



## **LOGISTICS AND MANAGEMENT OF TRANSPORT AND HANDLING OPERATIONS IN WASTE ECONOMY**

### **LOGISTIKA U FUNKCIJI TRANSPORTA I KORIŠĆENJA OTPADNIH MATERIJA**

Peter BINDZÁR, Ján SPIŠÁK

Technical University of Košice, Košice, Slovakia

**Abstract:** This contribution is orientated on description of waste economy in the region of Rožňava. The region consists of following villages: Betliar, Gemerská Poloma, Henckovce, Nižná Slaná, Gočovo, Vlachovo, Vyšná Slaná, Rejdová and Dobšiná. Insufficient utilizing of the economical potential of the waste, significant transportation costs or storage costs influence the expansion of the region in a negative way. Ecologically applicable and economically profitable handling with the waste isn't possible today without using the philosophy of material flow control, e.g. without using logistics. In this contribution there is presented the scheme to make the transport and handling with the waste more effective by application of micro logistics.

**Key words:** municipal solid waste, logistics, transportation costs, waste disposal

**Apstrakt:** U ovom radu dat je prikaz sistema odlaganja i korišćenja otpadnih materija koji se primenjuje u oblasti Rožňava i to u sledećim mestima: Betliar, Gemerská Poloma, Henckovce, Nižná Slaná, Gočovo, Vlachovo, Vyšná Slaná, Rejdová i Dobšiná. Može se reći da je ekonomski razvoj ove oblasti značajno ugrožen kako zbog nedovoljnog iskorišćenje otpada odnosno njegovih ekonomskih potencijala tako i zbog velikih troškova vezanih za transport i odlaganje otpadnih materija. Ekološki prihvatljiv i ekonomski rentabilan metod korišćenja otpada u današnje vreme nije moguće bez primene logistike, odnosno bez planiranja i upravljanja materijalnim tokovima. U radu je dat primer korišćenja mikro logistike u cilju racionalnijeg i efikasnijeg transporta i korišćenja otpadnih materija

**Ključne reči:** komunalni čvrst otpad, logistika, troškovi prevoza, odlaganje otpada

## **1 INTRODUCTION**

The rapid growth of human population as well as non-limited economic growth especially in the states with developed economics (like countries of reach North) results in breaking the stability of all-planetary systems. Problems of environmental damage are thanks to the human activity acting more globally. Basic global problems, which draw all people are following [2]:

## **1 UVOD**

Ubrzan rast stanovništva i ekonomski progres, naročito u zemljama sa razvijenom privredom (kao što su zemlje bogatog Severa i Zapada) dovode do narušavanja stabilnosti različitih eko sistema. Problem ugrožavanja životne sredine zahvaljujući ljudskom delovanju postaje globalan. Osnovni globalni problemi koji su zajednički za celu društvenu zajednicu su sledeći [2]:

- global warming,
- ozone layer weakening in stratosphere,
- acidic depositions,
- biological diversity threat.

Although it is not typically global problems there are some other questions that are also substantial and that have long-term effect:

- soil degradation,
- water contamination (oceans, rivers, underground waters),
- waste production (quantity, toxicity, radioactivity).

Human activities leading to waste production and its usage (industry, agriculture, generation of electricity,...) can be compared to the metabolic process. The energy and mass input the system and after it is utilized its going out of the system. Following the basics of physical rules the mass or energy don't rise nor fade from nothing. During the mass transformation (on exploitation, processing, producing, transport,...) and at the end of its life all used goods become to be a waste. For market environment the waste disappear but in fact it is not really fade away. As the human population grow and are able to utilize more substances they are able to produce more waste. Not only municipal waste grows up in its volume and weight but the toxic waste is growing too.

It is very hard to suppose that consumer way of life will have a downward trend so it is necessary to look for methods that can utilize, process and transport the waste in more efficient way. Tools of logistics are applicable for this problem so that it is possible make the process of handling with waste more effective.

## **2 WASTE ECONOMY CONTROL AND PERMANENT SUSTAINABLE DEVELOPMENT**

The principles of permanent sustainable development are good applicable in the field of waste economy control. These principles prefer preventive methods prior to the correction proceedings. It is also very important to control the waste economy during the product life cycle.

The effort for permanent sustainable development of the society is based on doing

- globalno zagrevanje,
- slabljenje ozonskog omotača,
- kiseli talog,
- ugrožena biološka raznovrsnost.

Postoje određeni problemi, koji iako nisu tipično globalni predstavljaju takođe veoma veliku opasnost i imaju dugoročne posledice:

- degradacija zemljišta,
- zagađenje vodenih površina (okeani, reke i podzemni vode),
- proizvodnja otpada (količina, toksičnost i radioaktivnost).

Ljudske aktivnosti koje utiču na proizvodnju i korišćenje otpada (industrija, poljoprivreda, proizvodnja energije itd.) mogu se uporediti sa metaboločkim procesima. Masa i energija koje ulaze u sistem moraju biti izbačeni iz njega posle iskorišćenja. U skladu sa osnovnim zakonima fizike masa ili energija se ne gube odnosno ne nestaju. U procesu transformacije mase (eksploatacija, prerada, proizvodnja, transport itd.) upotrebljene materije u krajnjoj instanci postaju otpad. Za tržiste ove materije ne postoje, ali one u suštini nisu nestale. Uz porast stanovništva raste i stepen potrošnje korisnih supstanci, ali i stepen proizvodnje otpadnih materija. Nije samo količina i obim komunalnog otpada u porastu, već dolazi i do porasta toksičnog otpada.

Teško je predpostaviti da će potrošački način života prestati da se razvija u uzlaznoj putanji, pa je zbog toga neophodno pronaći efikasnije i delotvornije metode za transport i iskorišćenje otpadnih materija. Logistička sredstva mogu dobro poslužiti za rešavanje ove problematike, odnosno za uspešnije rukovanje otpadnim materijama.

## **2 UPRAVLJANJE OTPADOM I NEPREKIDNI ODRŽIVI RAZVOJ**

Principi neprekidnog održivog razvoja se mogu uspešno primeniti na sistem upravljanja otpadom. Ovi principi daju prednost preventivnim metodama u odnosu na korektivne mere. Takođe je veoma važno uspostaviti kontrolu nad sistemom upravljanja otpadom još u toku životnog ciklusa proizvoda.

Napor društva da uspostavi neprekidni održivi razvoj zasniva se na vršenju delatnosti koje nisu

activities that are not only ecological but also economical. The basic opinion to get permanent sustainable development is to connect ecological, economical and social approaches [4]:

**Ecological approach** requires respecting of biosphere rules like preservation of biodiversity, necessary stability in global systems of biosphere and so one. Very important is prevention against negative impact on environment, introducing new technologies, utilization of new mineral and energetic resources, maximal support of waste recycling. To do all these things it is necessary to save natural resources. To do so it is necessary for human population be more sensitive against environmental as well as they need to prefer environmentally suitable products etc..

**Economical approach** is focused on effective utilization of company's capital. The basic rule for introducing new environmental technologies is its economic effectiveness. That's mean what is ecologically applicable is also economically profitable. The approach requires some benefits at the beginnings like tax relief or entry investments but meaning long-term period it is important real economic efficiency.

**Social approach** urges on human relations, cooperation in many fields. Effective utilization of environmental tools depends on how people look at the environmental problems. Education and pedagogy is very important for society in order to improve their knowledge about environment.

The individual ideas for realization of permanent sustainable development are not single-valued. At present, one side of environmentalists and politicians prefer the need of turning the human attitudes towards to the environmental. It is the way called "depth ecology". The second way – technocratic is based on solving problems technically. It seems that the right way is a combination of all described approaches as well as the responsibility taking of present time for the future in all fields.

One of the basic principles of strategy of waste economy management is a closeness to waste, e.g. the place where the waste accumulates and where it is recycling. **Transport-Logistics operations** are an important part of waste economy and ones of the most significant cost

samo ekološki prihvatljive već i ekonomski rentabilne. Naime. Osnovni princip neprekidnog održivog razvoja je da objedini ekološki, ekonomski i društveni pristup (4):

**Ekološki pristup** zahteva poštovanje zakona biosfere kao što je očuvanje biloške raznovrsnosti, neophodne stabilnosti globalnih sistema biosfere itd. Veoma važan faktor je zaštita životne sredine od negativnog uticaja novih tehnologija, eksploracija novih materijala i energetskih resursa i maksimalna podrška u recikliranju otpada. Da bi se sve ovo postiglo neophodno je prvenstveno očuvati prirodne resurse. U tom cilju potrebno je podići svest celokupnog društva na viši nivo tako da postane osjetljivije na pitanja ugrožavanja životne sredine.

**Ekonomski pristup** zasniva se se na što efikasnijem korišćenju finansijskih resursa. Osnovno pravilo za uvođenje novih, ekološki prihvatljivih tehnologija je njihova rentabilnost. Drugim rečima ono što je ekološki prihvatljivo treba da bude i ekonomski isplativo. Ovakav pristup zahteva u početnoj fazi određene beneficije kao što su poreske olakšice, investicije, i slično ali se dugoročno moraju pokazati kao rentabilne u realnim tržišnim uslovima.

**Društveni pristup** poziva se na međuljidske odnose i saradnju na mnogim poljima. Efikasno korišćenje raspoloživih sredstava za zaštitu životne sredine zavisi od načina na koji ljudi pristupaju ovom problemu. Edukacija i vaspitanje predstavljaju veoma važne faktore za unapređenje nivoa znanja i svesti o potrebi za očuvanjem životne sredine.

Individualne ideje za realizaciju neprekidnog održivog razvoja se ne zanemaruju. U sadašnje vreme, jedan deo ekologa i političara daje prednost humanom pristupu koji se drugačije naziva „dubinska ekologija“. S druge strane postoji i takozvani „tehnokratski pristup“ koji nastoji sve probleme da reši sa tehničke strane. Čini se da je najispravniji pristup kombinacija ova dva principa kao i preuzimanje odgovornosti za posledice koje trenutne aktivnosti mogu imati u budućnosti.

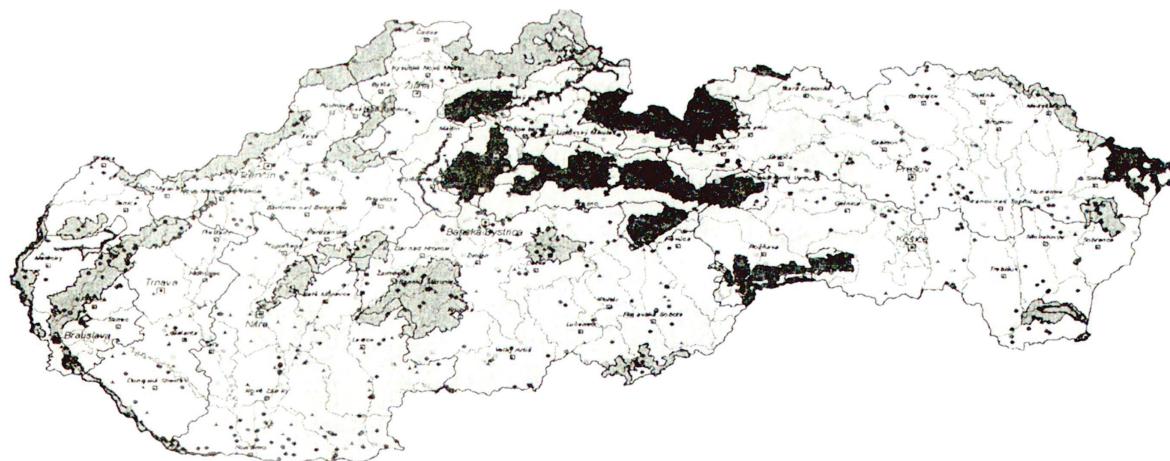
Jedan od osnovnih principa strategije upravljanja otpadom je blizina lokacije, odnosno mesto odlaganja i recikliranja otpada. **Procesi transportne logistike** predstavljaju važan segment upravljanja otpadom i jedna od najznačajnijih stavki u ukupnim troškovima. I pored velikog značaja logistike u ovoj oblasti

items. Even though the logistics is very important in waste economy, there is only a small part of interest about it. Logistics costs can reach more than 50% of total costs on waste economy.

There is not possible to use the rule "environmentally applicable – economically profitable" without using logistics principles like system approach, coordination, method or global optimisation.

### **3 DESCRIPTION OF WASTE ECONOMY IN THE UPPER GEMER REGION**

Region to be described (*Figure 1*) is located at South part of central west Carpathian Mountains, at the border of 2 areas - Slovenské Rudohorie and Slovenský kras. The region is horizontally and vertically rugged and its height above sea level is from 200m up to 1476m. In addition, two conservation areas are in the Rožňava region - National park Slovenský raj (north-east) and Protected Landscape Area – Biosphere reservation Slovenský kras (south-east). Slovenský kras was certified as a biosphere reservation in the year 1977. It was based within the program MaB – Man and Biosphere declared with UNESCO.



*Figure 1 Location of Upper Gemer region on the map of Slovak republic (source: [www.sazp.sk](http://www.sazp.sk))*  
*slika 1 Lokacija regiona Gornji Gemer na mapi Slovačke Republike (izvor [www.sazp.sk](http://www.sazp.sk))*

For region's waste economy there is typical minimal recycling of waste at present. Only the metal and paper recycling are worthy of note. Other waste compounds are stored outside the region at the waste dumps and together with domestic refuse. Insufficient utilizing of waste's economic potential, large transportation costs and storage costs negatively influence the region development. In the region there was about 1998 t

interesovanje za njenu primenu je veoma malo. Naime, troškovi logistike mogu dostići i do 50% od ukupnih troškova upravljanja otpadom.

Međutim, jednostavno je nemoguće ostvariti cilj „ekološki prihvatljivo i ekonomski rentabilno“ bez primene logističkih principa kao što su sistemski pristup, koordinacija, metoda ili globalna optimizacija.

### **2 PRIKAZ PROCESA UPRAVLJANJA OTPADOM U REGIONU GORNJI GEMER**

Pomenuti region (Slika 1) nalazi se u južnom delu zapadnih Karpatskih planina na granici dve oblasti; Slovenské Rudohorie i Slovenský kras. Teren u ovom regionu je i horizontalno i vertikalno neujednačen, pa se nadmorska visina kreće od 200m do 1476m. Osim toga u ovom regionu nalaze se i dve zaštićene oblasti i to oblast Rožňava u Nacionalnom parku Slovenský raj (u severoistočnom delu) i oblast Zastićenog prirodnog predela – Rezervat biosfere Slovenský kras (u jugoistočnom delu). Oblast Slovenský kras je dobila sertifikat „rezervata biosfere“ 1977 godine i to u okviru programa MaB (Čivek i Biosfera) koji je objavio UNESCO.

Što se tiče upravljanja otpadom, trenutno u ovom regionu recikliranje otpadnih materija je na minimalnom nivou. Recikliranje metala i papira su jedini vredni pomene. Ostali vidovi otpada odvoze se izvan granica regiona i odlažu na deponije zajedno sa komunalnim otpadom. Nedovoljno iskoriscenje ekonomskih potencijala, veliki transportni troškovi i troškovi odlaganja negativno utiču na razvoj ove regije. U ovoj

of municipal waste per year 2004. A figure 2 shows a percentage of individual waste elements in the region that is described.

oblasti 2004 godine proizvodnja komunalnog otpada dostigla je količinu od 1998t. Slika 2 prikazuje procentualno učešće pojedinačnih otpadnih materija u ovoj oblasti.

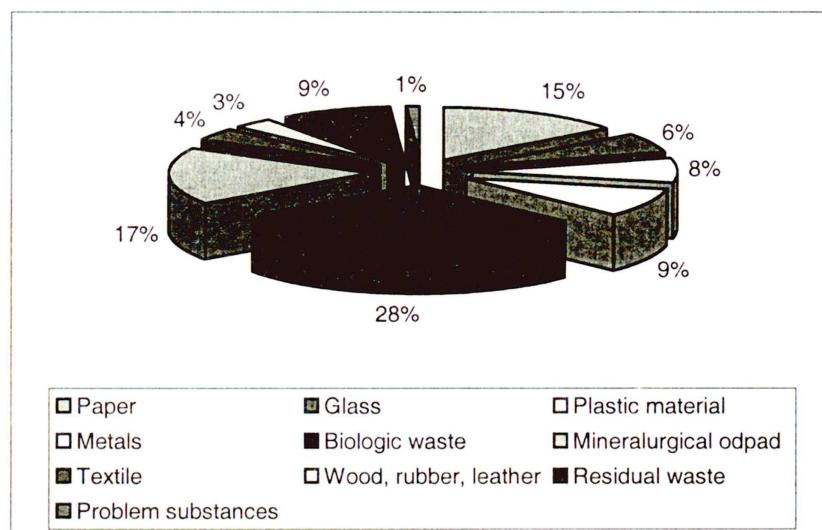


Figure 2 Percentage diagram of individual elements of municipal waste in year 2004  
slika 2 Dijagram procentualnog učešća pojedinačnih otpadnih materija 2004 godine

The following table (table 1) shows an average amount of some commodities per month. The elements in the table are considered to be separated.

Tabela koja je data u nastavku (tabela 1) prikazuje prosečnu mesečnu količinu nekih komponenti. Sve komponente razmatrane u ovoj tabeli posmatraju se ponaosob.

Table 1 Average amount of separated elements per month in tons (2004)

Tabela 1 Prosečna mesečna količina pojedinih elemenata izraženo u tonama (2004)

Village	Average amount of individual elements in tons			
	Paper	Glass	Plastic	Metals
Betliar	1,5	0,6	0,76	1
Dobšiná	11	4,5	5,6	6,7
Gem. Poloma	4,9	2	2,5	3
Gočovo	0,5	0,2	0,3	0,3
Henckovce	1,6	0,6	0,8	1
Nižná Slaná	2,3	0,9	1,2	1,4
Rejdová	0,7	0,3	0,3	0,4
Vlachovo	1,4	0,6	0,7	0,9
Vyšná Slaná	0,6	0,3	0,3	0,4
<b>Total:</b>	<b>24,5</b>	<b>10</b>	<b>12,5</b>	<b>15,1</b>

#### 4 COST ITEMS IN WASTE ECONOMY

It is always important to have a respect to economy when doing rationalization of waste economy. Therefore it is necessary to know individual cost items that input the transport or manipulation process or process of pre-processing the waste. Considering the region that is described there is following cost items:

#### 4 TROŠKOVI UPRAVLJANJA OTPADOM

Za racionalizaciju upravljanja otpadom neophodno je uzeti u obzir sve ekonomski aspekti tog procesa, odnosno treba sagledati sve pojedinačne stavke koje predstavljaju ulazne elemente procesa transporta, manipulacije ili preliminarne prerade otpadnog materijala. Imajući u vidu prethodno pomenuti region treba razmotriti sledeće stavke:

## Flat costs

Flat costs consists of:

- yearly rent of the hall,
- annual salary + taxes,
- personal protective means for the employees (working clothes, gauntlets)
- press equipment to paper and plastic,
- auxiliary material (wire, scissors),
- working tools.

## Transportation costs

While the flat costs are the same for every village the transportation costs vary from village to village so it is necessary to determine transport cost for every single village. It is because the number of transport units, number of kilometres and time of waste haulage is different for every single village.

Transportation costs include:

- costs per kilometre,
- wage costs to driver (driver's hour-wage).

## 5 IMPROVEMENT PROPOSALS FOR THE SYSTEM OF TRANSPORTATION AND HANDLING WITH THE WASTE IN UPPER GEMER REGION

Poor waste economy in the Upper Gemer region can be improved by increasing the ecological privity of the population, by building new processing plants or using logistics while managing waste economy. In order to optimise collection and transport of the waste, there were proposed two methods:

### Method A

Method A is based on the separated waste collecting in every single village of the region. The elements that are separated covers paper, glass, plastic, metals and the other municipal waste. Villages will realize the collection and transport. Proposed time period of waste collecting is once a month for all elements (paper, glass, ...).

Table 2 shows the numbers we can reach by application of method A. From the table it is clear that positive numbers (profit) reach only Gemerská Poloma and Dobšiná [1]. It is because profit or loss depends on waste quantity. More waste makes more money. Of course, method A

## Osnovni troškovi

Osnovne troškove čine:

- godišnji zakup prostora,
- lični dohoci i porezi na godišnjem nivou,
- sredstva lične zaštite za zaposlene (radna odela, rukavice)
- oprema za presovanje papira i plastike,
- pomoćni materijal (žice, makaze),
- alat.

## Transportni troškovi

Osnovni troškovi su manje više isti u svakom od navedenih mesta, dok transportni troškovi variraju od mesta do mesta pa je potrebno precizno definisati troškove transporta za svako pojedinačno mesto s obzirom da je broj transportnih jedinica, kilometraža i vreme transporta različito za svaki od ovih mesta.

Transportni troškovi obuhvataju:

- troškove po kilometru
- troškovi dnevnička za vozače (satnice)

## 2 PREDLOG ZA UNAPREĐENJE TRANSPORTA I RUKOVANJA OTPADOM U REGIJI GORNJI GEMER

Veoma nerazvijen sistem upravljanja otpadom u regiji Gornji Gemer može se značajno unaprediti podizanjem nivoa ekološke svesti stanovništva, izgradnjom novih prerađivačkih pogona ili primenom logistike za upravljanje procesima. Za optimizaciju sakupljanja i transporta otpada predložene su dve metode.

### Metod A

Metod A zasniva se na selektivnom sakupljanju otpada i svakom pojedinačnom mestu u regionu. Sakupljaju se sledeće komponente: papir, staklo, plastika, metal i drugi komunalni otpad. Svako mesto je zaduženo za organizaciju sakupljanja i prevoza. Predloženi vremenski period za sakupljanje otpada je jednom mesečno za sve navedene komponente (papir, staklo itd.).

Tabela 2 prikazuje količine koje se mogu ostvariti primenom metode A. Iz tabele jasno se vidi da pozitivne rezultate (profit) mogu ostvariti samo Gemerská Poloma i Dobšiná [1]. Naime, dobit ili gubitak direktno zavisi od sakupljene količine otpada, odnosno više otpada stvara veću dobit

is economically unprofitable so it is necessary to look for more economic solutions. For details about method A see literature [1].

. Naravno metod A nije ekonomski opravdan pa je neophodno pronaći rentabilnija rešenja. Opširniji podaci o metodi A mogu se naći u literaturi [1].

*Table 2 Yearly costs comparison  
Tabela 2 Poređenje godišnjih troškova*

A village	Expenses [Sk]	Earnings [Sk]	Profit [Sk]
<b>Betliar</b>	591 380	192 600	-398 780
<b>Dobšiná</b>	907 700	1 695 788	<b>788 088</b>
<b>Gem. Poloma</b>	686 780	755 128	<b>68 348</b>
<b>Gočovo</b>	500 300	67 447	-432 853
<b>Henckovce</b>	560 060	245 180	-314 880
<b>Nižná Slaná</b>	630 620	356 865	-273 755
<b>Rejdová</b>	514 820	101 414	-413 406
<b>Vlachovo</b>	529640	219 235	-310 405
<b>Vyšná Slaná</b>	511 700	96 211	-415 489
<b>Total:</b>	<b>5 433 000</b>	<b>3 729 868</b>	<b>-1 703 132</b>

## Method B

Because by the previous method only 7 of 9 villages are loss making, there was proposed another method (method B). Method B considers more efficient utilization of devices, halls or employees. The method is based on creating of 3 collecting centres instead of 9 in previous method. The centres are as following:

1. **Dobšiná** - created for villages Dobšiná, Rejdová, Vyšná Slaná
2. **Nižná Slaná** - created for villages Vlachovo, Gočovo, Nižná Slaná
3. **Gemerská Poloma** - created for villages Henckovce, Gemerská Poloma, Betliar

## Flat costs for B method

Each of the collecting centres needs a storage place for the waste. The paper elements require a closed storage place that is important for mechanization as well. Unused agricultural buildings are best suitable to store waste elements like paper. In addition, each collecting centre needs press equipment for paper and plastic. Glass will be stored on containers that are used until now. The metals will be stored on the open storage place. Employees will be hired from the National Employment Agency. It is because their salary can be refunded from the sources fixed at public utilities. The manager will be a member of municipal office and his salary would be 8.000,- Sk + 3040,- Sk (tax to insurance office). Flat costs are shown in detail in the table 3.

## Metoda B

S obzirom da bi primena metode A pravila gubitke u 7 of 9 navedenih mesta, predložen je drugačiji metod (metod B). Metod B uzima u obzir efikasnije korišćenje opreme, prostora i zaposlenih. Metod se zasniva na izgradnji 3 centra za sakupljanje otpada umesto 9, kako je predloženo u prethodnoj metodi. Ti centri su:

1. **Dobšiná** - za mesta Dobšiná, Rejdová, Vyšná Slaná
2. **Nižná Slaná** - za mesta Vlachovo, Gočovo, Nižná Slaná
3. **Gemerská Poloma** - za mesta Henckovce, Gemerská Poloma, Betliar

## Osnovni troškovi B metode

Svaki od pomenutih centara mora obezbediti skladišni prostor za otpadni materijal. Za papirne komponente potrebno je obezbediti zatvoreno skladište, koje je potrebno i zbog mehanizacije. Za ovu svrhu najbolje je koristiti poljoprivredne objekte koji su van upotrebe. Osim toga svaki sakupljački centar mora imati prese za papir i plastiku. Staklo će se skladištiti u kontejnere koji su i do sada korišćeni. Metalni otpad se može čuvati i u otvorenim skladišnim prostorima. Za angaživanje radnika koristiće se usluge Državnog zavoda za zapošljavanje, jer se na taj način njihove plate mogu refundirati iz sredstava javnih komunalnih preduzeća. Direktor ovog pogona bi se angažovao iz opštinskog nadleštva i njegova plata bi iznosila 8.000,- Sk + 3040,- Sk (porez i osiguranje). Osnovni troškovi detaljno su prikazani u tabeli 3.

*Table 3 Determination of flat costs*  
*Tabela 3 Definisanje osnovnih troškova*

Cost item	Value
Yearly rent of the hall, 10x15m (value 250,- Sk/m <sup>2</sup> )	37.500,- Sk
Annual salary of the manager	132.480,- Sk
Personal protective means for the employees (working clothes, gauntlets)	3.200,- Sk
Press equipment for paper and plastic	400.000,- Sk
Auxiliary material	12.000,- Sk
Working tools	16.000,- Sk
<b>Total flat costs:</b>	<b>601.180,- Sk</b>

Flat costs in previous method (Method A) were determined by the same way; the difference in case of B method is that press equipment has bigger capacity and power. It is because in B method it is supposed more of waste per one press machine. Flat rate is determined in relation to the collective farms, legislation about taxes as well as in relation to prices of Notes, s.r.o. Slavošovce.

#### Transportation costs for B method

The B method considers 3 collection centres. Transportation costs need to be determined for each centre. For example, table 4 shows transportation cost items for the Dobšiná centre. For better view the transportation costs are divided into 2 fields.:

- haulage costs of waste from the villages to the appropriate centre,
- annual transportation costs of the centre. The costs are necessary for waste transport from the collecting centre to processing plant,

Osnovni troškovi prethodne A metode određeni su na isti način, razlika je u tome što prese prikazane u B metodi imaju veće kapacitete i snagu, jer B metoda predpostavlja veću količinu otpada po svakoj presi. Osnovna cena određena je u odnosu na sakupljačke punktove. Zakonska regulativa vezano za poreze i cene data je u Napomenama, s.r.o. Slavošovce.

#### Transportni troškovi B metode

Metoda B uzima u obzir 3 sakupljačka centra. Za svaki cenar treba posebno odrediti transportne troškove. Na primer, tabela 4 prikazuje transportne troškove po stawkama za centar Dobšiná. Radi boljeg pregleda transportni troškovi su podeljeni u dve grupe:

- troškovi prevoza otpada od mesta do odgovarajućeg centra,
- godišnji transportni troškovi centra. Uzimaju se u obzir troškovi od sakupljačkog centra do pogona za preradu otpada,

*Table 4 Transportation costs of the Dobšiná centre*  
*Tabela 4 Transportni troškovi za centar Dobšiná*

Cost item	Value
Haulage costs for Dobšiná village	144.000,- Sk
Haulage costs for Vyšná Slaná village	126.720,- Sk
Haulage costs for Rejdová village	135.360,- Sk
<b>Total haulage costs for the Dobšiná centre:</b>	<b>406.080,- Sk</b>

Haulage costs in table 4 were calculated with relation to the actual kilometres as well as from freight rate of public transport operators. Because the waste is not processed in the collecting centres (just stored) it is necessary to carry out its transport to the processing plant several times a year. Paper or plastic are going to be transported to Slovmag, a.s. company. The metals or glass will be sold to "primary commodities operator" in Dobšiná so that costs to transport are saved. In the future we consider that metals can be sold to U.S. Steel, s.r.o. Košice company. Considering the shipping weight of the cargo truck (6 tons) as well as average amount of the waste produced in 1 month in Dobšiná, Rejdová, Vyšná Slaná villages (table 1) it is possible to compute annual transportation costs for the Dobšiná centre (table ).

Troškovi prevoza prikazani u tabeli 4 izračunati su u odnosu na postojeću kilometražu i na osnovu cene javnog prevoza. S obzirom da se otpad ne prerađuje u sakupljačkom centru (već samo skladišti) neophodno je obezbediti transport do prerađivačkog pogona i to nekoliko puta godišnje. Za transport papira i plastike zadužena je kompanija Slovmag, a.s. Metal i staklo biće prodavano „primarnim trgovcima“ u centru Dobšiná radi uštede na transportu. U budućnosti razmatra se mogućnost plasiranja metalnog otpada kompaniji U.S Steel, s.r.o. Košice. S obzirom da je nosivost teretnog kamiona 6 tona jednaka prosečnoj mesečnoj količini otpada u mestima Dobšiná, Rejdová, Vyšná Slaná (tabela 1) moguće je izračunati godišnje transportne troškove za centar Dobšiná (tabela 5).

*Table 5 Annual transportation costs for the Dobšiná centre  
Tabela 5 Godišnji transportni troškovi centra Dobšiná*

Cost item	Value
Transport cost to Slovmag, s.r.o. and back - 1 drive 148 km x 30 Sk/km	4.440,- Sk
Driver's hour-wage 600,- Sk/hour x 2 hours	1.200,- Sk
<b>Costs for 1 drive:</b>	<b>5.640,- Sk</b>
Number of transportation units per year (paper + plastic)	38
<b>Total annual costs:</b>	<b>214.320,- Sk</b>

#### Total annual costs for the Dobšiná centre

Total annual costs for the Dobšiná centre (table 6) can be calculated as a sum of flat costs, haulage costs and yearly transportation costs as well as the costs to the litter bags (its price is determined by HIBEX, s.r.o. company).

#### Ukupni transportni troškovi centra Dobšiná

Ukupni godišnji troškovi centra Dobšiná (tabela 6) mogu se izračunati kao zbir osnovnih troškova, troškova prevoza i godišnjih transportnih troškova i troškova za vreće za otpatke (njihovu cen odredila je kompanija HIBEX, s.r.o.).

*Table 6 Total annual costs for the Dobšiná centre  
Tabela 6 Ukupni godišnji troškovi centra Dobšiná*

Cost item	Value
Haulage costs	406.080,- Sk
Yearly transportation costs to processing plant	214.320,- Sk
Flat costs	601.180,- Sk
Price for litter bags	270.000,- Sk
<b>Total annual costs:</b>	<b>1.491.580,- Sk</b>

In order to make some profits it is necessary to make some business with individual waste elements, for example by its selling to another person. For the Dobšiná centre the earnings are as the following (table 7).

All other centres are calculated by the same way – see the results in *table 8*

U cilju ostvarivanja profita neophodno je poslovati i sa individualnim sektorom, odnosno prodavati otpad drugim licima. Centar Dobšiná ostvario bi sledeću dobit (tabela 7).

Za sve ostale centre kalkulacije su vršene na isti način. Vidi rezultate prikazane u tabeli 8.

*Table 7 Hypothetic annual earnings from selling the waste elements*  
*Tabela 7 Hipotetička godišnja dobit od prodaje pojedinih komponenti*

Commodity	Quantity	Price	Value
Paper	148 t	2.500,- Sk/t	370.000,- Sk
Plastic (mix)	74 t	6.000,- Sk/t	444.000,- Sk
Glass	61 t	600,- Sk/t	36.600,- Sk
Metals	90 t	4.000,- Sk/t	360.000,- Sk
Saving earnings for the waste	373 tons x 1.836,- Sk		684.828,- Sk
<b>Total earnings:</b>			<b>1.895.428,- Sk</b>

*Table 8 Comparison of earnings and expenses for all centres*  
*Tabela 8 Poređenje dobiti i troškova za sve centre*

Centre	Expenses [Sk]	Earnings [Sk]	Profits [Sk]
Dobšiná	1.491.580	1.895.428	403.848
Nižná Slaná	1.008.140	679.288	-328.852
Gemerská Poloma	1.107.860	1.245.384	137.524
<b>Total:</b>	<b>3.607.580</b>	<b>3.820.100</b>	<b>212.520</b>

## 6 CONCLUSION

The new concept introduced by this contribution is useful for the waste economy in the Upper Gemer region. Ecologic, economic and social side of the problem is considered in the concept. Here are two makrologistics proposals in the contribution. The first one expects that collecting centre be built in every single village. Table 2 shows the numbers we can reach by application of the first proposal. From the table it is clear that positive numbers (profits) reach only Gemerská Poloma and Dobšiná. Of course, this way is economically unprofitable so it is necessary to look for more economic solutions.

The second one (B method) is based on building just 3 collecting centres instead of 9 in previous method. By application B method there is only Nižná Slaná centre with the loss (*table 8*). By waste processing in Želba, a. s. Nižná Slaná we can reduce expenses for the transport and so make a profit even in this centre. Then all of the

## 6 ZAKLUČAK

Koncepcija koja je izložena u ovom radu može biti od velike koristi za granu privrede koja se bavi otpadom u regionu Gornji Gemer. Koncepcija obuhvata ekološki, ekonomski i društveni aspekt ovog problema i dva makrologistička predloga. Prvi podrazumeva izgradnju sakupljačkih cenara u svakom mestu, a u tabeli 2 prikazani su numerički rezultati koji se mogu postići primenom ovog rešenja. Iz tabele se jasno vidi da se pozitivni rezultati (profit) mogu postići samo u mestima Gemerská Poloma i Dobšiná.. Naravno, ovakvo rešenje nije profitabilno, pa je potrebno naći drugo rentabilnije.

Drugi (B metod) zasniva se na izgradnji 3 sakupljačka centra umesto 9, kao u prethodnom slučaju. Primenom B metode gubici se javljaju samo u centru Nižná Slaná (tabela 8). Međutim, ukoliko se otpad iz Nižná Slaná prerađuje u centru Želba, a. s. mogu se smanjiti troškovi i ostvariti dobit čak i u ovom slučaju, što znači da

3 centres will be profitable. By using logistics principles it is possible to make the waste economy more efficient as well as more effective.

će sva tri centra ostvarivati profit. Primenom logističkih principa moguće je u ovoj oblasti ostvariti bolje rezultate i pozitivnije efekte.

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