IMPACT OF ENERGY PRICES ON INCOME OF LABOUR ON FIELD CROP OPERATIONS[1]

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Summary

The starting point of the paper is the fact that the economic effects of field crop operations is highly conditioned by energy prices (primarily diesel fuel prices) as well as by the raw material whose prices to a large extent depend on energy price (fertilisers). Hence, it is determined on the basis of the model of family farm (specialized in field crop production) that the change in the prices of the given inputs influences the change in gross margin and farm profit.

A special attention is paid to the changes in gross margin per worker and per working hour, as well as to the profit per worker and per working hour, which is caused by a varying of the purchase prices of raw materials, whose prices depend on energy prices (diesel fuel and fertilisers).

It is determined by the analysis that diesel D-2 is distinguished because of its importance for profitable business operations of the examined family farms regarding that the 20% price increase of diesel D-2 leads to the decrease in family farm profit by 35.56%. In the second place, the highest impact on the profit is created by the prices of different NPK fertilisers, whereas the prices of KAN and UREA fertilisers do not have so significant impact on the farm profit. By subsidizing the price of the aforementioned inputs for

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family farms, it is possible to produce greater economic effects of labour on family farms and thus influence the reduction of rural poverty. This solution is acceptable only in the short run, but in long term perspective it is needed to emphasize investments instead of subsidies.

Key words: *family farms, gross margin per worker, profit per worker, gross margin per working hour, profit per working hour.*

JEL: *Q10, Q12, Q14*

Introduction

The Republic of Serbia did not avoid the consequences of the world economic crisis as well as the crises related to energy on the global level. Therefore, it leads to the increase in prices of the most important inputs in agricultural production, and primarily in the prices of diesel fuel and fertilisers. It results in the increase of variable costs of agricultural production, and in the rise of total costs, decrease in gross margin and profit (in some enterprises, as well as total for the whole farm). This situation is primarily reflected in farms involved in crop production, and then this prices increase is transferred to livestock production through the costs of animal feed. Through crop and livestock production, this price rise is also reflected in processing industry.

According to Furman et al. (2004) agriculture, as a great energy consumer, annually spends 651,585.8 t of diesel fuel, which comprises 31.89% of total consumption in the Republic of Serbia (2,042,971.5 t). However, it is only a half in comparison with the period of 20 years ago when 1,300,000 t of diesel fuel were spent in agriculture annually (Brkić and Janić, 2005). Bearing that in mind, it is obvious that the increase in fuel prices primarily caused by fuel products world market trends significantly influences the costs of agricultural production (Todorović et al., 2009b). The similar situation can be discerned in the case of fertilisers, which are currently (due to high market prices and uncertainty regarding the prices of agricultural products) much less used than they once were. In other words, given the high price of fertilisers, many family farms are not able to apply a sufficient amount thereof, which is certainly negatively reflected in yield, and accordingly in the profitability of business operations.

The price increase of raw material and fuel adversely affects the level of production intensity. Producers, striving to gain profit in conditions of expensive production, tend to reduce technology and produce at the expense of environment (primarily soil), which is socially unacceptable (Bošnjak and Rodić, 2010). Todorović and Filipović (2010a) stated that the most significant item in wheat production costs (35.75%) is cost of fertilisers, which is a consequence of its high purchase price. The potential savings on fertilisers applied by some farms in the absence of favourable financing sources cannot be called rationalisation, because reduced investments in fertilisers is negatively reflected in the profitability of production (it is well-known fact that the amount of applied fertiliser is one of the factors which significantly influences the level of yield). The same authors

state that the example of the farms which fully implemented cultural practices (which comprises the application of an adequate amount of fertilisers), shows that the adequate application of fertiliser, even in the conditions of its high purchase price, has the economic justification given that it contributes to the increase in production profitability. This is stated by the authors because producers in Serbia (due to high prices of fertilizers and absence of financial means) often use minimal quantities of fertilizers (much less than standard quantities).

It is important to consider the possibilities for mitigating consequences caused by high prices of fuel and fertilisers. Bearing in mind the mainly monopolistic position of suppliers related to the family farms and the fact that the farmers individually (independently of each other) procure the necessary inputs for agricultural production, it is completely evident that in such circumstances family farms do not obtain or hardly obtain price discount on greater quantity of purchased raw material.

That is, among other things, the consequence of unfavourable structure of land tenure of family farms at the level of the Republic of Serbia, taking into consideration that according to the research of Bogdanov and Božić (2005), only 5.5% of farms own more than 10 ha of land. Apart from that, the purchases of the inputs for agricultural production are most frequently made at local dealers, where the prices are, as a rule, higher than the prices at wholesale. Due to cyclical cash flow on the family farms specialized in field crop production, the purchases of the raw material are not made in advance, but at the moment when it is needed or on the basis of deferred payment (Todorović et al., 2009a). All this negatively influences family farm operations, due to the increase in production costs incurred as a consequence of the higher purchase prices of the inputs for agricultural production. The associations of producers can have an important role in overcoming this problem regarding either the associations of farmers, cooperatives or any other form of linking small agricultural producers. The association membership can provide better market position of family farm, thereby creating a favourable environment for improving its profitability (Cicea et al., 2009).

This paper aims at examining the economic effects of the change in raw material prices (which depend on energy prices – diesel fuel and fertilisers) on economic effects of field crop operations, as well as on economic effects of labour of farm members. The aim of the paper is also to give some recommendations for agricultural policy. Nevertheless, investigation is focused on direct short term effects on farm incomes of input price changes, due to frequent changes of agrarian policy in Serbia, as well as impossibility to predict with certainty when Serbia will become a member of the EU.

Materials and methods

In order to accomplish the aforementioned aim, the interviews with 15 family farms holders from AP Vojvodina were conducted. A detailed analysis of natural, organisational and economic conditions in which the farms operate was carried out, then the analysis of all available resources which are at their disposal as well as the analysis of production results.

Based on that, a model of family farm specialized in field crop production was made with the following main characteristics:

- The farm is situated in the lowland region and has 10 ha of arable land of uniform quality and optimum plot size,

- The farm is involved in intensive crop production.

- Crop area is used for growing cereals (maize and wheat) and industrial crops (sunflower and soya bean) with respect to crop rotation restrictions. Production technology is typical for the given crops and the region in which the farm is located,

- The whole crop production is market-oriented, that is, there is not any form of internal realisation of the obtained products;

- One family member is constantly engaged on the farm and

- The farm has at its disposal necessary machinery (except for combine harvester) for implementation of the designed production technology (tractor 30 kW and appropriate other machinery).

As a basis for the research, calculations of fixed costs at the level of the whole farm were used, as well as variable costs per enterprises and total variable costs for the whole farm. Based on these elements, the indicators of economic effects of field crop operations were determined, and these are gross margin of the whole farm (as a difference between the total production value and total variable costs) and profit which is made on the farm (as a difference between the total production value and the sum of total fixed and variable costs).

Apart from the aforementioned calculation methods, the sensitivity analysis method was used in the paper for the purpose of determining changes in gross margin and family farm profit depending on the change in purchase price of the following raw materials used on the farm:

- Fuel (diesel D-2) and
- Fertilisers (NPK 8:16:24, NPK 15:15:15, UREA and KAN).

Sensitivity analysis started from the assumption that the purchase price of the observed raw materials varies within the range of ±20%, reflecting the changes that often occur in practice. The same method of analysis was used to determine changes of input prices (in percentage) that will provide information when the farm operation is unprofitable.

Results and discussion

In the paper, firstly are observed the impacts of diesel fuel and fertilisers prices on gross margin and family farm profit. The impact of diesel price on the mentioned economic indicators of field crop operations is shown in Table 1.

Table 1. Change in gross margin and family farm profit depending on fuel price (diesel D-2)

| Change of the purchase price of fuel (diesel D-2)	Gross margin of family farm			Family farm profit		
	Value (RSD)	Change (RSD)	Change (%)	Value (RSD)	Change (RSD)	Change (%)
-20.00%	678,066.83	41,671.14	6.55%	158,866.58	41,671.14	35.56%
-10.00%	657,231.26	20,835.57	3.27%	138,031.01	20,835.57	17.78%
0.00%	636,395.69	0.00	0.00%	117,195.44	0.00	0.00%
10.00%	615,560.12	-20,835.57	-3.27%	96,359.86	-20,835.57	-17.78%
20.00%	594,724.54	-41,671.14	-6.55%	75,524.29	-41,671.14	-35.56%

Source: Authors` calculation

It can be noted that the profit of farm is much more sensitive to changes in prices of fuel (diesel D-2) than gross margin. Hence, the change of 1% in fuel price causes the change of 0.327% in gross margin, whereas the change in profit is 1.778%. The significance of diesel fuel prices for economic effects of field crop operations is indicated by the fact that the change of 20% in fuel price (when other factors remain unchanged) results in the change of the total of 35.56% in farm profit. Bearing in mind that the fuel prices tend to rise, it is clear that in the future they can substantially reduce the farms profits.

Fertilisers are raw materials whose price to a large extent depends on energy price on the world market. On the other hand, exclusion of fertilisers from crop production is impossible, since it would significantly reduce the yields of grown crops. Therefore, the analysis of the impacts of different fertilisers` price on gross margin (Graph 1) and on profit (Graph 2) of family farms was carried out.

When conducting it, we started from the fact that some fertilisers (such as UREA) are used both in the autumn and in the spring. Their prices can be considerably different in these two seasons, so for that difference in prices, the impact of price of fertilisers used in the spring and in the autumn on gross margin and family farm profit is separately shown in graphs. Graphs 1 and 2 are designed so that the abscissa shows the percentage change in purchase prices of some types of fertilisers, whereas the ordinate reads how much it (expressed in per cent) will affect varying of gross margin (Graph 1) and profit (Graph 2) of family farm.

Graph 1. Percentage change in gross margin of family farms depending on the percentage change in the price of different types of fertilisers
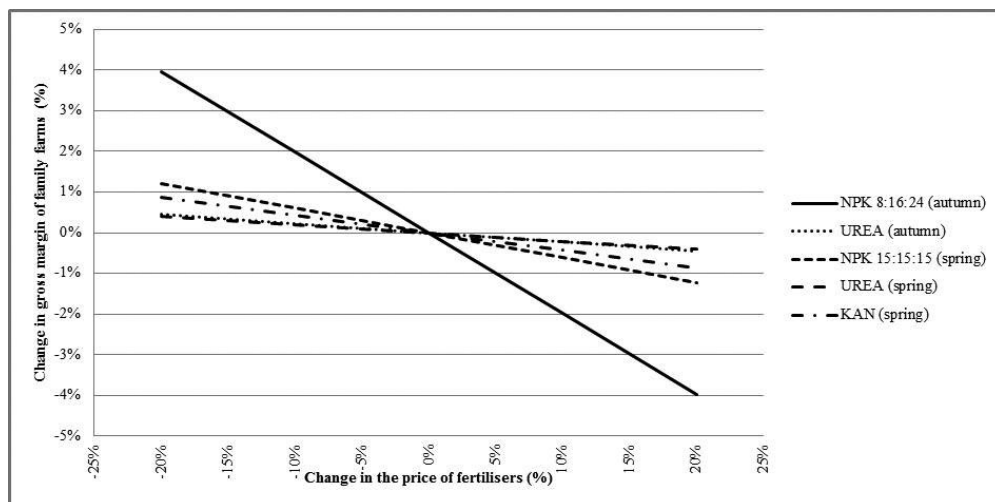
Source: Authors` calculation

Graph 2. Percentage change in profit of family farms depending on the percentage change in the price of different types of fertilisers
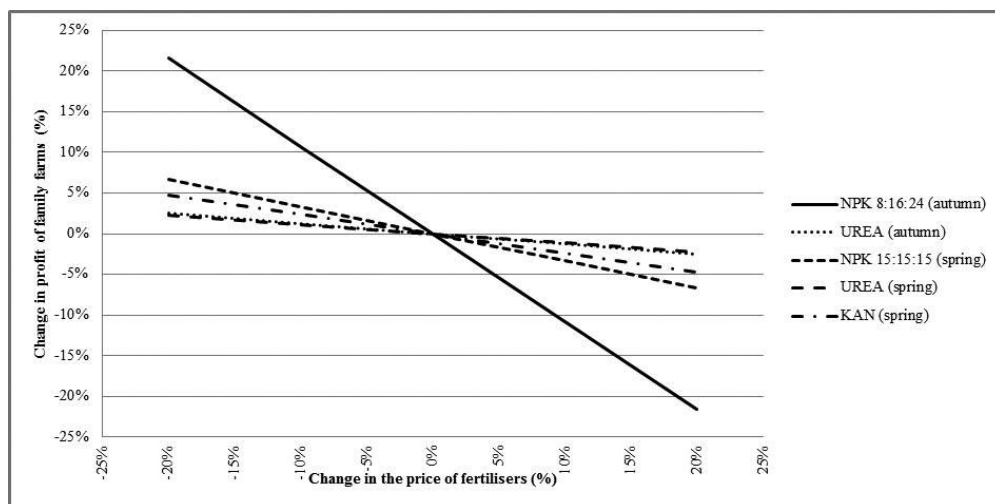
Source: Authors` calculation

As regards gross margin and profit, the fertiliser NPK 8:16:24 is distinguished, so 20% increase in its price leads to reducing of gross margin by approximately 4%, whereas profit is reduced between 21% and 22%.

The comparison of the single impact of diesel fuel and fertilisers price on gross margin and profit of the family farm (in case purchase prices of these raw materials changes by 10%) is shown in Table 2.

Table 2. Impact of individual changes in purchase prices of fuel and fertilisers on gross margin and profit of family farm

Rank	Title	Change of input prices	Change of gross margin of family farm	Change of profit of family farm
1	Diesel D-2	10%	3.27%	17.78%
2	NPK 08:16:24 (autumn)	10%	1.98%	10.77%
3	NPK 15:15:15 (spring)	10%	0.61%	3.31%
4	KAN (spring)	10%	0.44%	2.38%
5	UREA (autumn)	10%	0.23%	1.25%
6	UREA (spring)	10%	0.21%	1.12%

Source: Authors` calculation

The results of the conducted analysis show that gross margin and family farm profit are most affected by diesel D-2 fuel, whereas UREA fertiliser is found to have the lowest impact, particularly that portion used in the spring.

Apart from analysing the impact of the changes in prices of individual raw materials on the success of field crop operations, calculation of the joint effects was also made. It is shown what changes in variable costs, total costs, gross margin and profit of the farm would occur if purchase prices of all observed raw materials (fuel and different types of fertilisers) simultaneously increased by 10%, that is, 20% (Table 3). The same changes in percentage value (but with opposite direction) would occur in case of decrease in prices of these raw materials.

Table 3. The joint effect of changes in purchase prices of fuel and fertilisers on the business indicators

Indicators	The initial value	When purchase prices rise 10%		When purchase prices rise 20%	
		Value (RSD)	Change (%)	Value (RSD)	Change (%)
Variable costs	716,090.40	759,000.12	+5.99%	801,909.84	+11.98%
Total costs	1,235,290.65	1,278,200.37	+3.47%	1,321,110.09	+6.95%
Gross margin	636,395.69	593,485.97	-6.74%	550,576.25	-13.49%
Profit	117,195.44	74,285.72	-36.61%	31,376.00	-73.23%

Source: Authors` calculation

It may be noted that the simultaneous increase in prices of fuel and fertilisers (which is in practice possible, since the prices of these raw materials depend on energy prices on the world market, as well as on the economic policy of the state) would lead to the drastic decrease in profit of family farms specialized in field crop production. Therefore, the increase of prices of these raw materials by 20% would lead to the decrease in farms profit by a total of 73.23%. On the other hand, decreasing in prices of fuel and fertilisers (which are currently at a very high level) to a large extent, would improve the effects of field crop operations.

Thus, state incentives regarding production costs have increasingly important role (Todorović, Filipović, 2010b; Todorović, 2010). Hence, it is necessary to bear this in mind when designing agrarian policy in the following periods.

The aforementioned changes would also reflect on the economic effects of labour on the farm, which can be expressed as gross margin and profit per worker and per working hour (Table 4).

Table 4. Impact of purchase price of observed raw materials on the income of labour

Indicators	The initial value	When purchase prices rise 10%		When purchase prices rise 20%	
		Value (RSD)	Change (%)	Value (RSD)	Change (%)
Gross margin	636,395.69	593,485.97	-6.74%	550,576.25	-13.49%
Gross margin per worker	636,395.69	593,485.97	-6.74%	550,576.25	-13.49%
Gross margin per working hour	2,268.31	2,115.36	-6.74%	1,962.42	-13.49%
Profit	117,195.44	74,285.72	-36.61%	31,376.00	-73.23%
Profit per worker	117,195.44	74,285.72	-36.61%	31,376.00	-73.23%
Profit per working hour	417.72	264.78	-36.61%	111.83	-73.23%

Source: Authors` calculation

The analysis showed that gross margin per worker and per working hour changes in the same per cent as well as total gross margin because of the increase in purchase prices. Similarly, the profit per worker and profit per working hour, due to the increase in purchase prices of raw material, changes in the same per cent as well as total profit of the farm. Therefore, the simultaneous increase in the purchase prices of diesel fuel and fertilisers by 20% causes a 3.66 times higher reduction of profit per worker and profit per working hour. On the other hand, the change in the aforementioned prices is much less reflected in varying of gross margin per worker and per working hour.

It is also possible to determine changes of purchase prices of all observed raw materials (Table 5), as well as specific raw materials that lead to unprofitable farm operation.

Table 5. Changes of purchase prices of observed raw materials when the farm operation is unprofitable

Indicators	The initial value	When purchase prices rise 27.31%		When purchase prices rise 148.31%	
		Value (RSD)	Change (%)	Value (RSD)	Change (%)
Gross margin	636,395.69	519,200.25	-18.42%	0.00	-100.00%
Profit	117,195.44	0.00	-100.00%	-519,200.25	-543.02%

Source: Authors` calculation

If prices of all materials (fuel and fertilizers) rise by 27.31%, family farm that deals with field crop operations will become unprofitable. Analysing possible price changes of specific raw materials it is determined that rise of diesel fuel price by 56.25% leads to unprofitable crop production. The same consequence will happen if price of the most important NPK fertilizer rises by 70.99%.

Besides, we should take into consideration that on the small family farms devoted to field crop production, the hidden unemployment is also present. Family members on these farms have great possibilities to be involved in crop production and to be engaged in some other activities (such as cattle fattening) so as to improve their economic status (Todorović et al., 2011).

It is in accordance with OECD data (2006) showing that "farm families relying increasingly on off-farm employment, the economic success of rural communities will depend on the development of new economic engines". Therefore OECD (2006) governments are increasingly interested in place-based approach to rural policy, which means emphasizing investments rather than subsidies. That also means integration of different sectoral policies and improvement the coherence and effectiveness of public expenditure in rural areas. According to Cvijanović et al. (2011) within CAP it could be noted "redirection towards fulfillment of various social and ecological goals". Erjavec and Salputra (2011) stated that "the form and scope of direct payments under the Common Agricultural Policy are controversial for several reasons: high budgetary costs, unfair distribution between old and new Member States and weak argumentation of payments". Therefore, authors suggest certain redefinitions within CAP for the period 2013-2020.

In 2012 (as well as in recent years) Serbian agricultural policy supports investments in agriculture using subsidized interest rates for agricultural loans. But, available amount of such loans for agriculture usually is not in accordance with actual needs. Support of investments in other farm related activities such as rural tourism is not sufficient, as well.

Therefore, in Serbian situation it is necessary (as a temporary solution) to use subsidies to prevent family field crop operations from significant profit decrease. At the moment,

Serbian government subsidizes 48% of market price of diesel fuel. But such subsidy is introduced in 2012, and it is not known for how long it will last. It is noticed that Serbian agricultural policy is changing frequently, so that it increases risk in agricultural production and disables farmers to makes long term business plans.

Conclusion

By the analysis, it is determined that the increase in diesel D-2 prices leads to the decrease in family farms profit by 35.56%, what makes this input distinguished for its importance for profitable operations of the observed farms. In the second place, the highest impact on the profit is created by the prices of different NPK fertilisers, whereas prices of KAN and UREA fertilisers do not have so powerful impact on the profit of the farms specialized in field crop production.

If the prices of all kinds of the observed raw material (fuel and various types of fertilisers) together change by 20%, they lead to the change in the whole farm profit as well as in the profit per worker and working hour even by 73.23%. On the other hand, the changes in prices of the observed inputs will not have so significant effects on gross margin of family farm, as well as on the indicators of economic effects of labour derived from gross margin.

Although, general strategy EU 2020 rejects the idea of supporting non sustainable input use, it is necessary to have such support in Serbia. Otherwise, consequence will be significant decline of profit at family farms dealing with field crop operations. Other negative effects of not subsidizing prices of fuel and fertilizers are decline of income of labor, as well as increase of poverty in rural areas. In long run above mentioned subsidies should be avoided and replaced by support to investments. But before that it is necessary to provide certain preconditions (increase in size of parcels and size of entire farms, so that it is possible to apply modern technology in field crop operations).

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UTICAJ CENA ENERGENATA NA EKONOMSKE EFEKTE RADA NA RATARSKIM PORODIČNIM GAZDINSTVIMA

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Rezime

Na ekonomske efekte poslovanja porodičnih gazdinstava ratarskog tipa veliki uticaj imaju cene energenata (dizel goriva) kao i repromaterijala čije su cene u velikoj meri zavisne od cene energenata (mineralna đubriva). Zbog toga je na modelu porodičnog ratarskog gazdinstva utvrđeno kako promena cena navedenih inputa utiče na promenu marže pokrića i profita gazdinstva. Posebna pažnja posvećena je promenama marže pokrića po radniku i času rada, kao i profita po radniku i času rada do koje dolazi usled variranja pomenutih nabavnih cena.

Analizom je utvrđeno da se po svom značaju za profitabilno poslovanje posmatranih gazdinstava izdvaja dizel D-2. Nakon njega najveći uticaj na visinu profita imaju cene različitih vrsta NPK đubriva, dok cene đubriva KAN i UREA nemaju tako veliki uticaj na visinu profita ratarskih gazdinstava. Preko subvencionisanja cena navedenih inputa za ratarska gazdinstva moguće je ostvariti veće ekonomske efekte rada na porodičnim gazdinstvima i time uticati na smanjenje ruralnog siromaštva.

Ovakvo rešenje je prihvatljivo samo u kratkom roku, ali dugoročno je potrebno da se veća pažnja posveti investicijama umesto subvencijama.

Ključne reči: *porodična gazdinstva, marža pokrića po radniku, profit po radniku, marža pokrića po radnom času, profit po radnom času*

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