ECONOMIC ASSESSMENT OF INVESTMENTS IN RURAL INFRASTRUCTURE IN HILLY-MOUNTAIN AREAS [1]

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Abstract

As one of the important elements of rural infrastructure, water supply represents the major precondition of modern lifestyle. However, in hilly mountainous regions of Serbian rural areas, water supply still does not have the treatment it deserves, while is not in line with the concept of sustainable development. Due to mentioned, there is a need for prompt attention to the issue of fresh water supply, while approach has to be in a planned manner, respecting both professional aspects, and all three pillars of sustainable development (economic, environmental and social). Considering that in hilly mountainous areas there are still local communities that have existed for many years without centralized or public water supply system, rural settlements are usually forced to rely on individual water supply solutions. Simultaneously with social progress, as well as towards the general increase in "urbanization" of villages, this issue is indispensably linked to overall development.

Author's research is focused on finding quality (technical) alternatives that secures the quality of fresh water, with special emphasis on economic assessment of investment in establishment of centralized water supply system. Preset economic model assumes overall investment of 1,843,589.74 EUR, or investment in fixed assets of 1,691,025.64 EUR, and investment in permanent working capital of 152,564.10 EUR. Applying the dynamic methods for evaluation of economic effectiveness of investments, there were derived next results: Net Present Value of 4,129,742.47

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EUR, Internal Rate of Return of 87.59%, and Payback Period of 10 years and 1.53 months. Considering planned exploitation period of investment (30 years) and occurred discount rate (7%), there could be concluded that in economic sense the investment is fully justified, while the local rural community could expect achieving of significant profit by its further utilization.

Key words: *rural areas, hilly-mountainous areas, water supply system, sustainable development, economic effectiveness of investment, Serbia.*

Introduction

Living in rural space could bring many benefits, but also several aggravating circumstances to local population, as are implementation of physical and social infrastructure elements in extent that meets the local needs (Barrios, 2008; Chakraborty et al., 2012; Atkociuniene, 2014).

Level of infrastructure development usually is the magnet for humans to settle some area. It prevents migrations, while brings newcomers to rural space opening the new entrepreneurial options and perspectives. It makes life in rural areas as decent alternative to this found in settlements (Munzwa, Wellington, 2010; Li et al., 2019). As a concept and policy platform, rural development has important role in systematic equipping of rural areas with basic and advanced infrastructures elements (electricity and IT systems, roads and traffic, water supply and sewage system, medical and social care, or education, sport and culture centers, etc.), (Jeločnik et al., 2011a; Jelocnik et al., 2011b; Surowka et al., 2021).

Coming from the fact that water supply represents one of the key developmental factors for any society, the municipality of Mali Zvornik (Serbia) serves as a positive example where this issue is given due attention. According to this, strategic approach and focus to all professional aspects in addressing the water supply problems of rural areas within the municipality of Mali Zvornik are the true example of good practice in the hilly and mountainous regions of Serbia.

As an essential link in sustainable development, social life strives to initiate and guide the social progress, or higher level of living quality, provoking the intensified transformation of rural areas into the urban environments. In this way, the issue of water supply becomes an indispensable aspect of social development, emphasizing the need for greater attention to this problem (Hoggart, Paniagua, 2001; Friedmann, 2005; Group of authors, 2006).

Initiative to perform the research for detailed study of hydrological conditions and the state of water supply served as the starting base for development of water supply system project turned to rural areas at the territory of Mali Zvornik municipality (Lazić et al., 2008).

Mentioned project for equipping rural areas within the municipality of Mali Zvornik includes two conceptual solutions. First alternative is based on construction of new water supply network, designed for thirty-year calculation (depreciation) period. The second technical solution is based on utilizing the existing system, while integrating new water supply system into it. For the purposes of this research, authors have selected the first solution, upon which they defined derived economic effects of investment in implementation of mentioned infrastructural element.

Materials and Methods

Focusing to assessment of economic effects derived from investment in water supply system implemented in rural areas of Mali Zvornik municipality, research is in line to principles towards ensuring the maximum level of financial benefits per unit of invested assets. According to that investment analysis relies both on quantitative and qualitative methods, securing investment in the most optimal (most cost-effective) business idea (Rajnović et al., 2016).

Investment analysis linked to water supply system implementation imply the use of methods for evaluating the economic efficiency of investments in agriculture. These include static and dynamic methods, as well as methods for evaluating the economic efficiency of investment under the conditions of risk and uncertainty (Gittinger Price, 1972; Românu, Vasilescu, 1993; Vasiljević, 2006; Subić, 2010; Subić et al., 2016; Subić et al., 2020; Jeločnik et al., 2022).

Research Results

The basic assumptions made in investment analysis include elements such are: overall investment (Table 1.), sources of financing (Table 2.), planned production value (Table 3.), planned costs of system running (Table 4.), profit and loss statement (Table 5.), and economic flow (Table 6.).

Table 1. Total investment (in EUR)

No.	Description	New investment	Total investment	Share in total investment (%)
I	**Fixed assets**	**1,691,025.64**	**1,691,025.64**	**91.72**
1.	Buildings and structures	1,551,086.80	**1,551,086.80**	84.13
2.	Other	139,938.84	**139,938.84**	7.59
II	**PWC**	**152,564.10**	**152,564.10**	**8.28**
TOTAL (I+II)		**1,843,589.74**	**1,843,589.74**	**100.00**

Source: Authors' calculation based on Subić, 2008.

Table 2. Sources of financing (in EUR)

No.	Description	New investments	Total Investments	Share in total investments (%)
I	**Internal financial resources**	**152,564.10**	**152,564.10**	**8.28**
1.	Fixed assets	0.00	0.00	0.00
2.	Current assets	152,564.10	152,564.10	8.28
II	**External financial resources**	**1,691,025.64**	**1,691,025.64**	**91.72**
1.	Fixed assets	1,691,025.64	1,691,025.64	91.72
TOTAL (I+II)			**1,843,589.74**	**100.00**

Source: Authors' calculation based on Subić, 2008.

Table 3. Planned production (in EUR)

No.	Description	Phases of work			Phases of project utilization			
		I (Year 2)	II (Year 3)	III (Year 5)	I (Year 5)	II (Year 5)	III (Year 5)	IV (Year 5)
1.	Water (Legal Entities)	166,343.04	398,242.58	544,553.66	544,553.66	544,553.66	544,553.66	544,553.66
2.	Water (Natural Persons)	252,694.73	604,977.51	1,432,218.83	1,432,218.83	1,432,218.83	1,432,218.83	1,432,218.83
3.	**Total income**	**419,037.78**	**1,003,220.09**	**1,976,772.49**	**1,976,772.49**	**1,976,772.49**	**1,976,772.49**	**1,976,772.49**

Source: *Authors' calculation based on Subić, 2008.*

Table 4. Planned production costs (in EUR)

No.	Cost description	Work phases			Phases of project utilization			
		I (Year 2	II (Year 3	III (Year 5)	I (Year 5)	II (Year 5)	III (Year 5)	IV (Year 5)
I	**Material costs**	**113,941.71**	**209,290.89**	**256,494.17**	**256,494.17**	**256,494.17**	**256,494.17**	**256,494.17**
1.	Raw materials and supplies	24,994.93	52,076.33	67,352.70	67,352.70	67,352.70	67,352.70	67,352.70
2.	Energy and fuel	31,505.96	69,734.84	92,527.09	92,527.09	92,527.09	92,527.09	92,527.09
3.	Other material costs	57,440.82	87,479.72	96,614.39	96,614.39	96,614.39	96,614.39	96,614.39
II	**Non-material costs**	**194,637.70**	**529,480.38**	**753,695.65**	**753,695.65**	**753,695.65**	**753,695.65**	**753,695.65**
1.	Depreciation	20,307.69	187,719.23	355,130.77	355,130.77	355,130.77	355,130.77	355,130.77
2.	Labor	117,784.76	245,401.68	284,210.74	284,210.74	284,210.74	284,210.74	284,210.74
3.	Services	20,878.76	43,513.46	56,281.49	56,281.49	56,281.49	56,281.49	56,281.49
4.	Other non-material costs	35,666.49	52,846.01	58,072.65	58,072.65	58,072.65	58,072.65	58,072.65
Total (I+II)		**308,579.42**	**738,771.27**	**1,010,189.82**	**1,010,189.82**	**1,010,189.82**	**1,010,189.82**	**1,010,189.82**

Source: *Authors' calculation based on Subić, 2008.*

Table 5. Profit and loss statement (in EUR)

No.	Description	Work phases			Phases of project utilization			
		I (Year 2)	II (Year 3)	III (Year 5)	I (Year 5)	II (Year 5)	III (Year 5)	IV (Year 5)
I	**TOTAL INCOME**	**419,037.78**	**1,003,220.09**	**1,976,772.49**	**1,976,772.49**	**1,976,772.49**	**1,976,772.49**	**1,976,772.49**
1.	Sales incomes	419,037.78	1,003,220.09	1,976,772.49	1,976,772.49	1,976,772.49	1,976,772.49	1,976,772.49
II	**TOTAL EXPENSES (1+2)**	**308,579.42**	**738,771.27**	**1,010,189.82**	**1,010,189.82**	**1,010,189.82**	**1,010,189.82**	**1,010,189.82**
1.	Operating expenses	308,579.42	738,771.27	1,010,189.82	1,010,189.82	1,010,189.82	1,010,189.82	1,010,189.82
1.1.	Material costs	113,941.71	209,290.89	256,494.17	256,494.17	256,494.17	256,494.17	256,494.17
1.2.	Non-material costs excluding depreciation and interest on loans	174,330.01	341,761.15	398,564.88	398,564.88	398,564.88	398,564.88	398,564.88
1.3.	Depreciation	20,307.69	187,719.23	355,130.77	355,130.77	355,130.77	355,130.77	355,130.77
2.	Financial expenses	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.1.	Interest on loans	0.00	0.00	0.00	0.00	0.00	0.00	0.00
III	**GROSS PROFIT (I-II)**	**110,458.36**	**264,448.82**	**966,582.67**	**966,582.67**	**966,582.67**	**966,582.67**	**966,582.67**
IV	**INCOME TAX ***	16,568.75	39,667.32	144,987.40	144,987.40	144,987.40	144,987.40	144,987.40
V	**NET PROFIT (III-IV)**	**93,889.60**	**224,781.49**	**821,595.27**	**821,595.27**	**821,595.27**	**821,595.27**	**821,595.27**

** The corporate income tax rate in this particular case is 15%.*

Source: *Authors' calculation based on Subić, 2008.*

Table 6. Economic flow (in EUR)

No.	Description	Work phases			Phases of project utilization			
		I (Year 2)	II (Year 3)	III (Year 5)	I (Year 5)	II (Year 5)	III (Year 5)	IV (Year 5)
I	**TOTAL CASH INFLOW (1+2)**	**419,037.78**	**1,003,220.09**	**1,976,772.49**	**1,976,772.49**	**1,976,772.49**	**1,976,772.49**	**2,349,154.54**
1.	Total income	419,037.78	1,003,220.09	1,976,772.49	1,976,772.49	1,976,772.49	1,976,772.49	1,976,772.49
2.	Remaining value of the project	0.00	0.00	0.00	0.00	0.00		372,382.05
	2.1. Fixed assets					0.00		219,817.95
	2.2. Permanent working capital					0.00		152,564.10
II	**TOTAL CASH OUTFLOW (3+4)**	**611,196.85**	**1,734,859.46**	**1,193,139.73**	**800,046.45**	**800,046.45**	**800,046.45**	**800,046.45**
3.	Investment value	306,356.37	1,144,140.09	393,093.28				
	3.1. In fixed assets	279,625.00	1,052,607.03	358,793.61				
	3.2. In permanent working capital	26,731.37	91,533.06	34,299.67				
4.	Costs excluding depreciation and interest on loans	288,271.73	551,052.04	655,059.05	655,059.05	655,059.05	655,059.05	655,059.05
5.	Corporate income tax	16,568.75	39,667.32	144,987.40	144,987.40	144,987.40	144,987.40	144,987.40
III	**NET CASH FLOW (I-II)**	**-192,159.08**	**-731,639.37**	**783,632.76**	**1,176,726.04**	**1,176,726.04**	**1,176,726.04**	**1,549,108.09**

Source: *Authors' calculation based on Subić, 2008.*

In line to research goal, static methods were used, such are (Tables 7-10.): Economic-efficiency coefficient, Net profit margin ratio, Accounting rate of return, and Payback period.

Table 7. Economic-efficiency coefficient (in EUR), (Ee > 1)

Years of investment realization	Total Income	Total Expenses	Economic-efficiency coefficient
0	**1**	**2**	**3 = 1/2**
I-II	419,037.78	308,579.42	1.36
III-V	1,003,220.09	738,771.27	1.36
VI-X	1,976,772.49	1,010,189.82	1.96
XI-XV	1,976,772.49	1,010,189.82	1.96
XVI-XX	1,976,772.49	1,010,189.82	1.96
XXI-XXV	1,976,772.49	1,010,189.82	1.96
XXVI-XXX	1,976,772.49	1,010,189.82	1.96

***Source**: Authors' calculation based on Subić, 2008.*

Table 8. Net profit margin ratio (in EUR), (NPMR > i)

Year of investment realization	Profit	Total Income	NPMR
0	**1**	**2**	**3 = 1/2*100**
I-II	93,889.60	419,037.78	22.41
III-V	224,781.49	1,003,220.09	22.41
VI-X	821,595.27	1,976,772.49	41.56
XI-XV	821,595.27	1,976,772.49	41.56
XVI-XX	821,595.27	1,976,772.49	41.56
XXI-XXV	821,595.27	1,976,772.49	41.56
XXVI-XXX	821,595.27	1,976,772.49	41.56

***Source**: Authors' calculation based on Subić, 2008.*

Table 9. Accounting rate of return (in EUR), (ARR > i)

Year of investment realization	Profit	Initial outlay	ARR
0	**1**	**2**	**3 = 1/2*100**
I-II	93,889.60	1,843,589.74	5.09
III-V	224,781.49	1,843,589.74	12.19
VI-X	821,595.27	1,843,589.74	44.56
XI-XV	821,595.27	1,843,589.74	44.56
XVI-XX	821,595.27	1,843,589.74	44.56
XXI-XXV	821,595.27	1,843,589.74	44.56
XXVI-XXX	821,595.27	1,843,589.74	44.56

***Source**: Authors' calculation based on Subić, 2008.*

Table 10. Simple payback period (in EUR), (SPP < n)

Year of investment Realization	Net cash flow from economic flow	Cumulative net cash flow
I-II	-192,159.08	-192,159.08
III-V	-731,639.37	-923,798.44
VI-X	783,632.76	-140,165.69
XI-XV	1,176,726.04	1,036,560.35
XVI-XX	1,176,726.04	2,213,286.39
XXI-XXV	1,176,726.04	3,390,012.42
XXVI-XXX	1,549,108.09	4,939,120.51

***Source**: Authors' calculation based on Subić, 2008.*

The calculation of the payback period is as follows:

$$|-140{,}165.69| / 1{,}176{,}726.04 = 0{,}12$$

[(that is 10,12 years or 10 years and 1,43 months (12*0,12)].

In addition to static methods, dynamic methods were also used in this research, namely (Tables 11-12.): Net present value, Internal rate of return, and Dynamic payback period. Unlike static methods, dynamic methods are based on the discounting technique, which is a way of bringing all revenues and expenses, incurred at different time periods, to their present value (Vasiljević, 2006). Using discounting technique, there could be brought all future revenues and expenditures to their present value (Gittinger Price, 1972).

Table 11. Net present value (NPV) and Internal rate of return (IRR), (in EUR)

No.	Description	Work phases			Phases of project utilization				Cumulative
		I (Year 2)	II (Year 3)	III (Year 5)	I (Year 5)	II (Year 5)	III (Year 5)	IV (Year 5)	
0	1	2	3	4	5	6	7	8	9
1.	Net cash flow from economic flow (columns 3 to 8)	-192,159.08	-731,639.37	783,632.76	1,176,726.04	1,176,726.04	1,176,726.04	1,549,108.09	5,079,286.20
2.	Discount rate (%)	7.00	7.00	7.00	7.00	7.00	7.00	7.00	
3.	Discount factor $(1+i)^{-n}$ where i = discount rate; n = year of investment life cycle	1.0000	1.0000	1.0000	0.9346	0.8734	0.8163	0.7629	
4.	Present value of net cash flow from economic flow (columns 3 to 8)	-192,159.08	-731,639.37	783,632.76	1,099,743.96	1,027,798.09	960,558.97	1,181,807.14	4,269,908.16
5.	**Net present value of investment (columns 2 to 8)**	**4,129,742.47**							
6.	**Relative net present value of investment [(columns 2 to 8) / | column 2|*100 > i**	**44.70%**							
7.	**Internal rate of return (IRR > i)**	**87.59%**							

***Source**: Authors' calculation based on Subić, 2008.*

Table 12. Dynamic payback period (in EUR), (DPP < n)

Year of investment Realization	Present value of net cash flow from economic flow	Cumulative net cash flow
I-II	-192,159.08	-192,159.08
III-V	-731,639.37	-923,798.44
VI-X	783,632.76	-140,165.69
XI-XV	1,099,743.96	959,578.27
XVI-XX	1,027,798.09	1,987,376.37
XXI-XXV	960,558.97	2,947,935.33

***Source**: Authors' calculation based on Subić, 2008.*

The payback period is calculated as follows: $|-140,165.69| / 1,099,743.96 = 0,13$

[(that is 10,13 years or 10 years and 1,53 months (12*0,13)].

The inability to predict future events (incomes, expenses, economic lifespan of the investment project) significantly impacts the justification for investment and reduces the real possibility of making the right decision. In line to this, decision-making is often faced with the problem of uncertainty and the need to reduce business risks. The assessment of the economic effectiveness of investment under conditions of uncertainty can be performed using various methods and techniques (Subić, 2010). For the purpose of research, there are considered two methods (Table 13.), specifically: Break-even point, and Margin of safety.

Table 13. Break-even point of investment exploitation (in EUR)

No.	Description	Work phases			Phases of project utilization			
		I (Year 2)	II (Year 3)	III (Year 5)	I (Year 5)	II (Year 5)	III (Year 5)	IV (Year 5)
1.	Incomes (I)	419,037.78	1,003,220.09	1,976,772.49	1,976,772.49	1,976,772.49	1,976,772.49	1,976,772.49
2.	Variable costs (VC)	231,726.48	454,692.58	540,704.91	540,704.91	540,704.91	540,704.91	540,704.91
3.	Fixed costs (FC)	76,852.94	284,078.70	469,484.91	469,484.91	469,484.91	469,484.91	469,484.91
4.	Gross margin (GM = I - VC)	187,311.30	548,527.51	1,436,067.58	1,436,067.58	1,436,067.58	1,436,067.58	1,436,067.58
5.	Break-even point (relative) (BEPr = (FC / GM) * 100), in %	41.03	51.79	32.69	32.69	32.69	32.69	32.69
6.	Break-even point (value) (BEPv = (I * BEPr) / 100), in EUR	171,929.22	519,560.91	646,254.30	646,254.30	646,254.30	646,254.30	646,254.30
7.	Margin of safety (relative) (MSr = ((1 - (BEPv / I)) * 100), in %	58.97	48.21	67.31	67.31	67.31	67.31	67.31
8.	Margin of safety (value) (MSv = (I*MSr/100)), in EUR	247,108.56	483,659.18	1,330,518.18	1,330,518.18	1,330,518.18	1,330,518.18	1,330,518.18

***Source**: Authors' calculation based on Subić, 2008.*

Conclusion

According to static assessment of investment economic efficiency (investment in implementation of water supply system for rural areas in the municipality of Mali Zvornik), the following conclusions can be drawn:

- The **economic-efficiency coefficient** is over than one, indicating that total income exceeds total expenses. Consequently, it can be concluded that the investment is economically viable, i.e. investment is profitable.

- The **net profit margin ratio** is higher than 7% (assumed weighted cost of capital). Therefore, it can be stated that investment project is accumulative (meaning that during the project's exploitation, the costs of financing sources are covered, and additionally profit is generated).

- Except in the first two years, **accounting rate of return** exceeds 7% (assumed weighted cost of capital). Thus, it can be concluded that the investment project is profitable (indicating that the financing costs are covered, and additional earnings are generated).

- The **payback period** of investment is 10.12 years, so investment will be repaid in 10 years and 1.43 months (0.12 x 12 months).

Considering dynamic assessment of economic efficiency of realized investment in water supply system, following conclusions can be drawn:

- Investment in over five-years utilization period (project lifespan) would enable investor to achieve a total profit increase, by the use of discount rate (i = 7%) at the starting moment of exploitation (n = 0), amounting to 4,129,742.47 EUR (NPV).

- Investment is profitable, as Internal rate of return (IRR) during the project implementation exceeds discount rate (87.59% > 7%).

- Investment project will be paid back in 10.13 years, what corresponds to 10 years and 1.53 months (0.13 x 12 months).

Considering investment analysis under conditions of risk and uncertainty, the following conclusions can be drawn:

- During the project utilization, i.e. in one of observed phases, production volume must not fall below 32.69%, or achieved sales revenues must not drop below 646,254.30 EUR.

- During the project utilization, i.e. in one of observed phases, decrease in production volume could come up to 67.31%, or revenues could drop up to 1,330,518.18 EUR.

Based on mentioned above, general conclusion is that investment in water supply system implemented in rural areas of municipality of Mali Zvornik is profitable, while it generates income, or it is fully justifiable.

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