FARM TYPES IN POLAND - IMPLICATIONS OF FUTURE POLICY REFORMS[1]

Edward Majewski
Warsaw Agricultural University
Faculty of Agricultural Economics
Nowoursynowska 166, 02-787 Warsaw, Poland
Email: edward_majewski@sggw.pl

Waldemar Guba
Ministry of Agriculture, Poland
Email: waldemar.guba@minrol.gov.pl

Adam Was
Warsaw Agricultural University, Poland
Email: adam_was@sggw.pl

Abstract

In the traditional understanding "risk arises when the stochastic elements of a decision problem can be characterized in terms of numerical objective probabilities, whereas uncertainty refers to decision settings with random outcomes that lack such objective probabilities" [Moschini, Hennessy 2001, p. 91]. This distinction, attributed to Knight (1921) is largely ignored in more recent publications. Moschini and Hennessy [op.cit.] state "we tend to use the word uncertainty mostly to describe the environment in which economic decisions are made, and the word risk to characterize the economically relevant implications of uncertainty". Following this view any ex-ante considerations in the decision making process refer to uncertainty regarding the prediction of an un-known future, whilst risk relates more to the ex-post measuring or ex-ante assessment of economic impacts of the decisions made. As such "risk" can be defined as "uncertainty of outcomes" [EC Working Document 2001, after Hardaker, Huirne and Anderson 1997; M]. For some reason, farm-businesses, more than any other businesses, may be subject to a variety of risks, such as human or personal, asset, production or yield, price, institutional and financial [EC Working Document 2001]. Of those, production risk, mainly due to the nature of agricultural production exposed to weather conditions and dependent on the healthy growth of animals, as well as price risk, resulting from the volatility of agricultural markets, have a direct and probably the greatest impact on farm incomes. In addition the dependence of European farming on policy related transfers (market price support and direct income support) means that farm incomes are increasingly exposed to price and income risk related with the CAP reforms. For example, the consequences of the new WTO agreement may result in lower price support and greater exposure to world market price volatility. At the same time pending the policy debate on the EU budget for the next programming period will put both the forms and levels of direct farm support under public scrutiny. This paper deals with the assessment of risk for selected farm types in Poland in the perspective of the years 2013 and 2018 considering different EU farm policy scenarios creating an additional institutional risk, which through different market-related measures may affect, direct prices support and thus incomes. The typical Polish heterogeneity of farm structure creates a good basis for comparison of the income situation of different types of farms, with a focus on the probability of achieving low incomes threatening the farm's existence. For this purpose a static simulation model using a Monte Carlo method was constructed. No changes in production structure and other possible adjustments, including investments, were considered.

Keywords: risk assessment, Poland, EU farm policy, income

[1] The research described in this paper is part of the 6th FP project "Income Stabilisation", see www.incomestabilisation.org

Introduction

In the traditional understanding "risk arises when the stochastic elements of a decision problem can be characterized in terms of numerical objective probabilities, whereas uncertainty refers to decision settings with random outcomes that lack such objective probabilities" [Moschini, Hennessy 2001, p. 91]. This distinction, attributed to Knight is largely ignored in more recent publications. Moschini and Hennessy [op.cit.] state "we tend to use the word uncertainty mostly to describe the environment in which economic decisions are made, and the word risk to characterize the economically relevant implications of uncertainty".

Following this view any ex-ante considerations in the decision making process refer to uncertainty regarding the prediction of an un-known future, whilst risk relates more to the ex-post measuring or ex-ante assessment of economic impacts of the decisions made. As such "risk" can be defined as "uncertainty of outcomes" [EC Working Document 2001, after Hardaker, Huirne and Anderson 1997].

For some reason, farm-businesses, more than any other businesses, may be subject to a variety of risks, such as human or personal, asset, production or yield, price, institutional and financial [EC Working Document 2001]. Of those, production risk, mainly due to the nature of agricultural production exposed to weather conditions and dependent on the healthy growth of animals and crops, as well as price risk, resulting from the volatility of agricultural markets, have a direct and probably the greatest impact on farm incomes. In addition the dependence of European farming on policy related transfers (market price support and direct income support) means that farm incomes are increasingly exposed to price and income risk related with the Common Agricultural Policy (CAP) reforms. For example, the consequences of the new WTO agreement may result in lower price support and greater exposure to world market price volatility. At the same time the policy debate on the EU budget for the next programming period will put both the forms and levels of direct farm support under public scrutiny.

This paper deals with the assessment of risk for selected farm types in Poland in the perspective of the years 2013 and 2018 considering different EU farm policy scenarios creating an additional institutional risk, which through different market-related measures may affect, direct prices support and thus incomes. The typical Polish heterogeneity of farm structure creates a good basis for comparison of the income situation of different types of farms, with a focus on the probability of achieving low incomes threatening the farm's existence. For this purpose a static simulation model using a Monte Carlo method was constructed. No changes in production structure and other possible adjustments, including investments, were considered.

Methodology

The level and volatility of farm incomes were estimated using a Monte Carlo simulation method in a farm model constructed for the @Risk package. For the simulation of farm incomes six of the most common production types in Poland (TF14), according to the FADN typology [FADN 2006a] were selected, each divided into 4 clusters by economic size (8-16, 16-40, 40-100, more than 100 ESU).
The following EU agricultural **policy scenarios** were considered:

Base 2004
Historic reference scenario.

Current CAP 2013
Reflection of continuation of all existing policies, including implementation of the already agreed reforms (Luxembourg 2003) with minor assumed changes (10% mandatory modulation of direct payments).

Further Liberalisation 2018
Best guess for the future 2018 CAP, based on the assumption of new WTO deal and its consequences for EU price, trade and direct support policy in the sector. Full decoupling and mandatory modulation of 10% of direct payments is assumed (only the biggest farms).

Full Liberalisation 2018
Withdrawal of all market and direct support measures. EU farm prices equal world market prices.

The **scenario parameters** have been set in the following way:
base scenario parameters were calculated from historical data;

future price levels were assumed on the basis of the most recent FAPRI and OECD "baseline" projections. The projected prices were adjusted by assuming deviations from those projections driven by scenario specific changes in policy instruments. The assumed impact of liberalisation reflects the level of current market price support and projected world price level.

volatility (standard deviation) of future prices was assumed based on analysis of variability of historic time-series for EU and world market prices. It was assumed that liberalisation enhances the volatility of future EU prices up to the level observed (historically) in case of world market prices.

future yields and their volatility were estimated based on the extrapolation of the long-term historic trends in yields. The same levels of yields for all scenarios have been assumed;

future inputs and costs were assumed on the basis of expert judgment. The assumption reflect changes in input prices and takes into account variety of factors driven each input market.

Examples of basic assumptions regarding model parameters for future policy scenarios are presented in tables 1-4.

The **key parameters of the base model** which were calculated from historical data can be grouped as follows:

Means of structural variables to describe the farm types (e.g. size of activities, yield, prices, inputs or costs) calculated from FADN data base for the years 2002-2004;

Standard Deviation for selected variables;

Cross correlations:
farm related (input-output, input-input) from historical farm data;
market related (price-price, price-yield; yield-yield) from national statistics data.

Due to data limitations input-output correlations for crop production were not included in the model.

Most of the farm activities in the model were described by the parameters of the distributions (standard deviation) of yields and prices. Similarly, the standard deviation was estimated for selected cost variables (energy, fertilizers, pesticides, seeds, purchased and farm produced feed for animals). Other variables of the model (e.g. fixed costs) were introduced as constant values specific for each farm type.

For simplification a normal distribution for all variables was assumed. The distribution was truncated on the left side at 0 for yields and for prices at the values, optionally, of $\bar{x} - 2\sigma$ or 0 or the intervention price, depending on which was the highest.

The estimation of **standard deviation in the base period,** which is a basic measure of instability of yields and prices in the simulation model, created some difficulties related mainly to available sources of data. Data from two different sources for the period 2002-2004 and Farm Survey[2] for the years 1997-2001, adjusted to FADN standards have been merged. For a given farm type (activity, size) all observations have been **pooled** across years (1997-2004) and standard deviations were estimated for the whole set of variables. Both data bases were merged for our estimations in the following way:

all farms from the Farm Survey which represent farm types selected for simulations;

randomly drawn 10% of FADN farm population.

As a result the total number of farms in the "merged" data base varied, in consecutive years, between 377 in 2003 and 732 in 2004.

Splitting the population of farms into selected farm types, and drawing data on single activities from smaller samples, which do not appear in all farms, reduces strongly the number of observations which can be used for estimation. As a consequence, a "within farms and across years" approach, which could be considered as the most appropriate, was not possible. That is why it was decided **to pool all the observations** within each farm type and estimate the standard deviation for the whole set of variables. Consequently, the analysis and its results are interpreted in relation to the experienced (ex-post for the base period) and envisaged (ex-ante for scenario analysis) situation in the **population** of farms, rather then in a single farm.

Any estimates of means and standard deviations from the pooled data in the simulations produce a randomly chosen value that depends on all the combined sources of variation, including the hopefully small net sampling errors, between farm performance levels and year to year variations due to weather and market/policy conditions.

As a result, the simulated income distributions for the represented farm population show the proportion of all farms likely to fall below some critical level, reflecting their economic viability. The statistics (mean and SD) capture all the variation even though it is not separated out into its respective components.

Model parameters for the future policy scenarios, taken from available forecasts, estimated from extrapolation of existing trends or assumed according to experts' judgment are presented in tables 1 – 4.

[2] Farm Survey conducted by the Institute of Agricultural and Food Economics in Warsaw. Polish FADN, which have been established very recently, provides data for the years 2002-2004 only, but for a large sample of farms (12000 in the year 2004). The Farm Survey, which is not fully compatible with FADN, provides historical data for a long period, however for much smaller population of farms (about 1000 on average in the period considered).

Table 1: Price assumptions for selected commodities (Indices of EU nominal prices; Base 2004 = 100)

Commodity	**Current CAP 2013**	**Further Liberalisation 2018**	**Full Liberalization 2018**
Wheat	105	100	98
Oil seed	105	105	105
Sugar Beets	56	56	39
Milk	83	86	69

Source: Own assumptions based on OECD-FAO 2005 and FAPRI 2006

Table 2: Estimated and assumed parameters for wheat prices and their volatility in the specialised cereal farms

Farm size (in ESU)	**Parameter**	**Base 2004**	**Current CAP 2013**	**Further Liberalisation 2018**	**Full Liberalization 2018**
8-16	Price level* (PLN/dt)	45,7	48,3	45,7	44,6
	Standard deviation	*7,1*	*8,42*	*9,73*	*13,82*
	Volatility (coeff. of var. in %)	15,48	17,41	21,28	30,95
16-40	Price level* (PLN/dt)	45,2	47,8	45,2	44,1
	Standard deviation	*6,7*	*8,0*	*9,2*	*13,1*
	Volatility (coeff. of var. in %)	14,81	16,7	20,4	29,6
40-100	Price level* (PLN/dt)	47,6	50,4	47,6	46,5
	Standard deviation	*7,0*	*8,3*	*9,6*	*13,7*
	Volatility (coeff. of var. in %)	14,69	16,5	20,2	29,4
100>	Price level* (PLN/dt)	43,6	46,1	43,6	42,6
	Standard deviation	*5,2*	*6,1*	*7,1*	*10,1*
	Volatility (coeff. of var. in %)	11,82	13,3	16,3	23,6

** price level for future scenarios were calculated by application of the indices for EU nominal prices from Table 1*

Source: Own estimates based on FADN (Base) and OECD-FAO 2005 and FAPRI 2006 (future scenarios)

Table 3: Input price change assumptions (Base 2004 = 100)

Cost element	Current CAP 2013	Further Liberalisation 2018	Full Liberalization 2018
Fertilizers, pesticides	120%	130%	115%
Seeds	125%	140%	125%
Purchased concentrates	110%	110%	95%
Cash crops for feed	110%	110%	95%
Energy	120%	130%	130%
Land lease cost (per farm)	120%	115%	75%
Taxes (per farm)	150%	200%	150%
Other costs (per farm)	120%	130%	130%
Hired labour	150%	180%	180%
Off farm income	130%	150%	150%

Source: Own assumptions

Table 4: Assumed future yields

Crops	Annual rate of yield increase (1992-2004)	Assumed future annual rate of yield increase	Yields (dt/ha)		
			Mean [2002 - 2004]	2013	2018
Wheat	0,93%	1,80%	38,4	45,1	49,3
Rye	0,85%	0,90%	24,5	26,6	27,8
Barley	1,34%	1,30%	31,7	35,6	38,0
Corn	4,13%	1,50%	57,1	65,3	70,4
Potatoes	1,84%	2,00%	189,3	226,3	249,8
Sugar beet	2,60%	2,00%	427,0	510,3	563,4
Oilseed rape	0,55%	0,50%	23,5	24,6	25,2
Milk	3,17%	2,50%	4127,3	5154,5	5831,8
Oats	1,66%	1,40%	24,8	28,1	30,2

Source: Own estimates based national statistics.

Characteristics of the analysed farm types

Basic characteristics of the FADN farm types selected for simulation is presented in table 5.

Table 5: Characteristics of selected farm types (mean values from the period 2002-2004)

Farm Type [TF14]	Size class [ESU]	Agricultural area [ha]	Number of livestock units	Share in LU [%]			Stocking rate [LU/100 ha]
				cows	other cattle	pigs	
Specialized farm types							
13 cereal, proteins, oilseeds	8-16	51,7	2,6	13%	9%	78%	5,2
	16-40	112,3	3,6	11%	7%	82%	3,1
	40-100	252,0	1,5	0%	98%	2%	0,6
	> 100	511,7	38,8	1%	10%	89%	7,6
41 dairy	8-16	22,1	21,8	73%	21%	6%	98,9
	16-40	38,5	39,5	73%	24%	3%	99,9
50 pigs	8-16	15,6	23,1	2%	2%	96%	148,5
	16-40	27,6	48,9	1%	1%	97%	177,1
	40-100	56,0	111,6	0%	1%	99%	199,1
	> 100	128,5	442,9	0%	0%	100%	344,6
Mixed farm types							
81-82 mixed crop and livestock	8-16	23,2	14,7	25%	16%	59%	63,4
	16-40	51,6	31,8	19%	11%	70%	61,6
	40-100	118,4	82,3	6%	7%	87%	69,5
	> 100	482,8	245,7	30%	14%	56%	50,9
60 mixed crops	8-16	21,0	9,8	25%	21%	54%	46,7
	16-40	41,8	18,8	16%	25%	59%	45,2
	40-100	134,2	51,3	20%	15%	64%	38,3
71 mixed livestock	8-16	19,6	17,9	44%	26%	31%	91,0
	16-40	36,9	35,3	44%	27%	29%	95,7
	40-100	73,3	84,9	48%	20%	32%	115,8

Source : own calculations base on FADN and pre-FADN databases.

All the farms in the sample can be classified as commercial, mostly family farms. They are characterized by different production orientation and also varied level of specialization.

Simulation results

Simulation results allow the assessment of the impact of the policy scenarios on the average level and variability of farm incomes for the considered farm types. The risk effect was measured as a percentage of farms with negative income and income falling below the minimum wage level (for two persons). This minimum was set at the average wage level in Poland. It was adjusted for the future scenarios assuming an increase of wages in the economy (30% by 2013 and 50% by 2018).

The average absolute farm incomes (table 6) show considerable stability over the analysed time horizon under CAP scenarios (Base, Most Likely, Likely). This reflects an impact of two major forces influencing farm incomes in Poland in the near future, both being elements of EU farm policy, however acting in opposite directions:

- positively affecting farm incomes is the gradual implementation of the direct payments system (phasing-in), increasing payments from the initial 2004 level (55% of the full eligible rate) up to 100% in the year 2013;
- adversely affecting farm incomes is the gradual decline in farm prices due to the implementation of recent reforms (dairy) and the assumed consequences of the Doha round for the CAP market price support policy. After 2013 the only factor compensating for the decline in support of agricultural prices and increase in farm costs will be technical progress improving farm productivity.

The Liberal scenario results in a considerable decline in average farm incomes, which clearly reflects the 'size' of the current income support provided by the CAP. Another observation is that the mean values of farm incomes are slightly higher in specialized farms. This cannot be attributed to the fact of specialization only, because mixed farms in the sample are on average smaller in terms of the area and stocking density. The results of the simulation also show, what is quite obvious, that the greater the economic size of farms, the higher the farm incomes that are generated.

Table 6: Farm income – mean (Euro per farm)

Farm Type [TF14]	Size class [ESU]	Base 2004	Current CAP 2013	Further Liberalisation 2018	Full Liberalization 2018
Specialized farm types					
13 cereal, proteins, oilseeds	8-16	10104	14691	13009	1902
	16-40	16912	33143	30066	7663
	40-100	62434	102284	92919	45058
	> 100	191218	296866	282333	177758
41 dairy	8-16	9527	10809	13210	4351
	16-40	21593	23429	28045	11583
50 pigs	8-16	7076	6970	6844	2266
	16-40	13482	15338	15549	8053
	40-100	32242	39207	43329	26715
	> 100	85867	115896	131492	76043
Mixed farm types					
81-82 mixed crop and livestock	8-16	6910	8232	8592	2164
	16-40	17521	20741	21264	7428
	40-100	38214	51865	52194	23134
	> 100	116556	155451	152739	26645
60 mixed crops	8-16	7012	6449	5794	501
	16-40	12632	13802	13238	2247
	40-100	65923	81198	76545	47524
71 mixed livestock	8-16	5151	6437	7366	1173
	16-40	12019	14839	17532	4975
	40-100	39354	41570	48088	19401

Source: Own calculations

A similar pattern emerges from the simulated distribution of farm incomes (table 7) . Even though farm types differ in terms of the percentage of holdings with negative income in any scenario, these percentages for most types remain below 10% in all CAP scenarios. However, the situation changes drastically in the liberal scenario under which the percentage of farms with negative incomes is significantly increased. Nevertheless, more than half of farms generate positive incomes in the liberal scenarios.

The risk of farm incomes falling below the assumed minimum wage level increases in all farm types and policy scenarios (table 8). Under the liberal scenario, the majority of farms of small economic size are not able to reach an adequate income.

The ability to generate a positive Farm Income allowing the covering of cost of own labour is one of the key factors determining economic sustainability of a farm. In our simulation the assumption was made that a farm should provide an income equal to at least the national minimum wages for 2 fully employed persons (in the base year 2400 Euro per person). Respectively, 2013 and 2018 minimum wages were assumed at the level of 3120 and 3600 Euro per person, taking into account the expected growth of the Polish economy and likely increase of wages.

It is important to emphasize that the model applied is a static one and no adjustments such as changes in production structure or increases of the production scale were considered.

The simulation results provide an insight into the proneness of different farm types to assumed policy changes. It turns out that the risk of making losses is considerably dependent on the production orientation and economic size of a farm. The least susceptible to income risk appear to be farms specializing in milk production (TF 41), which can be explained by a relative stability of milk prices and milk yields. Among specializing farms a somewhat higher exposure to risk was detected for cereal farms (TF 13), which partly results from greater yield and price volatility. Those most exposed to income risk appear to be farms specializing in pig production (TF 501), which can be explained by the high volatility of pig and feed prices.

A wider portfolio of production activities on a farm should diminish the risk of negative income. This hypothesis is confirmed by the simulation results: non-specialized farms with a mixed production structure showed lower income risk compared with specialized pig farms, despite the fact that pigs accounted for more than half of the livestock. Among the mixed farms considered the lowest risk occurs in mixed livestock farms (mainly grazing - TF 71). These farms are characterized by about 30% share of pigs in the total number of livestock units, which enhances income instability. On the other hand, the domination of cattle has a stabilizing impact on farm income in that category of farms. Somewhat higher income risk occurs in mixed cropping farms (TF 60) and mixed farms (TF 81-82), though in the liberal scenario mixed farms (TF 81-82) are less exposed to risk than the farms where crop production dominates.

Table 7: Risk of getting farm income below zero

Farm Type [TF14]	Size class [ESU]	Base 2004	Current CAP 2013	Further Liberalisation 2018	Full Liberalization 2018
Specialized farm types					
13 cereal, proteins, oilseeds	8-16	5,7%	1,8%	3,4%	40,1%
	16-40	14,0%	3,5%	6,0%	34,6%
	40-100	5,7%	1,4%	2,6%	19,3%
	> 100	2,1%	0,4%	0,9%	8,3%
41 dairy	8-16	0,4%	0,1%	0,1%	11,0%
	16-40	0,1%	0,0%	0,0%	3,4%
50 pigs	8-16	13,5%	17,7%	20,3%	39,5%
	16-40	17,0%	15,8%	18,5%	33,2%
	40-100	16,8%	13,8%	15,1%	26,3%
	> 100	25,8%	21,4%	21,4%	32,5%
Mixed farm types					
81-82 mixed crop and livestock	8-16	2,6%	1,5%	1,7%	31,4%
	16-40	2,1%	1,2%	1,8%	24,2%
	40-100	5,8%	2,2%	3,6%	22,2%
	> 100	7,2%	4,0%	5,3%	39,1%
60 mixed crops	8-16	1,1%	2,1%	5,3%	44,8%
	16-40	1,4%	1,5%	2,3%	36,7%
	40-100	0,2%	0,1%	0,5%	4,7%
71 mixed livestock	8-16	3,2%	1,4%	1,0%	36,4%
	16-40	1,3%	0,4%	0,3%	19,6%
	40-100	0,2%	0,2%	0,2%	8,5%

Source: Own calculations

Table 8: Risk of getting farm income below minimum wage

Farm Type [TF14]	Size class [ESU]	Base 2004	Current CAP 2013	Further Liberalisation 2018	Full Liberalization 2018
Specialized farm types					
13 cereal, proteins, oilseeds	8-16	19%	11,7%	22,5%	76,1%
	16-40	22%	6,5%	12%	49,5%
	40-100	7,6%	2,0%	3,8%	24,0%
	> 100	2,8%	0,5%	1,0%	9,9%
41 dairy	8-16	11,0%	10,6%	7,0%	80,5%
	16-40	1%	1%	0%	27,3%
50 pigs	8-16	37%	46%	52%	73,0%
	16-40	28%	28%	31%	51,2%
	40-100	20%	18%	20%	33,9%
	> 100	27%	22%	22%	33,4%
Mixed farm types					
81-82 mixed crop and livestock	8-16	27,6%	30,6%	38,9%	88,6%
	16-40	7,5%	6,5%	8,7%	50,8%
	40-100	8,7%	4,2%	6,6%	29,9%
	> 100	8,4%	4,4%	6,5%	43,1%
60 mixed crops	8-16	24,4%	47,0%	64,7%	96,6%
	16-40	9,1%	11,0%	18,0%	78,3%
	40-100	0,5%	0,3%	0,9%	8,5%
71 mixed livestock	8-16	46,2%	48,7%	50,2%	97,3%
	16-40	9,6%	5,9%	5,7%	65,8%
	40-100	0,8%	0,7%	0,4%	19,3%

Source: Own calculations

Simulation results verify the hypothesis that farms from clusters of smaller economic size are to the greatest extent exposed to the risk of generating farm incomes below the set threshold level.

This is visible especially under the liberal scenario, within the assumptions made. There is a significant difference in the percentage of farms with negative incomes if the CAP and the Liberal scenarios results are compared. It indicates the strong income stabilizing effects of the CAP for smaller scale farms.

Conclusions

Assessment of risk in farms of different types gives an insight into the phenomenon of strongly diversified farm structure in Poland and allows us to simulate the impact of policy changes on the risk of financial outcomes in the future.

The simulation results show that likely reduction of the price protection for most agricultural commodities and reduction of direct payments may result in the increased risk of achieving low farm incomes, although the differences between the three CAP scenarios are not very marked. The gradual liberalization of the CAP which may be expected in the future will moderately affect Polish farms especially in the perspective of the year 2013 due to the increase of direct payments in line with the phasing-in schedule. The most exposed to the risk of low incomes are pig farms and mixed farms with a high share of pigs in the total livestock numbers. Farm types which seem to be least sensitive to the assumed policy changes are dairy and farms from all production orientation types of greater economic size. Still, the smaller farms are relatively strongly protected by all CAP scenarios.

More radical policy changes, as represented by the Liberal scenario, would dramatically worsen the financial situation of smaller farms, very likely driving a large number of farm holdings out of business. The most recent years in Poland are marked by the rapid concentration of production in commercial farms in almost all farm activities. A strong liberalization of the agricultural policies would speed up significantly such structural changes in the Polish farming sector.

References:

European Commission, Agriculture Directorate-General, 2001. Working Document "*Risk Management Tools for EU Agriculture*".

FADN Poland, 2006a. *Standard results obtained by the farms participating in Polish FADN in 2005*. http://www.fadn.pl/mediacatalog/documents/wyniki_stand_ogolne_2005r.pdf

FADN Poland, 2006b. *Standard results obtained by the individual farms having the accountancy system in 2005.* http://www.fadn.pl/mediacatalog/documents/wyniki_stand_indywidualne_2005r.pdf

FAPRI 2006 U.S. and World Agricultural Outlook; Food and Agricultural Policy Research Institute; Iowa USA

Hardaker, J.B., Huirne, R.B.M. and Anderson, J.R. (1997), Coping with Risk in Agriculture. CAB International, Oxon, United Kingdom. ISBN 0 85199 199 X.

Moschini G., Hennessy D.A., 2001. Uncertainty, risk aversion, and risk management for Agricultural producers. *Handbook of Agricultural Economic, vol. 1A Agricultural Production*, edit. Gardner B.L., Rausser G.C. Elsevier.

OECD – FAO Agricultural Outlook: 2005 – 2014
Statistical Yearbook Poland – Main Statistic Office publications 1979-2006