ECONOMIC EFFECTS OF INVESTMENT IN IRRIGATION SYSTEMS IMPLEMENTATION AT THE SMALL FAMILY FARMS

Marko Jeločnik[1], Jonel Subić[2], Aleksandar Zdravković[3]
**Corresponding author E-mail: marko_j@iep.bg.ac.rs*

A R T I C L E I N F O

Original Article

Received: *05 August 2022*

Accepted: *15 September 2022*

doi:10.5937/ekoPolj2203793J

UDC
658.154:[631.347:631.1.017.3

Keywords: *crop production, small family farms, irrigation, investment analysis*

JEL: *Q01, Q12, Q14*

A B S T R A C T

Water is the source of life for all living beings, but also an irreplaceable input in agricultural production. According to the available water and land potentials in Serbia irrigation is used at generally negligible arable areas. Although it represents an agro-technical measure whose implementation usually causes significant investment costs for the farm, its application ensures high and stable yields of high quality crops' fruits, while indirectly it affects increase in incomes and continuity in farm sustainability. The main goal of the paper is presenting an assessment of the effects of investing in implementation of the irrigation system (type Tifon) on a small family farm primarily active in crop farming. Investment analysis was based on basic static and dynamic methods for assessing the effectiveness of investments. The assessment was focused to two modalities in crop production, i.e. implementation of irrigation in crop farming at 25 ha and 30 ha. In both observed modalities the investment was assessed as economically justified alternative for farm business improvement, while there are shown slightly better results with the rise of used agricultural surfaces.

Introduction

As a segment of plant agricultural production, for crop farming are linked almost all specifics of agriculture, with a significant dependence on the characteristics of available land and water resources and climate conditions.

1 Marko Jeločnik, Ph.D., Senior Research Associate, Institute of Agricultural Economics, Volgina Street no. 15, 11060 Belgrade, Serbia, Phone: +381 11 69 72 852, E-mail: marko_j@iep.bg.ac.rs, ORCID ID (https://orcid.org/0000-0003-4875-1789)

2 Jonel Subić, Ph.D., Principal Research Fellow, Institute of Agricultural Economics, Volgina Street no. 15, 11060 Belgrade, Serbia, Phone: +381 11 69 72 863, E-mail: jonel_s@iep.bg.ac.rs, ORCID ID (https://orcid.org/0000-0003-1342-1325)

3 Aleksandar Zdravković, Ph.D., Research Associate, Institute of Economic Sciences, Zmaj Jovina Street no. 12, 11000 Belgrade, Serbia, Phone: +381 11 26 23 055, E-mail: aleksandar.zdravkovic@ien.bg.ac.rs, ORCID ID (https://orcid.org/0000-0002-6208-097X)

The primary importance of crop production results in ensuring food security for global population, as well as in provision of livestock nutrition, or in continuous suppling with valuable raw materials to many industries, such as food industry, light chemical and petrochemical industries, textile industry, or pharmacy and others.

Globally, in 2019, there were about 1.38 billion hectares of arable land in the function of crop production, i.e. almost 30% of available agricultural land. According to its share in used arable land, cereals dominate. In general, currently there occurs an extremely moderate growth trend in total arable land areas that is mostly the consequence of pronounced growth in world's population and strivings to secure global food security. Besides, there are certain geographical exceptions. So, in Europe and North America comes to slight decrease in arable land areas (FAO, 2022). It's primarily a result of lower population density compared to available arable land areas, or significant intensification in agricultural production, while its stronger reliance on contemporary technical and technological achievements and digitalization activities, as well as greater rate of urbanization, but also more expressed orientation to preservation of accessible natural resources, ecosystems and rural landscapes (Satterthwaite et al., 2010; FAO, 2017).

According to the research of Lowder et al. (2016), it was estimated that there is almost 460 million farms worldwide. Besides, agro-food production and crop farming is mainly organized at small family farms, where the 72% of them have the size lower than 1 ha, what is primarily pooled by the farm structure available in developing countries. Generally, most of them are practicing the rain-fed farming.

Farming is generally organized in open field, meaning that it usually faces the various natural and climate risks (Zarkovic et al., 2014). Gained results in plant production are mainly affected by the drought, and partly by hail, excessive rains, frost, etc. (Stričević et al., 2020). It has to be underlined that the water could be considered as a source of life for all living organisms, as it supports the growth, development and functioning of the most of them (Hossain, 2015). In plant production, a small but continuous loss of water could generally lead to plant stress and dehydration, affecting the further decrease in yields quantity and quality, while larger water deficit even in couple days could be a fatal for plant. What this mean for farmer? Any decrease in yields gained in dry land farming directly reflects to the level of farm profitability, as well as to lowering the farm competitiveness (Molden et al., 2010).

Although the irrigated areas are relatively small and mostly covered by modest and obsolete irrigation systems, there are certain countries with significant level of applied irrigation in practice. For example, in line to available WB dataset (WB, 2022), the largest area of irrigated land is in Suriname, Bangladesh, or Pakistan, where is irrigated more than 50% of available agricultural land. Related to developed countries with contemporary approach in agricultural production, Israel irrigates around the 30% of disposed land fund in agriculture, or Italy and Greece 19%, Spain around 12%, the Netherlands and China around 10%, or USA and France less than 6%. Some other assessment show that irrigation grows into the basic and significant precondition for stable and efficient agro-food production, where almost 20% of available arable land is globally irrigated (Durkalic et al., 2019; Zemunac et al., 2021).

For the decades, agro-food sector has significant role in development of Serbian economy and improving of its global image. This is obvious through the high share of GDP derived from mentioned sector, around 20%, or high rate in overall employment, up to 20%, as well as positive and constantly growing export and foreign trade balance. Besides, although the national agro sector is covered with highly dispersed types of support measures, their level usually does not fit the needs of agriculture (Bogdanov & Vasiljevic, 2011; Munćan & Božić, 2013; Mitrović et al., 2017).

Within the structure of agricultural production dominates plant production that basically maintains the food security at national level, and keeps up the increase tempo of export (Stojanović, 2022; Melović, 2022). According the last census of agriculture plant production is spread at around 3.5 million ha of utilized agricultural areas, where 75% belongs to arable land. These areas are mostly under the crops, primarily grains (around 70% of them), specifically corn and wheat. Factors that generally limit the further development of crop production are small farm estates, insufficient or ad hoc use of agrochemicals and irrigation, use of obsolete mechanisation and equipment, lack of contemporary technological alternatives, low investment intensity, insufficient appliance of standardization, etc. (Zekic et al., 2013; Jelocnik et al., 2021).

Cheaper and more quality food production has become the imperative for securing the farm competitiveness (Todorović, 2018a). There is an opinion that market-oriented farms dominantly oriented to traditional crop farming (i.e. grains, oilseeds and legumes) could guarantee their sustainability and developmental orientation only with production organized on more than 20-25 ha with the full application of modern agri-techniques and GAP.

This is one of reasons why starting from production year 2014/2015 public subsidies in plant production were limited to 20 ha, what primarily supports the sustainability and survival of economically weaker farms (Todorović, 2018b). Mentioned is mostly in accordance with current average farm size (around 5.4 ha UAA) and farm's structure in Serbia, where for example over the 78% farms have less than 5 ha of UAA, while slightly over the 3% of farms cultivate over the 20 ha of UAA, where they cover over the 44% of overall fund of UAA (Bajramović et al., 2016).

In current conditions crop farmers are mainly forced to sell crops during or just after the harvest period when the price of crops is much lower. Lack of financial assets makes crops storing usually impossible, i.e. paying the public or private warehouse or building the farms' own silos, affecting the lower profitability (Zakić et al., 2014). In addition, generally there is a lack of crop production planning and recording at farms, causing the shortage in accurate data related to used agro-techniques and inputs, or volume and quality of gained yields. Rare, usually larger farms keeps recoding the Fields Book as the adequate tool in crop production management (Zakić et al., 2017).

In Serbia, crop production is usually followed by the frequent and intense heatwaves and drought, what simultaneously endanger the expected production quantity and products safety (Jeločnik & Zubović, 2018). Unfortunately, regardless of the source, irrigated areas are so modest and ranges between the 1-3% of total sum of arable land (Kljajić et al., 2013; Jević et al., 2021Pantić et al., 2021; Pavlović et al., 2017). Under the irrigation are mainly grains and silage corn, around 36% of totally irrigated surfaces (Zubović et al., 2018).

As agro-technic measure, in crop production irrigation serves to compensate any deficit of required water for optimal growth and development of plants caused by low-level rainfalls or their inadequate distribution within the vegetation that could endanger achievement of expected yields and incomes (Subić et al., 2017a). So, technically, as it secures stable and increased yields and incomes, implementation of irrigation system could be considered as certain level of value-added creation at micro level (Jeločnik & Subić, 2020). It could be mentioned that irrigation serves to boost the overall sustainability of crop farming, or even overall farm (Lewandowski et al., 1999).

The main paper goal is to estimate if the implementation of certain type of irrigation system (specifically Tifon) at small farms involved in crop production could be economically justified business step in conditions of national agriculture. In other words, previously conducted research was searched for the answer: Does the investment in irrigation in predefined models of crop production could be economically justified for crop producer?

Used Methodology

Research involved assessment of the economic effects derived from the investment into the irrigation system type Tifon that was installed and later used at the small family farm. Methodological framework for primary data collecting was based on couple in-depth interviews with the manager of the selected family farm located in the territory of South Banat District.

The analysis of previously gained data was based on the standard static (Total Output-Total Input Ratio, Net Profit Margin, Accounting Rate of Return, or Simple Payback Period) and dynamic (Net Present Value, Internal Rate of Return and Dynamic Payback Period) methods for investment effectiveness assessment (Subić, 2010). At the same time, theoretical and logical data check was done through the desktop analysis of available scientific and professional literature sources. Investment analysis was made for two production models, one that includes implementation of irrigation on 25 ha, and other on 30 ha of arable land under the field crops. All gained primary data and derived results refer to production cycle 2020/21. In order to provide certain level of results comparability, all values are presented in EUR. Besides, all data are presented in adequate tables, while they are adjusted to assumed size of production capacity.

Results with Discussion

Despite the fact that there is high necessity for irrigation in crop production in the conditions of Serbian agro-sector, this does not automatically mean that each investment in implementation of irrigation system is economically justified for the farmer. Related to this, any farm should, in accordance with its production or revenue potential, make an economic analysis of the planned investment into the establishment and later use of the selected irrigation alternative. Along the needs, farm can treat irrigation as a basic or supplementary agro-technical measure.

Observed farm is solely directed to conventional crop production, while it can be considered as farm fully oriented to market and further tech-tech development. Production is organized on 30 ha of hi-quality arable land area, where the 25 ha is owned by farm, while the rest is rented. The all production parcels are abutting each other, having the adequate shape without the slopes. Farm disposes with complete mechanization for crop farming, as well as with one draw well, facilities for storing inputs and agricultural products, and spacious garage for mechanization and equipment, etc. Farm operates as a physical person.

Agro-climate conditions that have been following the farm production for several years (occurrence of drought of moderate intensity and time mismatch of rainfalls and water needs during the vegetation period) have imposed the need for applying the irrigation as a basic measure. In line to farms' production potential and cultivated crops (winter wheat, soybean, and corn), the irrigation system type Tifon is recognized as optimal solution. With this business step farmer is expecting to strengthen and stabilize the achieved yields in all cultivated crops, or he expects to improve the efficiency in utilization of available production resources. According the used inputs, conducted agro-technical measures and manipulation with agricultural products, the farm is consistently complying the all GAP principles.

Financing the irrigation system, power generator with the pump, drilling of additional draw well, laying of the primary pipeline, or covering the corresponding part of the permanent working capital (PWC) would be done with the farm's own financial resources while certain parts will be additionally reimbursed from specific grant of the Provincial Secretariat for Agriculture, Water Management and Forestry (possibility for covering the 30-60% of the value of certain segment of the investment excluding the VAT), (PSAWMF, 2021), (Tables 1-3.).

Assessing the planned investment includes both defined production models (irrigation of 25 ha or 30 ha), while the need for this activity is to consider whether the farm would be able to successfully "service" the investment by its application at the smaller area if there comes to cancelation of lease agreement.

Table 1. Planned investment in irrigation system (in EUR)

No.	Description	Value
1.	System for irrigation – type Tifon	18,790.0
2.	Power generator with the water pump	12,810.0
3.	Installation of the primary pipeline	3,830.0
4.	Establishment of draw well	3,220.0
Total		38,650.0

Source: IAE, 2021.

In line to previously organized crop production, farmer decides to buy irrigation system type Tifon with associated equipment from local distributor (hydraulic cart, 90 mm PE hose 400 m long, water cannon with a set of 3 nozzles, some auxiliary hoses, manometer and tachometer, 6-speed gearbox, turbine and other). The minimally required pressure for the operation of the system is 5 bar (Best&Co, 2021). Tifon is run by 9 KW diesel aggregate in package with the multi-stage pump. Lack of plentiful well that is able to service the entire surface with the enough water requires the building, or drilling another draw well with accompanying equipment (upward pipe, protective sieves, valve and connector). Also, the primary pipeline (80 mm aluminium pipes, 400 m long) with adequate connectors and connection points will be installed towards connecting the draw well with Tifon.

Table 2. Structure of planned investment (in EUR)

No.	Description	Total investment	Share (in %)
1.	Fixed assets	38,650.0	90.9
2.	Permanent working capital	3,865.0	9.1
Total		42,515.0	100.0

Source: IAE, 2021.

According to the structure of planned investment, more than 90% (Table 2.) of needed financial assets is relating to fixed assets.

Table 3. Financing of planned investment (in EUR)

No.	Description	Value	Reimbursement rate (in %)	Public grant	Own assets
1.	Tifon	18,790.00	60	9,019.2	9,770.8
2.	Power generator	12,810.00	60	6,148.8	6,661.2
3.	Primary pipeline	3,830.00	30	919.2	2,910.8
4.	Draw well	3,220.00	60	1,545.6	1,674.4
5.	PWC	3,865.00	0	0.0	3,865.0
Total		42,515.00	-	17,632.8	24,882.2

Source: IAE, 2021.

In line to totally needed financial assets for the investment realisation, 41.47% will be additionally reimbursed from the public grant (Table 3.). Regardless of fact that investment will be generally covered by farms' and public financial assets, investment analysis assumes the "calculative" interest rate of 4%. Explanation lies in conservative approach considering that all needed assets originate as external financial assets, while the used interest rate reflects the current price of borrowed capital at national level used for this purposes. Analysis assumes five years period.

Generation of farm incomes is based on crop rotation of three crops (wheat, corn and soybean), while some of crops in certain production year occur as main or subsequently sawn (second) crops. Despite the simplicity, production is highly adjusted to common agro-technic recommendations and available farm mechanisation and facilities. Farm is also user of public subsidies for crop production just for owned land area. Creation of annual farm incomes for both models is presented in next table (Table 4.). All produced crops have been selling to local agro-companies after the harvesting. Deriving from farmer's large experience in crop production it is assumed that there are no oscillations in achieved crop yields. So, in order to simplify the analysis, all values (yields, prices and subsidies) are fixed to their level obtained in 2021. Besides, in some extent lower yields than expected in crop production by the use of irrigation are caused by slightly reduced soil fertility. Completely produced quantities of each crop imply high and standardized quality that is used for human consumption. According to data from Table 4., it is obvious that rise of production capacities for 20% could lead farm to 18.45% higher cumulative gross incomes within the observed five years period (280,970.3 EUR : 332,800.3 EUR).

Table 4. Creation of farm incomes in both (25 ha and 30 ha) production models (in EUR, in EUR/t)

Element	UM	Price/UM	Quantity	Total
I model - production on 25 ha				
I year				
Corn	t	178	250	44,500.0
Subsidy (for crop production)	set	33.5	25	837.5
Reimbursement for irrigation implementation	-	-	-	17,632.8
Total				62,970.3
II year				
Wheat	t	185	162.5	30,062.5
Soybean as second crop	t	550	62.5	34,375.0
Subsidy (for crop production)	set	33.5	25	837.5
Total				65,275.0
III year				
Corn	t	178	250	44,500.0
Subsidy (for crop production)	set	33.5	25	837.5
Total				45,337.5
IV year				
Wheat	t	185	162.5	30,062.5
Corn as second crop	t	178	175	31,150.0
Subsidy (for crop production)	set	33.5	25	837.5
Total				62,050.0
V year				
Corn	t	178	250	44,500.0
Subsidy (for crop production)	set	33.5	25	837.5
Total				45,337,5
II model - production on 30 ha				

Element	UM	Price/UM	Quantity	Total
I year				
Corn	t	178	300	53,400.0
Subsidy (for crop production)	set	33.5	25	837.5
Reimbursement for irrigation implementation	-	-	-	17,632.8
Total				71,870.3
II year				
Wheat	t	185	195	36,075.0
Soybean as second crop	t	550	75	41,250.0
Subsidy (for crop production)	set	33.5	25	837.5
Total				78,162.5
III year				
Corn	t	178	300	53,400.0
Subsidy (for crop production)	set	33.5	25	837.5
Total				54,237.5
IV year				
Wheat	t	185	195	36,075.0
Corn as second crop	t	178	210	37,380.0
Subsidy (for crop production)	set	33.5	25	837.5
Total				74,292.5
V year				
Corn	t	178	300	53,400.0
Subsidy (for crop production)	set	33.5	25	837.5
Total				54,237.5

Source: IAE, 2021.

Following tables (Tables 5-11.) provide the overview of all costs incurred during the crops production under the irrigation. The most of used inputs are purchased in local retails, while the applied norms correspond to GAP and adequate suggestions of the local agri-extension adjusted to available microclimate and production conditions. Related to costs of used direct material (Table 5.), all crop seeds are locally verified high yielding crop varieties, while all agro-chemicals are approved for the use at national level. Deficit of manure at local level and high costs of its potential transport have been directing the farm to use of slightly increased doses of complex mineral fertilizers during the pre-sowing period and crop vegetation. Depending on sown crop, pesticides are applied through 2-4 treatments. In order to reduce the total costs, the consolidated quantities of agro-chemistry are purchased. Disposing with draw wells at own property, farm is exempt from paying the costs of used water.

Table 5. Sum of costs of direct material in both (25 ha and 30 ha) production models (in EUR)

No.	Element	Year				
		I	II	III	IV	V
Crop production – I model (25 ha)						
1.	Seeds	4,132.5	6,100.0	4,132.5	6,732.5	4,132.5
2.	Mineral fertilizers	16,000.0	13,700.0	16,000.0	14,575.0	16,000.0
3.	Pesticides	2,732.5	4,515.0	2,732.5	4,150.0	2,732.5
Total		**22,865.0**	**24,315.0**	**22,865.0**	**25,457.5**	**22,865.0**

No.	Element	Year				
		I	II	III	IV	V
Crop production – II model (30 ha)						
1.	Seeds	4,959.0	7,320.0	4,959.0	8,079.0	4,959.0
2.	Mineral fertilizers	19,200.0	16,440.0	19,200.0	17,490.0	19,200.0
3.	Pesticides	3,279.0	5,418.0	3,279.0	4,980.0	3,279.0
Total		**27,438.0**	**29,178.0**	**27,438.0**	**30,549.0**	**27,438.0**

Source: IAE, 2021.

Costs of energy cover fuel spent for mechanized operations carried out by available farm mechanisation and equipment, as well as fuel spent for running the implemented irrigation system. In line to quite even requirements of crops toward the water and mechanized operations over a longer period, both models could relay to annually stable energy costs (Table 6.).

Table 6. Sum of costs of used energy in both (25 ha and 30 ha) production models (in EUR)

No.	Element	Year				
		I	II	III	IV	V
Crop production – I model (25 ha)						
1.	Fuel - mechanisation	6,427.5	9,600.0	6,427.5	9,505.0	6,427.5
2.	Fuel - irrigation	2,657.5	5,312.5	2,657.5	5,312.5	2,657.5
Total		9,085.0	14,912.5	9,085.0	14,817.5	9,085.0
Crop production – II model (30 ha)						
1.	Fuel - mechanisation	7,713.0	11,520.0	7,713.0	11,406.0	7,713.0
2.	Fuel - irrigation	3,189.0	6,375.0	3,189.0	6,375.0	3,189.0
Total		10,902.0	17,895.0	10,902.0	17,781.0	10,902.0

Source: IAE, 2021.

Annual costs of maintaining the irrigation system or used mechanization and equipment in both model assumes fixed sums (Table 7.). They cover regular service, as well as small repairs, or any action that prevents stoppage of production caused by broken mechanization.

Table 7. Sum of other material costs in both (25 ha and 30 ha) production models (in EUR)

No.	Element	Year				
		I	II	III	IV	V
Crop production – I model (25 ha)						
1.	Maintaining of irrigation system	169.7	169.7	169.7	169.7	169.7
2.	Maintaining of equipment and mechanization	678.7	678.7	678.7	678.7	678.7
Total		848.4	848.4	848.4	848.4	848.4
Crop production – II model (30 ha)						
1.	Maintaining of irrigation system	203.6	203.6	203.6	203.6	203.6
2.	Maintaining of equipment and mechanization	814.5	814.5	814.5	814.5	814.5
Total		1,018.1	1,018.1	1,018.1	1,018.1	1,018.1

Source: IAE, 2021.

Depreciation rate and its value are adjusted to expected period of use of implemented irrigation system (Table 8.). General suggestion considers the use of the system by optimal intensity up to ten years and further moment of the investment maintaining carrying out. Considering the case that the same investment is used in both models, the value of previously determined salvage value is unique (undepreciated book value of fixed assets increased for PWC), while it is limited by the usual duration of credit line used for that purposes (five years).

Table 8. Value of depreciation (in EUR)

Investment	Retail price (excluding VAT)	Investment life cycle (year)	Depreciation rate (in %)	Value of depreciation	Credit life cycle (years)	Salvage value
Fixed assets	**38,650.00**	**10**	**10.00**	**3,865.00**	5	**19,325.00**
PWC	3,865.00	-	-	-	-	**3,865.00**
Salvage value - total		**-**	**-**	**-**	**-**	**23,190,00**

Source: IAE, 2021.

Crop production under irrigation initiates the labour costs (Table 9.) derived from the employment of 2 farm members and 1 external employee in both models, while the sum of costs appeared in second model is for 20% higher. All persons involved in production activities are highly skilful and well experienced.

Table 9. Sum of labour costs in both (25 ha and 30 ha) production models (in EUR)

No.	Element	Number of employees	Share in total no. of employees (in %)	No. of working months	Gross salary per month	Gross salary - total
Crop production – I model (25 ha)						
I	**Full employees**	2	66.66	4	425.00	3,400.00
II	**Seasonal employees**	1	33.33	2	425.00	850.00
Total		**3**	**100.00**	**-**	**-**	**4,250.00**
Crop production – II model (30 ha)						
I	**Full employees**	2	66.66	5	425.00	4,250.00
II	**Seasonal employees**	1	33.33	2	425.00	850.00
Total		**3**	**100.00**	**-**	**-**	**5,100.00**

Source: IAE, 2021.

Both production models are burdened by certain non-material costs (Table 10.) that mutually differ primarily related to size of cultivated land area. They involve few national taxes, as are property and irrigation tax, annual laboratory analyses of soil fertility and water quality, general crop insurance, land renting and other non-material costs. Second model generates for 89% higher costs, before all as it involves land renting of 5 hectares.

Table 10. Sum of non-material costs in both (25 ha and 30 ha) production models (in EUR)

No.	Element	Year				
		I	II	III	IV	V
Crop production – I model (25 ha)						
1.	Irrigation tax	775.00	775.00	775.00	775.00	775.00
2.	Part of property tax	148.00	148.00	148.00	148.00	148.00
3.	Laboratory analyses	92.50	92.50	92.50	92.50	92.50
4.	Crop insurance	424.00	424.00	424.00	424.00	424.00
5.	Other non-material costs	164.50	164.50	164.50	164.50	164.50
Total		**1,604.00**	**1,604.00**	**1,604.00**	**1,604.00**	**1,604.00**
Crop production – II model (30 ha)						
1.	Irrigation tax	930.00	930.00	930.00	930.00	930.00
2.	Part of property tax	178.00	178.00	178.00	178.00	178.00
3.	Laboratory analyses	92.50	92.50	92.50	92.50	92.50
4.	Crop insurance	509.00	509.00	509.00	509.00	509.00
5.	Land renting	1,125.00	1,125.00	1,125.00	1,125.00	1,125.00
6.	Other non-material costs	197.50	197.50	197.50	197.50	197.50
Total		**3,032.00**	**3,032.00**	**3,032.00**	**3,032.00**	**3,032.00**

Source: IAE, 2021.

Next table (Table 11.) summarise the all costs derived in crop production after the implementation and further use of irrigation system within the observed period. It could be seen that in both models material costs are dominating, while within the material costs the costs of direct materials have the highest share (over the 53%). Besides, there is certain level of annual oscillation in the cash outflow in both models, as the consequence of different production requirements of grown crops. Generally, the sum of total costs is annually for over the 20% higher in second than in first production model.

Table 11. Structure of total costs in both (25 ha and 30 ha) crop production models (in EUR)

No.	Element	Year				
		I	II	III	IV	V
Crop production – I model (25 ha)						
A.	**Material costs**	**32,798.4**	**40,075.9**	**32,798.4**	**41,123.4**	**32,798.4**
1.	Costs of direct material	22,865.0	24,315.0	22,865.0	25,457.5	22,865.0
2.	Costs of energy	9,085.0	14,912.5	9,085.0	14,817.5	9,085.0
3.	Other material costs	848.4	848.4	848.4	848.4	848.4
B.	**Non-material costs**	**9,719.0**	**9,719.0**	**9,719.0**	**9,719.0**	**9,719.0**
1.	Depreciation	3,865.0	3,865.0	3,865.0	3,865.0	3,865.0
2.	Labour	4,250.0	4,250.0	4,250.0	4,250.0	4,250.0
3.	Interest	0.0	0.0	0.0	0.0	0.0
4.	Other non-material costs	1,604.0	1,604.0	1,604.0	1,604.0	1,604.0
Total (A+B)		**42,517.4**	**49,794.9**	**42,517.4**	**50,842.4**	**42,517.4**
Crop production – II model (30 ha)						
A.	**Material costs**	**39,358.1**	**48,091.1**	**39,358.1**	**49,348.1**	**39,358.1**
1.	Costs of direct material	27,438.0	29,178.0	27,438.0	30,549.0	27,438.0
2.	Costs of energy	10,902.0	17,895.0	10,902.0	17,781.0	10,902.0

No.	Element	Year				
		I	II	III	IV	V
3.	Other material costs	1,018.1	1,018.1	1,018.1	1,018.1	1,018.1
B.	**Non-material costs**	**11,997.0**	**11,997.0**	**11,997.0**	**11,997.0**	**11,997.0**
1.	Depreciation	3,865.0	3,865.0	3,865.0	3,865.0	3,865.0
2.	Labour	5,100.0	5,100.0	5,100.0	5,100.0	5,100.0
3.	Interest	0.0	0.0	0.0	0.0	0.0
4.	Other non-material costs	3,032.0	3,032.0	3,032.0	3,032.0	3,032.0
Total (A+B)		**51,355.1**	**60,088.1**	**51,355.1**	**61,345.1**	**51,355.1**

Source: IAE, 2021.

After insight into the profit and loss statements (Table 12.) derived from the use of irrigation system in defined crop production models, it could be seen that during the observed period in both models exists the continuity in achievement of the positive business results (net profit). Along to national legislation, 10% income tax is applied. Unfortunately, there are visible oscillations (within the same model or between the models) in the value of gained profit, what is mainly the consequence of sown crops in certain year. Observed cumulatively or on annual basis, second model seems to be more profitable for farm, as in average it annually generates for 813.9 EUR higher net-profit (9,500.5 EUR : 10,314.4 EUR).

Table 12. Profit and loss statement in both (25 ha and 30 ha) crop production models (in EUR)

No.	Element	Year				
		I	II	III	IV	V
Crop production – I model (25 ha)						
I	**Total revenues (1+2+3)**	**62,970.3**	**65,275.0**	**45,337.5**	**62,050.0**	**45,337.5**
1.	Sales revenues	44,500.0	64,437.5	44,500.0	61,212.5	44,500.0
2.	Subsidies	837.5	837.5	837.5	837.5	837.5
3.	Other revenues (reimbursement)	17,632.8	0.0	0.0	0.0	0.0
II	**Total expenditures (1+2)**	**42,517.4**	**49,794.9**	**42,517.4**	**50,842.4**	**42,517.4**
1.	Business expenditures	42,517.4	49,794.9	42,517.4	50,842.4	42,517.4
1.1.	Material costs	32,798.4	40,075.9	32,798.4	41,123.4	32,798.4
1.2.	Non-material costs without depreciation and interest	5,854.0	5,854.0	5,854.0	5,854.0	5,854.0
1.3.	Depreciation	3,865.0	3,865.0	3,865.0	3,865.0	3,865.0
2.	Financial expenditures	0.0	0.0	0.0	0.0	0.0
2.1.	Interest	0.0	0.0	0.0	0.0	0.0
III	**Gross profit (I-II)**	**20,452.9**	**15,480.1**	**2,820.1**	**11,207.6**	**2,820.1**
IV	**Income tax**	2,045.3	1,548.0	282.0	1,120.8	282.0
V	**Net profit (III-IV)**	**18,407.6**	**13,932.1**	**2,538.1**	**10,086.8**	**2,538.1**
Crop production – II model (30 ha)						
I	**Total revenues (1+2+3)**	**71,870.3**	**78,162.5**	**54,237.5**	**74,292.5**	**54,237.5**
1.	Sales revenues	53,400.0	77,325.0	53,400.0	73,455.0	53,400.0
2.	Subsidies	837.5	837.5	837.5	837.5	837.5
3.	Other revenues (reimbursement)	17,632.8	0.0	0.0	0.0	0.0
II	**Total expenditures (1+2)**	**51,355.1**	**60,088.1**	**51,355.1**	**61,345.1**	**51,355.1**
1.	Business expenditures	51,355.1	60,088.1	51,355.1	61,345.10	51,355.1
1.1.	Material costs	39,358.1	48,091.1	39,358.1	49,348.1	39,358.1

No.	Element	Year				
		I	II	III	IV	V
1.2.	Non-material costs without depreciation and interest	8,132.0	8,132.0	8,132.0	8,132.0	8,132.0
1.3.	Depreciation	3,865.0	3,865.0	3,865.0	3,865.0	3,865.0
2.	Financial expenditures	0.0	0.0	0.0	0.0	0.0
2.1.	Interest	0.0	0.0	0.0	0.0	0.0
III	**Gross profit (I-II)**	**20,515.2**	**18,074.4**	**2,882.4**	**12,947.4**	**2,882.4**
IV	**Income tax**	2,051.5	1,807.4	288.2	1,294.7	288.2
V	**Net profit (III-IV)**	**18,463.7**	**16,267.0**	**2,594.2**	**11,652.7**	**2,594.2**

Source: IAE, 2021.

As the investment is completely financed from the own resources, there is no farm obligations to creditors, so basically forming of economic flow (Table 13.) does not include the interest. Although there is certain level of oscillations in gained values of net cash flow, they are positive during the complete period. Derived net cash flow in second production model has slightly higher values, what is primarily caused by more pronounced gap between the income sides of the observed models. Development of economic flow enables later realisation of investment analysis, i.e. calculation of static and dynamic indicators (Tables 14-19.).

Table 13. Forming of economic flow in both (25 ha and 30 ha) crop production models (in EUR)

no	Element	Initial moment	Year				
			I	II	III	IV	V
	Crop production – I model (25 ha)						
I	**Cash inflow (1+2)**	**0.0**	**62,970.3**	**65,275.0**	**45,337.5**	**62,050.0**	**68,527.5**
1.	Total revenues	0.0	62,970.3	65,275.0	45,337.5	62,050.0	45,337.5
2.	Salvage value	0.0	0.0	0.0	0.0	0.0	23,190.0
	2.1. Fixed assets	0.0	-	-	-	-	19,325.0
	2.2. PWC	0.0	-	-	-	-	3,865.0
II	**Cash outflow (3+4+5)**	**42,515.0**	**40,697.7**	**47,477.9**	**38,934.4**	**48,098.2**	**38,934.4**
3.	Investment value	42,515.0	-	-	-	-	-
	3.1. In fixed assets	38,650.0	-	-	-	-	-
	3.2. In PWC	3,865.0	-	-	-	-	-
4.	Costs without depreciation and interest	0.0	38,652.4	45,929.9	38,652.4	46,977.4	38,652.4
5.	Income tax	0.0	2,045.3	1,548.0	282.0	1,120.8	282.0
III	**Net cash flow (I-II)**	**-42,515.0**	**22,272.6**	**17,797.1**	**6,403.1**	**13,951.8**	**29,593.1**
	Crop production – II model (30 ha)						
I	**Cash inflow (1+2)**	**0.0**	**71,870.3**	**78,162.5**	**54,237.5**	**74,292.5**	**77,427.5**
1.	Total revenues	0.0	71,870.3	78,162.5	54,237.5	74,292.5	54,237.5
2.	Salvage value	0.0	0.0	0.0	0.0	0.0	23,190.0
	2.1. Fixed assets	0.0	-	-	-	-	19,325.0
	2.2. PWC	0.0	-	-	-	-	3,865.0
II	**Cash outflow (3+4+5)**	**42,515.0**	**49,541.6**	**58,030.5**	**47,778.3**	**58,774.8**	**47,778.3**

no	Element	Initial moment	Year				
			I	II	III	IV	V
3.	Investment value	42,515.0	-	-	-	-	-
	3.1. In fixed assets	38,650.0	-	-	-	-	-
	3.2. In PWC	3,865.0	-	-	-	-	-
4.	Costs without depreciation and interest	0.0	47,490.1	56,223.1	47,490.1	57,480.1	47,490.1
5.	Income tax	0.0	2,051.5	1,807.4	288.2	1,294.7	288.2
III	**Net cash flow (I-II)**	**-42,515.0**	**22,328.7**	**20,132.0**	**6,459.2**	**15,517.7**	**29,649.2**

Source: IAE, 2021.

Static indicators of investment evaluation

As was previously defined, by one part investment analysis involves calculation of static indicators, i.e. Total Output-Total Input Ratio, Net Profit Margin, Accounting Rate of Return, and Simple Payback Period. In practice, investment alternatives are assessing related to the value of indicators in all or pre-defined representative year of investment usage (Subić, 2010).

a) Total Output-Total Input Ratio (Ee)

This indicator e is applied to describe the overall productivity of used inputs (Furniss, 1964) after the irrigation system is implemented at the farm. Success of farm activities are driven both by market “generosity”, i.e. by the general need for certain agri-food product and its current price, as well as by derived costs linked to practicing the selected production line (Oosterhaven, 1988). The main goal of farm manager is to favour as many as possible production lines with suitable value of mentioned ratio, i.e. to try to maximize the value of the ratio in each specific production line practiced at the farm (Ruttan, 1957). Unfortunately, for farm is so hard to control the income side of business, as it is usually the direct reflection of market stability, but it could control well the incurred costs in production cycles. So, related to pairing the values of gained output and overall costs, farm could find in two situations, reporting the gross profit or loss (Sen, 1962).

At observed farm, investing the money is economically acceptable in both models (Table 14.), as the value of the Total Output-Total Input Ratio overcomes the one (Ee>1) in all years of irrigation system exploitation. In average, ratio takes the value of 1.13, or 1.12, as related to selected crop rotation it shows certain annual oscillations. It should be mentioned that its value will be somewhat higher after adding the subsidies to income.

Table 14. Total Output - Total Input Ratio in both (25 ha and 30 ha) crop production models (in EUR), (economically justified Ee > 1)

Year	Total output (realised production)	Total input (production costs)	Ee
0	1	2	3 = 1/2
Crop production – I model (25 ha)			
I	44,500.0	42,517.4	1.05
II	64,437.5	49,794.9	1.29
III	44,500.0	42,517.4	1.05
IV	61,212.5	50,842.4	1.20
V	44,500.0	42,517.4	1.05
Crop production – II model (30 ha)			
I	53,400.0	51,355.1	1.04
II	77,325.0	60,088.1	1.29
III	53,400.0	51,355.1	1.04
IV	73,455.0	61,345.1	1.20
V	53,400.0	51,355.1	1.04

Source: IAE, 2021.

b) Net Profit Margin

Indicator represents the ratio between the net profit (earnings after tax) and realised production (sales revenues) gained in observed period at certain farm (Mishra et al., 2012; Yuliani & Anggaradana, 2021). Considering the investment economically justified requires that indicator (NPMR) gains the values higher than the active calculative interest rate in all specified years of investment usage (Subić et al., 2020).

In both models (Table 15.), investment could be assumed justified, as the indicator has values over the predefined interest rate (i = 4%) in all years. It is notable that the value of indicator is being eroded in certain years, what is primarily the consequence of accepted model of crop-rotation (existence of single or double cropping). In average, the NPMR takes the value of 18.17, or 16.24. Gained indicator's value for both models, slightly favour the first production model, what is primarily caused by the existence of the costs of rent (almost 2% of overall costs) and lower sum of production subsidies in second model.

Table 15. Net profit margin ratio in both (25 ha and 30 ha) crop production models (in EUR), (economically justified NPMR > i)

Year	Net profit	Total output (realised production)	NPMR
0	1	2	3 = 1/2*100
Crop production – I model (25 ha)			
I	18,407.61	44,500.00	41.37
II	13,932.09	64,437.50	21.62
III	2,538.09	44,500.00	5.70
IV	10,086.84	61,212.50	16.48

Year	Net profit	Total output (realised production)	NPMR
0	1	2	3 = 1/2*100
V	2,538.09	44,500.00	5.70
Crop production – II model (30 ha)			
I	18,463.68	53,400.00	34.58
II	16,266.96	77,325.00	21.04
III	2,594.16	53,400.00	4.86
IV	11,652.66	73,455.00	15.86
V	2,594.16	53,400.00	4.86

Source: IAE, 2021.

c) Accounting Rate of Return

This indicator measures the ratio between the gained net profit and invested sum into the used investment object. Investment will serve as good solution for the farm if gained value of indicator (ARR) is above the defined calculative interest rate in certain period. Even more, use of investment will be considered more attractive for the farm by increasing the difference between the indicator and interest rate (Whittington, 1979; Penman, 1991). As with previous indicator investment in irrigation system seems to be justified in both models (Table 16.), as ARR overcomes the calculative interest rate (i = 4%) in all observed years. Again, sharp fall in ARR in certain years is caused by applied crop-rotation. Related to average values of ARR (22.35, or 24.26), investment is better fitting the second model.

Table 16. Accounting Rate of Return ratio in both (25 ha and 30 ha) crop production models (in EUR), (economically justified ARR > i)

Year	Net profit	Initial outlay	ARR
0	1	2	3 = 1/2*100
Crop production – I model (25 ha)			
I	18,407.61	42,515.00	43.30
II	13,932.09	42,515.00	32.77
III	2,538.09	42,515.00	5.97
IV	10,086.84	42,515.00	23.73
V	2,538.09	42,515.00	5.97
Crop production – II model (30 ha)			
I	18,463.68	42,515.00	43.43
II	16,266.96	42,515.00	38.26
III	2,594.16	42,515.00	6.10
IV	11,652.66	42,515.00	27.41
V	2,594.16	42,515.00	6.10

Source: IAE, 2021.

d) Simple Payback Period

Assuming the equal annual cash flows in certain period of investment usage, indicator confronts the invested value with net cash flow (NCF) derived in representative year. It defines the period required for returning the invested assets from the accumulated net cash flows (CNFC), (Subić, 2010; Jeločnik & Subić, 2020). So, in case that the value of net profit is significantly oscillating within the observed period, indicator assumes direct calculation of years needed for investment repayment from the cumulative (overall) revenues (Loginovskiy, 2016).

In line to presented in Table 17., investment will be repaid from farm business in 2 years and 4.56 months at model I, or in 2 years and 0.12 months at model II. In these circumstances, both models could be considered economically justified, as the period needed for covering the initial outlay is relatively short, i.e. shorter than usual period of credit expiration for that purposes at national level. Besides, indicator slightly favours the second model.

Table 17. Simple payback period in both (25 ha and 30 ha) crop farming models (in EUR), (SPP < n)

Year	NCF	CNCF
Crop production – I model (25 ha)		
0	-42,515.00	-42,515.00
I	22,272.61	-20,242.39
II	17,797.09	-2,445.30
III	6,403.09	3,957.79
IV	13,951.84	17,909.63
V	29,593.09	47,502.72
Crop production – II model (30 ha)		
0	-42,515.00	-42,515.00
I	22,328.68	-20,186.32
II	20,131.96	-54.36
III	6,459.16	6,404.80
IV	15,517.66	21,922.46
V	29,649.16	51,571.62

Source: IAE, 2021.

Dynamic indicators of investment evaluation

In second part, economic analysis of irrigation system implementation includes development of dynamic indicators, i.e. Net Present Value, Internal Rate of Return and Dynamic Payback Period.

Compared to static, dynamic approach in investment analysis is adjusted to the time preference of money, i.e. it considers the time value of money. So, all net cash flows linked to the realisation of certain investment, developed throughout the overall time period of investment usage, will be usually set (discounted) to the current moment and current values (Subić et al., 2017b).

a) Net Present Value (NPV) and Internal Rate of Return (IRR)

Basically, net present value (NPV) shows the cumulative distinction between the present values of cash inflows and outflows gained within the complete economic flow of certain investment realization and use. In line to used calculative rate of interest, i.e. minimally expected yield of profit, NPV points out to level of growth in assets caused by investment use during its lifetime (Juhász, 2011). Gaining the positive value of NPV assumes that incomes derived during the investment usage exceed the overall costs of the investment implementation (Götze et al., 2008).

Simultaneously, internal rate of return (IRR) assess the level of profitability of certain investment alternative. It represents the discount rate that equals the NPV of certain project to zero. This is an annual rate of return that could be achieved through the investment realisation (Kelleher & MacCormack, 2005). Some general rule says that investment will be accepted only if IRR is above the cost of capital (current interest rate at the financial market), or while ranking the investment alternatives those with the highest IRR will be financed (Magni, 2010).

In both models farm could expect the growth in profit (in line to discount rate of i = 4%) derived from the investment use in next five years, or it could achieve the value of NPV (Table 18.) of 37,297.16 EUR (model I) and 40,944.19 EUR (model II). In same time, gained values for IRR define the use of investment in both models of production as fully profitable for the farmer, i.e. in both production models IRR significantly surpass (31.14% or 33.63%) the predefined calculative interest rate (4%). According to gained values for NVP and IRR, implementation of investment better fits the second model of production.

Table 18. NPV and IRR in both (25 ha and 30 ha) crop production models (in EUR)

no.	Element	Initial moment	Year					Cumulative
			I	II	III	IV	V	
0	1	2	3	4	5	6	7	8
	Crop production – I model (25 ha)							
1.	NCF from economic flow (3 to 7)	-42,515.00	22,272.61	17,797.09	6,403.09	13,951.84	29,593.09	***90,017.72***
2.	Discount rate (i, in %)	4.00	4.00	4.00	4.00	4.00	4.00	
3.	Discount factor	1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	
4.	Present value of NCF from economic flow (3 to 7)	-42,515.00	21,415.97	16,454.41	5,692.32	11,926.09	24,323.36	***79,812.16***
5.	**NPV of investment (2 to 7)**	**37,297.16**						
6.	**Relative NPV of investment [(2 to 7) / | col. 2|]*100 > i**	**0.88**						
7.	**Internal rate of return (IRR > i)**	**31.14%**						
	Crop production – II model (30 ha)							
1.	NCF from economic flow (3 to 7)	-42,515.00	22,328.68	20,131.96	6,459.16	15,517.66	29,649.16	***94,086.62***
2.	Discount rate (i, in %)	4.00	4.00	4.00	4.00	4.00	4.00	
3.	Discount factor	1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	
4.	Present value of NCF from economic flow (3 to 7)	-42,515.00	21,469.88	18,613.13	5,742.17	13,264.56	24,369.45	***83,459.19***
5.	**NPV of investment (2 to 7)**	**40,944.19**						
6.	**Relative NPV of investment [(2 to 7) / | col. 2|]*100 > i**	**0.96**						
7.	**Internal rate of return (IRR > i)**	**33.63%**						

Source: IAE, 2021.

b) Dynamic Payback Period

This indicator defines the period needed for repaying the previously invested assets from the discounted net cash flows derived from the investment object use (Bhandari, 2009).

Table 19. Dynamic payback period in both (25 ha and 30 ha) crop production models (in EUR), (DPP < n)

Year	Present value of NCF	CNCF
Crop production – I model (25 ha)		
0	-42,515.00	-42,515.00
I	21,415.97	-21,099.03
II	16,454.41	-4,644.62
III	5,692.32	1,047.70
IV	11,926.09	12,973.80
V	24,323.36	37,297.16
Crop production – II model (30 ha)		
0	-42,515.00	-42,515.00
I	21,469.88	-21,045.12
II	18,613.13	-2,431.99
III	5,742.17	3,310.18
IV	13,264.56	16,574.74
V	24,369.45	40,944.19

Source: IAE, 2021.

Observing the value of the indicator for both models (Table 19.), it could be noticed that investment will be returned in relatively short period. Specifically, for model I farmer could expect repayment of invested assets in 2 years and 9.84 months, while in case of model II needed time is 2 years and 5.04 months. Related to this indicator, investment in both models is economically justified, while second model is slightly favoured.

In line to gained values for indicators of static and dynamic investment analysis, generally both models could be considered economically justified. Besides, farm have to strive to realize investment linked to second model, as investment reacts well to spreading of production surfaces. Even more, all indicators in second model will be much better if there are no costs of renting.

It will be also interesting to reconsider economic justification of investment if farm does not apply for reimbursement of part of invested assets, or if calculative interest rate increase on 6%, related to potential business risks towards the occurrence of economic crisis.

According to the value of dynamic indicators, in case when farm is not supported by public subsidies, it will be still worthy to invest in both models (model I: NPV - 22,038.01 EUR; IRR - 17.76%; DPP - 4 years and 1.08 months, or model II: NPV - 25,685.04 EUR; IRR - 19.99%; DPP - 3 years and 10.81 months).

In same time, in case when calculative interest rate increase on 6%, it will be also economically justified to farm to invest in both models (model I: NPV - 32,877.24 EUR; IRR - 31.14%; DPP - 3 years and 0.36 months, or model II: NPV - 36,337.42 EUR; IRR - 33.63%; DPP - 2 years and 7.8 months), while investment seems to be more sensitive on lack of public support.

Conclusion

Pressure of climate change to ensuring the stability in crop production in Serbia is mainly expressed through the decrease in rainfalls or shift in their patterns, as in appearance of frequent heatwaves and semi-intensive to hard droughts. Meanwhile, although the implementation of irrigation systems is publically supported, this agro-technic measure is not often present on small farms active in crop production.

Although there are not universal agro-technique solutions or unique receipt for crop farms, we assume that the bottom-line that guarantees the market orientation and sustainability to family farms is between 25 to 30 ha of used land surfaces, including the irrigation. As adequate alternative for irrigation at “small” size crop farms could be Tifon irrigation system.

Results derived from assessment of economic effects linked to investment in implementation of irrigation system at two size farm modalities (crop farming at 25 ha and 30 ha) partially covered by public support show that in both modalities under assumed production circumstances investment could serve (NPV from 37.3 to 40.9 thousands EUR, IRR from 31.1% to 33.6%, or DPP from 2 years and almost 10 months to 2 years and 5 months) as instrument that will surely boosts the farm business sustainability. It is proved that increase in irrigated agricultural surfaces could cause better economic effects, while farm could also hold out the observed investment in irrigation system without public support or under the increased interest rate.

Some further steps could be recognized in determining the minimal surfaces under the crops (including the optimal crop structure, crop rotation or crop production intensity) that makes investment in implementation of the Tifon irrigation system economically justified for farmer.

Acknowledgements

Paper is a part of research financed by the MESTD RS and agreed in decisions no. 451-03-68/2022-14 from 17.01.2022., and no. 4561-03-68/2022-14 from 17.01.2022.

Conflict of interests

The authors declare no conflict of interest.

References

1. Bajramović, S., Bogdanov, N., Butković, J., Dimitrievski, D., Erjavec, E., Gjeci, G., Gjokaj, E., Hoxha, B., Stomenkovska, I., Konjević, D., Kotevska, A., Martinović, A., Miftari, I., Nacka, M., Ognjenović, D., Rednak, M., Tuna, E., Volk, T. & Zhllima, E. (2016). *Analysis of the agricultural and rural development policies of the Western Balkan countries*. JRC Technical Report, Volk, T., Erjavec, E., Ciaian, P., Gomez y Paloma, S. (eds.), Joint Research Centre, European Commission, Seville, Spain.
2. Best&Co (2021). *Ocmis tifon Ø90/400.* Portal of Best & Co International, Vrbas, Serbia, retrieved at: www.bestcoprodavnica.com/product--ocmis-tifon-90-400, 3rd March 2022.
3. Bhandari, S. (2009). Discounted payback period: Some extensions. *Journal of Business and Behavioral Sciences*, 21(1):28-38.
4. Bogdanov, N. & Vasiljevic, Z. (2011). Role of agriculture and multifunctional rural development in Serbia. *Applied Studies in Agribusiness and Commerce*, 5(1-2):47-55.
5. Durkalic, D.., Furtula, S.., & Borisavljevic, K. (2019). Ranking tourism market performance in EMU countries: results of PROMETHEE – GAIA approach. *Hotel and Tourism Management*, 7(2), 67–76. https://doi.org/10.5937/menhottur1902067D
6. FAO (2017). *The future of food and agriculture: Trends and challenges*. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.
7. FAO (2022). *Available arable land*. Database of FAOSTAT, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy, retrieved from: https://www.fao.org/faostat/en/#data/RL, 16th February 2022.
8. Furniss, I. (1964). Productivity of Canadian agriculture, 1935 to 1960: A quarter century of change. *Canadian Journal of Agricultural Economics*, 12(2):41-53.
9. Götze, U., Northcott, D. & Schuster, P. (2008). *Investment appraisal: Methods and models*, 2nd edition, Springer, Berlin, Germany.
10. Hossain, M. (2015). Water: The most precious resource of our life. *Global Journal of Advanced Research*, 2(9):1-11.
11. IAE (2021). *Dataset toward the irrigation system and crop irrigation at the selected farm*. Internal dataset derived from in-depth interview, Institute of Agricultural Economics, Belgrade, Serbia.
12. Jeločnik, M. & Subić, J. (2020). *Evaluation of economic efficiency of investments in organic production at the family farms*. In: Course for trainers: Organic farming, eco-market and their capitalization through the entrepreneurial initiative, Alexandru Ioan Cuza University, Iasi, Romania, pp. 261-300.
13. Jelocnik, M., Subic, J. & Nastic, L. (2021). *Upravljanje troskovima na poljoprivrednim gazdinstvima*. Institut za ekonomiku poljoprivrede, Beograd, Srbija.

14. Jeločnik, M. & Zubović, J. (2018). *Irrigation and Food Security: Case of Soybean Production in Serbia.* In: Establishing Food Security and Alternatives to International Trade in Emerging Economies, IGI Global, Hershey, USA, pp. 269-296.
15. Jević, J., Pavković, V., & Jević, G. (2021). The role of social media in contemporary tourism business. *Oditor*, *7*(2), 133-156. https://doi.org/10.5937/Oditor2102133J
16. Juhász, L. (2011). Net present value versus internal rate of return. *Economics & Sociology*, 4(1):46-53.
17. Kelleher, J. & MacCormack, J. (2005). Internal rate of return: A cautionary tale. *McKinsey Quarterly*, 20:71-75.
18. Kljajic, N., Vukovic, P. & Arsic, S. (2013). *Current situation in irrigation in the Republic of Serbia.* In: Sustainable Technologies, Policies, and Constraints in the Green Economy, IGI Global, Hershey, USA, pp. 123-139.
19. Lewandowski, I., Härdtlein, M. & Kaltschmitt, M. (1999). Sustainable crop production: Definition and methodological approach for assessing and implementing sustainability. *Crop science*, 39(1):184-193.
20. Loginovskiy, O. (2016). Use of an investment payback period in order to analyze project effectiveness. *Bulletin of the South Ural State University: Series of Computer Technologies, Automatic Control, Radio Electronics*, 16(4):132-135.
21. Lowder, S., Skoet, J. & Raney, T. (2016). The number, size, and distribution of farms, smallholder farms, and family farms worldwide. *World Development*, 87:16-29.
22. Magni, C. (2010). Average internal rate of return and investment decisions: A new perspective. *Engineering Economist*, 55(2):150-180.
23. Mishra, A., Harris, J., Erickson, K., Hallahan, C. & Detre, J. (2012). Drivers of agricultural profitability in the USA: An application of the Du Pont expansion method. *Agricultural Finance Review,* 72(3):325-340.
24. Mitrović, S., Mitrović, A. & Cogoljević, M. (2017). Contribution of Agriculture to the Development of Serbia. Economics of Agriculture, 64(2):805-819.
25. Melović, M. (2022). Agritourism in Montenegro – Empirical research in the function of strategic development. *Hotel and Tourism Management*, 10(1), 9–24. https://doi.org/10.5937/menhottur2201009M
26. Molden, D., Oweis, T., Steduto, P., Bindraban, P., Hanjra, M. & Kijne, J. (2010). Improving agricultural water productivity: Between optimism and caution. *Agricultural water management*, 97(4):528-535.
27. Munćan, P. & Božić, D. (2013). The effects of input subsidies on field crop production in Serbia. *Economics of agriculture*, 60(3):585-594.
28. Oosterhaven, J. (1988). On the plausibility of the supply-driven input-output model. *Journal of Regional Science*, 28(2):203-217.

29. Pantić, N., Cvijanović, D., & Imamović, N. (2021). Economic analysis of the factors influencing the supply and demand of raspberry. *Ekonomika poljoprivrede*, *68*(4), 1077-1087. https://doi.org/10.5937/ekoPolj2104077P
30. Pavlović, P., Kostić, N., Karadžić, B. & Mitrović, M. (2017). The soils of Serbia. Springer Netherlands, Heidelberg, Germany.
31. Penman, S. (1991). An evaluation of accounting rate-of-return. *Journal of Accounting, Auditing & Finance*, 6(2):233-255.
32. PSAWMF (2021). *Bespovratna sredstva za navodnjavanje u 2021. godini*. Provincial Secretariat for Agriculture, Water Management and Forestry (PSAWMF), Novi Sad, Serbia, retrieved at: https://podsticaji.rs/apv-bespovratna-sredstva-za-navodnjavanje-u-2021-godini/, 3rd March 2022.
33. Ruttan, V. (1957). Agricultural and Non-agricultural Growth in Output per Unit of Input. *Journal of Farm Economics*, 39(5):1566-1576.
34. Satterthwaite, D., McGranahan, G. & Tacoli, C. (2010). Urbanization and its implications for food and farming. *Philosophical transactions of the royal society B: Biological sciences*, 365(1554):2809-2820.
35. Sen, A. (1962). An aspect of Indian agriculture. *Economic Weekly*, 14(4-6):243-246.
36. Stojanović, Ž. (2022). *Agriculture in Serbia*. In: Geography of Serbia, Springer, Cham, Germany, pp. 199-206.
37. Stričević, R., Lipovac, A., Prodanović, S., Ristovski, M. A., Petrović Obradović, O., Đurović, N. & Đurović, D. (2020). Vulnerability of agriculture to climate change in Serbia: Farmers' assessment of impacts and damages. *Journal of Agricultural Sciences,* 65(3):263-281.
38. Subić, J. (2010). *Specifičnosti procesa investiranja u poljoprivredi*. Institute of agricultural economics, Belgrade, Serbia.
39. Subić, J., Kljajić, N. & Jeločnik, M. (2017a). *Obnovljivi izvori energije i navodnjavanje u funkciji održivog razvoja poljoprivrede: Ekonomski aspekti*. Institut za ekonomiku poljoprivrede, Beograd, Srbija.
40. Subić, J., Kljajić, N. & Jeločnik, M. (2017b). Renewable Energy Use in Raspberry Production. *Ekonomika poljoprivrede*, 64(2):821-843.
41. Subić, J., Nastić, L. & Roljević Nikolić, S. (2020). Economic effects of investment in dairy farming. *Western Balkan Journal of Agricultural Economics and Rural Development*, 2(2):135-146.
42. Todorović, S. (2018a). Ekonomska efikasnost ratarske proizvodnje porodičnih gazdinstava različite veličine. *Agroekonomika*, 47(78):63-71.
43. Todorović, S. (2018b). *Economic efficiency of different crop production models on family farms*. Doctoral dissertation, Faculty of Agriculture, University of Belgrade, Serbia, retrieved at: http://aspace.agrif.bg.ac.rs/bitstream/handle/123456789/60/57.pdf?sequence=1&isAllowed=y, 17th July 2022.

44. WB (2022). Agricultural irrigated land (% of total agricultural land): World. Portal of the World Bank (WB), Washington DC, USA, retrieved at:https://data.worldbank.org/indicator/AG.LND.IRIG.AG.ZS?locations=1W&most_recent_value_desc=true, 22nd February 2022.
45. Whittington, G. (1979). On the use of the accounting rate of return in empirical research. *Accounting and Business Research*, 9(35):201-208.
46. Yuliani, N. & Anggaradana, I. (2021). Pengaruh net profit margin, return on assets, likuiditas terhadap financial distress (Studi Kasus Pada Perusahaan Agriculture Terdaftar di Bursa Efek Indonesia Periode 2017-2019). *Jurnal Ilmiah Akuntansi dan Bisnis,* 6(1):1-9.
47. Zakić, V., Kovačević, V. & Damnjanović, J. (2017). Significance of financial literacy for the agricultural holdings in Serbia. Ekonomika poljoprivrede, 64(4):1687-1702.
48. Zakić, V., Kovačević, V., Ivkov, I. & Mirović, V. (2014). Importance of public warehouse system for financing agribusiness sector. *Economics of Agriculture,* 61(4):929-943.
49. Zarkovic, N., Toscano, B., Mrksic, D. & Lisov, M. (2014). Key features of crop insurance in Serbia. *Bulgarian Journal of Agricultural Science*, 20(1):23-33.
50. Zekic, S., Gajic, M. & Matkovski, B. (2013). *Serbian agriculture in regional and European integration.* In: 135 EAAE Seminar - Challenges for the Global Agricultural Trade Regime after Doha, DAES, Belgrade, Serbia, pp. 369-376.
51. Zemunac, R., Savic, R., Blagojevic, B., Benka, P., Bezdan, A. & Salvai, A. (2021). Assessment of surface and groundwater quality for irrigation purposes in the Danube-Tisa-Danube hydro-system area (Serbia). *Environmental Monitoring and Assessment*, 193(8):1-19.
52. Zubović, J., Jeločnik, M., Zdravković, A., Subić, J. & Radovanović, S. (2018). Using Spatial and Seasonal Panel Model to Determine Impact of Climatic Factors on Maize Yields in Serbia. *Romanian biotechnological letters*, 23(2):13383-13393.