

# TECHNICAL, FINANCIAL AND ECOLOGICAL CONSIDERATIONS OF ORGANISING AN INTEGRATED SWAMPING SYSTEM ON THE IER VALLEY

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**ABSTRACT.** In order to combat the adverse effects of sewerage and inking works (desertification, secondary salinity, reducing of groundwater level) a system of re-swamping of Ier Valley was conceived, operating as an integrated agricultural exploitation - fishery and touristical. Technically speaking, the system will consist of 16 thresholds and 11 water basins, totalling 33 ha of body of water and 495.000 cubic meters water reserve, with various destinations (flow regulations, irrigations, livestock breeding, fishery, etc). The economic value of the project is 6.227.443,00 lei and the investment could be implemented during 2010-2013. The investment holder, the Oradea „Someș – Crișuri” subsidiary of ANIF could provide its funding, as follows: bank loans - 23,86 %; state budget allocations -16,37 %; attracted funds - 59,84 %. The total income to be obtained through this investment is only of 3.814.900 lei, which shows us that, even in ideal conditions, the investment costs cannot be returned in the first 10 years of exploitation, only up to 61,56 %. It becomes clear that in the analysis of this type of investment, as all environment investments, cannot be used the cost-profit method, but the social and ecological cost-benefits.

**Keywords:** agricultural exploitation, system of re-swamping, Ier Valley, environment investments

## INTRODUCTION

In the period of 1960-1980, in the whole country there have been made sewerage and inking works in the swampy areas, inclusively on the Ier Valley, with a view to obtain new agricultural lands (Karácsonyi, 1994-1995). The negative ecological and economical consequences of such works were visible in no more than 10 years of agricultural exploitation of these lands. The ground water descended much under the absorption horizon of the plants roots and the phenomenon of soil salinisation covered important areas. The lands were abandoned, becoming fallows, because the value of the agricultural production didn't cover the exploitation costs.

The fail of this experience and the lack of funds for channels' dredging which have clogged raised the question of return of polders to their original look and functions, by organising re-swamping systems, but better capitalized than a century ago, as agricultural exploitation-fishery and touristical (Barde, 1992; Platon, 1997; Rojanschi et al., 2003). Such an integrated swamping system is proposed further by the author.

## MATERIALS AND METHODS

The study concerns the middle course of Ier Valley, from Căuaș to Roșiori, where huge sewerage and inking works have been made.

In this view, a technical project of re-swamping has been conceived, consisting of execution of thresholds and water reservoirs with multiple destinations, but providing a permanent and constant flow on the river, since the summer drought can lead to the its drying.

The technical project was then analyzed under its ecological and social cost-benefits (Henley and Spash,

1993; Cistelecan, 2002; Ardelean, 2003) and it was taken as valid regarding the effects on environment (flow, ground water, biodiversity, increase if the potential of natural resources from the area etc). As a consequence, a complex case study was carried out, which included an analysis of: necessity and opportunity; pre-feasibility and feasibility; technico-economical; investment evaluation and funding.

As a result, the survey was the subject of a financed crossborder project (HU-RO) regarding the valuation of natural resources of flood areas from Tisa's tributaries from the Nord-Western Romania (Lenti and Ardelean, 2012).

## RESULTS AND DISCUSSIONS

### Substantiating the investment necessity and opportunity.

Through the project for technical and inking hydro-ameliorative of the Ier Valley, approved by the National Waters Committee of Romania in 1960, almost 65.000 ha of land removed from the effect of excess humidity were returned to agriculture (Karácsonyi, 1994-1995), land currently affected by drought and secondary salinity, becoming in fact, unsuitable areas for agriculture (Ardelean et al., 2008).

In order to become suitable for agriculture, works are necessary to bring the ground water closer to the surface, from which the plants roots may have an efficient absorption which can be achieved by re-swamping works.

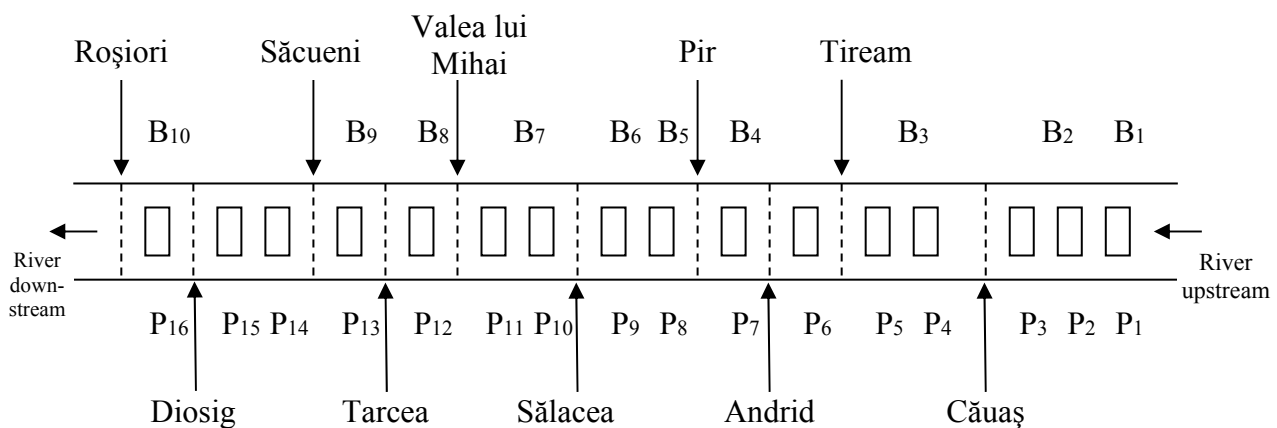
The opportunity of such investment is given by the fact that all channels are in advanced stage of clogging, on which aquatic vegetation, specific for swamp is already installed, and the investment cost would be relatively small.

**Functional and technological description of investment.**

The investment is regarding to putting into service a re-swamping system of the Ier Valley. (table no. 1, figure no. 1).

**Table no. 1.** The Ier swamping system- territorial-administrative distribution

No.	Administrativ-territorial unit	Thresholds	Breach in dam and weir	Flood areas (ha)	Water capacity of reservoirs (cm)
1.	Căuaș	3	2	3+3=6	90.000
2.	Tiream	2	1	3	45.000
3.	Andrid	1	-	-	-
4.	Pir	1	1	2	30.000
5.	Sălacea	2	2	3+3=6	90.000
6.	Valea lui Mihai	2	1	5	75.000
7.	Tarcea	1	1	4	60.000
8.	Săcueni	1	1	3	45.000
9.	Diosig	2	1	2	30.000
10.	Roșiori	2	1	2	30.000
	<b>TOTAL</b>	<b>16</b>	<b>1</b>	<b>33</b>	<b>495.000</b>



Note: P – thresholds; B – basins

**Figure no. 1.** Geographical distribution of dams and water reservoirs on Ier

As technical considerations, the investment will consist on the followings:

a) Arrangement of 16 thresholds in the minor riverbed of Ier ( $L = 5$  m;  $\hat{I} = 1$  m;  $G = 1,5$ ) downstream

distributed starting from (Căuaș) (middle course). The Ier water will pass over the thresholds only in the medium and high flows periods (floods).

b) Execution in dams of 11 breaches for evacuation of water exceeding the average level of river, through a ditch, in 11 water reserve basins.

c) Execution of 11 adduction pipes into the water reserve basins at 1 meter river water to take over the water exceeding this level, which is introduced into the basins.

d) Execution of 11 water pipes to evacuate the water from the reserve basins into the river at the average level of water in the basins, when the water flow of Ier is very small, in drought periods.

e) Providing the necessary areas for the 11 water reserve basins - about 33 hectares, purchased from the Ier neighboring agricultural companies (Căuaș, Ghenci, Vezendiu, Piru Nou, Sălacea, Otomani, Valea lui Mihai, Tarcea, Cadea, Ianca and Roșiori) by 5.000 lei /ha.

f) Placement of water reserve basins in negative microforms of relief (natural sink with a bottom of impermeable clay) former swamp lands 40-50 year ago, and execution of delimitation works from the rest of relief (stripping, dam reservation, land filling, compacting).

g) Execution of environment protection works in the area of water reserve basins (grass and trees plantation) to consolidate the boundary land.

h) Initial filling of water reserve basins in the periods of spring floods.

i) Populating the water reserve basins with fish specific to puddle (carp), which are extensively raising.

Functionally, the Ier swamping system will have the following roles:

a) it will ensure the river swamping, through the deposit of water suspensions (silt);

b) it will block the silt drain, contributing to the river clogging;

c) it will ensure the maintaining of a more constant flow river (at about 1,3 m);

d) a water reserve will be formed, of maximum 495.000 cm, with various usages;

e) it will substantially increase the fishery resources of Ier, contributing to the development of sportive fishery and of recreational activities.

#### Main characteristics of investment.

The thresholds will cover the whole width of the minor riverbed (5 m) and will not exceed 1,0 m height in order to not totally block the freshets. They will be downstreamly located, but very close to the breaches of water supply.

- The dam breaches will be executed in such a manner as not to affect their function to protect against floods.

- The water reserve basins will cover the negative relief forms to return them their original functions, as puddles or swamps.

- In order to increase the economical and ecological value of investment, the water reserve basins will be populated with fish specific for impound waters.

- The reservoirs water can be used to irrigations and in zooculture.

- The system operates so that is requires a reduced number of maintenance personnel.

#### Required materials, equipment, transport and labour force for investment implementation.

The materials, equipment (own), transport, direct labour and social taxes (VAT including) are presented in tables no. 2-4.

**Table no. 2.** The swamping system of the Ier Valley-technical works

According to Governmental Decision no. 28/09.01.2008

No.	Work name	Units	Quantity	Unit price	
				euro	thousands euro
1.	<b>fillings in riverbed (land threshold)</b>				
	excavations	100 cm	2,50	72,80	0,182
	land transport	tons	4,50	2,40	0,011
	land filling	100 cm	2,50	65,10	0,163
	total/piece				0,356

	TOTAL		16,00		5,689
2.	<b>deforestations</b>				
	land deforestation	100 sqm	315,00	16,00	5,040
3.	<b>rockfilling</b>				
	stone transport	tons	75,00	6,20	0,465
	material (stone)	tons	75,00	6,00	0,450
	rockfilling execution	cm	41,67	19,20	0,800
	total/threshold piece				1,715
	TOTAL		16,00		27,440
4.	<b>brush (fascines) matress</b>				
	fascines collection	cmc	60,00	1,20	0,072
	layers of fascines	sqm	30,00	4,10	0,123
	total/piece				0,195
	TOTAL		16,00		3,120
5.	<b>access roads</b>				
	embankments	100 cm	10,50	82,00	0,861
	roads constructions	sqm	3.500,00	18,00	63,000
	TOTAL				63,861
6.	<b>fillings in dam body</b>				
	land fillings	100 cm	110,00	65,10	7,161
	compactation	100 cm	110,00	57,00	6,270
	total/piece				13,431
	TOTAL		16,00		214,896

7.	<b>environment protection</b>				
	grass plantation	100 sqm	620,00	18,00	11,160
	trees plantation	piece	800,00	2,80	2,240
	TOTAL				13,400
8.	<b>water reserve basins</b>				
	dam stripping reservation	100 sqm	72,00	17,80	1,282
	land fillings	100 cm	101,00	90,00	9,090
	compactation	100 cm	101,00	57,00	5,757
	total/piece				16,129
	TOTAL		11,00		177,415
9.	<b>undercrossings</b>				
	embankments	100 cm	17,60	155,00	2,728
	constructions	piece	22,00	3.250,00	71,500
	TOTAL				74,228
10.	<b>adduction pipes into the water reserve basins</b>				
	embankments	100 cm	12,65	115,00	1,455
	constructions	lm	550,00	125,00	68,750
	TOTAL				70,205
11.	<b>evacuation pipes from water reserve basins</b>				
	embankments	100 cm	15,18	115,00	1,746
	constructions	lm	715,00	125,00	89,375
	TOTAL				91,121
12.	<b>Fish populating</b>	Kg	10.897	31.595	78,99

**Table no. 3.** Overall estimate of the "Swamping system of the Ier Valley" investment

1 EURO = 4,1000 lei at 09.03.2010

No.	Expenditures chapters and sub-chapters	Amount (VAT excluded)		VAT	Amount (VAT included)	
		Thousands lei	Thousands euro	Thousands lei	Thousands lei	Thousands euro
1	2	3	4	5	6	7
<b><u>PART I</u></b>						
<b>CHAPTER 1</b>						
<b>Expenditures for land aquisition and arrangement</b>						
1.1	Land aquisition	165,000	40,244	31,350	196,350	49,088
1.2.	Land arrangement expenditures	0,000	0,000	0,000	0,000	0,000
1.3.	Environment protection and fish populating arrangements	143,301	34,951	27,227	170,528	41,592
	<b>TOTAL CHAPTER 1</b>	<b>308,301</b>	<b>75,195</b>	<b>58,527</b>	<b>366,878</b>	<b>90,068</b>
<b>CHAPTER 2</b>						
	<b>TOTAL CHAPTER 2</b>	<b>0,000</b>	<b>0,000</b>	<b>0,000</b>	<b>0,000</b>	<b>0,000</b>
<b>CHAPTER 3</b>						
<b>Expenditures for design and technical assistance</b>						
3.1	Field studies	0,000	0,000	0,000	0,000	0,000
3.2	Obtaining permits, approvals and authorisations	61,206	14,928	11,629	72,835	17,765
3.3	Design and engineering	61,818	15,078	11,745	73,563	17,942
3.4	Organising of public procurement procedures	0,000	0,000	0,000	0,000	0,000

3.5	Consultancy	28,700	7,000	5,453	34,153	8,330
3.6	Technical assistance	36,900	9,000	7,011	43,911	10,710
	<b>TOTAL CHAPTER 3</b>	<b>188,624</b>	<b>46,006</b>	<b>35,839</b>	<b>224,462</b>	<b>54,747</b>
<b>CHAPTER 4</b>						
<b>Expenditures for the basic investment</b>						
4.1	Constructions and installations	3.005,357	733,014	571,018	3.576,375	872,286
	<b>TOTAL CHAPTER 4</b>	<b>3.005,357</b>	<b>733,014</b>	<b>571,018</b>	<b>3.576,375</b>	<b>872,286</b>
<b>CHAPTER 5</b>						
<b>Other expenditures</b>						
5.1	Various and incidental costs	30,603	7,464	5,815	36,418	8,882
	<b>TOTAL CHAPTER 5</b>	<b>30,603</b>	<b>7,464</b>	<b>5,815</b>	<b>36,418</b>	<b>8,882</b>
<b>CHAPTER 6</b>						
<b>Expenditures for technological tests and delivery to the beneficiary</b>						
	<b>TOTAL CHAPTER 6</b>	<b>0,000</b>	<b>0,000</b>	<b>0,000</b>	<b>0,000</b>	<b>0,000</b>
	<b>OVERALL TOTAL</b>	<b>3.444,524</b>	<b>840,128</b>	<b>654,409</b>	<b>4.098,983</b>	<b>1.000,983</b>

**Table no. 4.** Summary of estimates for "Swamping system of the Ier Valley"

1 EURO = 4,1000 lei at 09.03.2010

No.	Works	Amount (VAT excluded)		VAT	Amount (VAT included)	
		Thousands lei	Thousand euro	Thousand lei	Thousand lei	Thousand euro
		2	3	4	5	6
<b>I – CONSTRUCTION WORKS</b>						
1.	1.1. Embankments	821,795	200,438	156,141	977,936	238,521

2.	1.2. Construction	1.405,912	342,905	267,123	1.673,035	408,057
	<b>TOTAL I (VAT excluded)</b>	2.227,707	543,343	423,264	2.650,971	646,578
<b>II – FITTING</b>						
	<b>TOTAL II (VAT excluded)</b>	0,000	0,000	0,000	0,000	0,000
<b>III – PROCUREMENT</b>						
	<b>TOTAL III (VAT excluded)</b>	0,000	0,000	0,000	0,000	0,000
	<b>TOTAL = TOTAL I + TOTAL II + TOTAL III (VAT excluded)</b>	2.227,707	543,343	423,264	2.650,971	646,578

By summing up the values of these tables it results a total amount of 2.650.971 lei/646.578 euro for the proper investment.

#### Operating expenditures.

Regarding the operation of the swamping system of the Ier Valley, we must consider the followings: a) the system would be operational only in 2014; b) at every 2 years a completion of fish resource is required (2 x 4 t of carp, 1,2 t of bighead carp, 3 kg of juvenile pike) which would be reduced by an extensively fishing; c)

the security personnel will fulfil the tasks of river flow monitoring, of fish basins security and collection of taxes for sportive fishing permits (which can be solved by employment of 22 persons, with a monthly salary of 750 lei/month); d) in order to assure a proper increase of fish resources, feed for phytophagus will be provided (1500 kg/ha at unit price of 2,1 lei/kg, during the 6 years of operation). The material and labour expenditures for the system operation during 10 years are displayed in the table no. 5.

**Table no. 5.** Maintenance expenditures of the re-swamping system of the Ier Valley for the period of 2010-2019

No.	Specification	MU	Quantity	Price/MU	Amount (VAT included)	Observation (per years)
1.	Fish re-population in the years of 2016 and 2018:					
	- carp	kg	8.000	11,90	95.200	2016 and 2018
	- bighead carp	kg	2.400	6,55	15.720	2016 and 2018
	- juvenile pike	pcs.	33.000	0,48	15.840	2016 and 2018
2.	Feed for phytofagus	kg	297.000	2,10	623.700	1500 kg/ha x 33 ha x 2,1 lei/kg x 6 years



3.	Security personnel	pers.	22	750/month	1.188.000	22 persons x 750 lei/month x 12 month x 6 years
<b>TOTAL 1-3</b>		-	-	-	<b>1.938.460</b>	<b>for 6 year</b>

It results a total amount of maintenance expenditures for a 10 year duration of 1.938.460 lei that is 193.846 lei/year.

**Total value of investment.**

It is displayed in the table no.6, which includes the expenditures of the proper investment, system operation, and project elaboration inclusively.

**Table no. 6.** The total value of the re-swamping system of the Ier Valley investment (VAT included)

No.	Specification	Amount (lei)
1.	Expenditure for effective investment (materiales, equipment, transport, labour etc.)	4.098.983
2.	Maintenance expenditures (fish resources, feed, labour)	1.938.460
3.	Design	160.000
<b>TOTAL 1-3</b>		<b>6.197.443</b>

Consequently, the total investment for the re-swamping of the Ier Valley amounts to 6.197.443 lei (VAT included).

**Investment timing.**

It will be carried out in two stages: stage I - thresholds execution and stage II - breaches, pipes and water reserve basins execution.

**Investment physical output:** 16 thresholds in the minor riverbed for water and silt stoppage; 11 pipes for water adduction from Ier; 11 pipes for water evacuation from reserve basins; 11 water reserve basins, with a total surface of 33 ha body of water and a capacity of 495.000 cm, with various usages.

**Duration of investment implementation.**

In the period of 2010-2013, as follows: 2010 - investment designing; 2011 - funding search; 2012 - implementation of stage I; 2013 - implementation of stage II.

In 2013, the swamping system of the Ier Valley is effectively operating and starting with 2015, the extensive fishery exploitation.

**Economical and ecological section of investment.**

After the implementation of this project, the investment will produce, starting with 2014, the following economical and ecological effects.

- Economical effects: Consist on products and service selling to beneficiaries.

- Water selling. It will be sold about 50 % of water from basins (225.000 cm) at a price of 30 lei/cm for irrigations and livestock breeding. So, from water selling during 6 years it results an amount of 40.500 lei.
- Reed selling. It can start with the autumn of 2016, when the water reserve basins will be naturalized (a reed belt of 20-30 m, about 20t/year at 1 lei/kg). It results an income of 80.000 lei from reed selling in the period of 2016-2019.
- Fish selling. It will be carried out starting with 2015, at the fish market price. Given the increase in weight of each fish species, it is expected a sale of 231 tons of live fish during 2015-2019, according to the table no. 7.

**Table no. 7.** Fish production in the water reserve basins of the "Re-swamping of the Ier Valley system" in the period of 2015-2019

Year	Fish production (t)	lei/kg	Income from fish selling (lei)	Observation

2015	25,7	16,00	411.200	first production year is weaker
2016	51,3	16,00	820.800	normal production
2017	51,3	16,00	820.800	normal production
2018	51,3	16,00	820.800	normal production
2019	51,3	16,00	820.800	normal production
<b>TOTAL 2015-2019</b>	<b>230,9</b>	<b>16,00</b>	<b>3.694.400</b>	<b>normal production</b>

It results, thus, an amount of 3.694.400 lei from fish selling in the period of 2015-2019, of which the most part will be capitalized through the sportive fishing.

As a result, the total income obtained through the project implementation during 2014-2019 is 3.814.900 lei, representing a yearly average of 762.980 lei.

Given the expenditures for the project implementation and for the system maintenance (6.197.443 lei) and the income expected to be obtained in the period of 2010-2019 through the system exploitation (3.814.900 lei), it results that, in 10 years of investment operation, only 61,57 % of it is returned, under ideal conditions. But, due to the fact that the products selling will be not fully completed, given the lack of demand, we could count only on a return of maximum 30,78 % in the first 10 years. It follows that neither for this environment project the cost-profit analysis cannot be applied, the cost-benefit analysis being more suitable, as it also includes ecological benefits.

We also tried to assess the investment efficiency through the method of income substitution through the value of transport expenditures of those interested in this location. But the evaluation is partially because persons are interested only in fishing. Considering 5 persons/day/basin, in total 150 days/year/basin and in average 80 km (for a round trip) to the destination of the fishermen, with a consumption of 7 l of fuel/100 km (5,6 l/80 km) at a price of 4,35 lei, it results:

11 basins x 5 persons/day x 150 days/an x 6 years x 5,6 l fuel x 4,35 lei/l = 1.205.820 lei

However, also this roughly estimation, shows us that the investment and operation expenditures in the period of 10 years provides a return of investment of 26 %. Therefore, in this investment the beneficial ecological effects are prevailing, not those economical.

### Ecological effects

The main ecological aspects are:

- The Ier flow becomes more constant, preventing the threath of Ier river drying in the prolonged periods of drought.
- The clogging of the minor riverbed of Ier will lead to the re-installation of aquatic vegetation associations, acting as biofilters and improving the water quality.
- The ground water will ascend closer to the surface, feeding the roots of plants, inclusively of those domesticated. As a result, the lands from both river banks (at least to 300-400 m distance) will be useful for agriculture. Therefore, the agricultural companies (farms) were willing to provide the required lands for the placement of water reservoirs.
- On the river-which will get a more archaic look (as swamp area) - valuable stagnant fish will be re-installed (carp, crucian, bream etc), improving the fish resources of Ier and the possibilities of income increasing through the sportive fishing.
- Reed areas will become important refuges and shelters for birds and animals, some of hunting value (wild boars, deers, rabbits, and pheasants) or places for migrant birds.

### Investment funding.

The investment holder and beneficiary is Oradea Someș-Crișuri subsidiary of ANIF.

**Funding requirement: 6.227.443,00 lei (TVA inclus).**

The funding is carried out according to the plan from the table no. 8.

No.	Funding source	Contribution (lei)	The share of funding in the total investment (%)

1	Bank loan, of which:	1.485.998,01	
	- Contribution to Structural Fund	50.022,66	
	- Contribution to Environment Fund (25 %)	258.461,18	23,86
	- For VAT	1.147.514,17	
2	State budget allocations, of which:	1.014.950,87	
	- state subsidies	514.950,87	16,37
	- governmental credits	500.000,00	
3	Attracted funds, of which:	3.726.494,12	
	- Structural Fund	2.451.110,58	
	- Environment Fund	775.383,54	59,84
	- LIFE+ Programme	500.000,00	
<b>TOTAL 1-3</b>		<b>6.227.443,00</b>	<b>100</b>

In the period of 2010-2012 no own income is obtained in the hydrographic Ier basin. In order to ensure the compliance with the obligation to contribute with own resources, the Oradea subsidiary of ANIF will provide 1.485.998,01 lei from a bank loan to cover its funding contribution and VAT payment. ANIF Oradea will also contribute to the investment financing with state budget allocations of 16,37 % of the total investment (514.950,87 lei state subsidies and 500.000 lei governmental credits). Over than 59,84 % of the investment represents attracted funds (extrabudgetary) (3.726.494,12 lei), of which: Structural Funds (2.451.110,58 lei), Environment Fund (775.383,54 lei) and funds from LIFE+ Programme (500.000 lei).

It has to be mentioned that the contribution of population is missing from the project funding, because it cannot and don't wish to be involved in environment projects.

#### **The project's impact on local development and business environment.**

The project has a large positive impact on the local development and business environment. It consists of following: utilisation of the local labour force (mainly, unemployed) at the system works and exploitation; maintaining a constant flow of the Ier water and a beneficial humidity in air and soil; re-storation of flood (swampy) areas of the Ier Valley, a landscape

attracting a higher number of tourists; maintaining a permanent reserve of water, threatened by drought; ascension of the groundwater closer to the surface; offers cheap water to irrigation and animal drinking; it increases the fish meat consumption in the region, improving the health status of the population.

#### **CONCLUSIONS**

The re-swamping system on the Ier Valley is a necessity and a way to return to the initial status of nature, by providing a plus of natural resources.

The system is a multifunctional one, providing ecological benefits (constant flow, fish resources, ascension of groundwater closer to the surface, re-installation of aquatic vegetation) as well as economical advantages (from fish, reed and vegetable selling).

The re-swamping investment cannot be analyzed through the method of cost-profit, but through methods of ecological cost-benefits, as its payment takes a longer period of time.

The system solves only partially the ecological reconstruction on Ier, being necessary a huge projects portfolio for which is not possible to access the necessary financial funds.

As the majority of actors of ecological restoration have poor financial resources, their funding is based mainly on accessing Community Funds.

Local economical agents and population are not aware of the necessity to contribute with their own resources at environment investments.

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