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AN ANALYSIS OF BRIQUETTE VALUE CHAIN AT THE LIMSKO FOREST AREA

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Abstract: Value creation represents an increase in the value of assets in the manufacturing process. Business processes that lead to value creation can be presented as a value chain. For wood products, total value creation takes place in the complex processes of production and exchange between forestry and timber industry. The research on the use of biomass for energy purposes is increasing in recent decades. Within the research on value chain, in our country were, to less extent were represented those related to woody biomass products. In this sense, the aim of the research is to determine the organization of woody biomass products (briquettes) value chain and its analysis in the Limsko forest area. A "door-to-door" survey was used as a research technique. Data collection was conducted in the period from April to May of 2013. In total, 19 representatives of enterprises, which are participants in the woody biomass products value chain in the Limsko forest area were surveyed. Manufacturing enterprise, located in Nova Varoš, was analysed as the main participant in this chain. In addition, its suppliers (15), wholesaler (1), retailer (1), and consumer (1) were analysed. The manufacturing enterprise exclusively used raw material produced in sawmills. The results indicate that an increase in value occurs, primarily, during the transportation of raw materials from sawmill to the manufacturing enterprise. The next increase in value occurs during the storage of raw materials within the manufacturing enterprise and with the emergence of new stages in the production process, as well as during the transportation of products to the wholesaler, retailer and consumer.

Keywords: organization, value chain, woody biomass

INTRODUCTION

The value chain is the concept of business management, which was first described and popularized by Michael Porter in 1985. It consists of *"...a series of interconnected activities that are needed to convert the raw materials into the final product. Each of these activities increases the value of the product. The emphasis is on the value that is added in each of the business activities"* (Nonić, 2015).

Value can be defined as the difference between the value of the final product for the final consumer and all the efforts that are realized in the entire value chain, with one goal: to fulfil consumer demands (Aćimović, 2006). In this respect, value creation represents *"...an increase of the value of goods in the production process"* (Schmithüsen et al., 2006). Business activities that lead to value creation can be represented as a value chain (Schmithüsen et al., 2006).

The analysis and understanding of specific value chains in enterprises are a precondition for successful adaptation of business processes and

activities to demands of the market and environment. This type of analysis allows a comprehensive analysis of the enterprise according to its strategic elements regardless of the specifics of the sector (Schmithüsen et al., 2006; Nonić, 2015).

The economic importance of forestry is, to a large extent, defined by the wood value chain. Forestry contributes to sustainable development goals with the production and processing of wood as a renewable raw material. The starting point of the chain is primary production in forestry, and it is followed by processes within the different branches of the wood industry (Schmithüsen et al., 2014).

In countries with developed wood industry, the tendency is to largely use wood waste1 for energy purposes. The most commonly used forms of woody biomass2 in the energy sector are pellets, briquettes and wood chips (Jovanović, Parović, 2009).

The process of producing briquettes is divided into several phases. The phases that precede the production of briquettes include procurement and preparation of raw materials. The phases after production also have an impact on the value of briquettes, and include storage, transportation, and sale (Musić, 2013). The reason for this is that *"...the value for the consumer is not only created in the value chain of specific business units, but also in the value chains of suppliers, distribution channels and consumers"* (Kaličanin, 2006).

The aim of the research is to determine the organization of woody biomass products (briquettes) value chain and its analysis in the Limsko forest area (FA). The purpose to create objective expert basis for further study on the specific business processes within the briquettes value chain, in order to improve the effects of doing business in this sector. The **subject** of this research are basic information about the production and sales of briquettes, within the woody biomass manufacturing enterprise, located in the territory of the Limsko FA. In this sense, the following information were included: the total volume of procured raw materials, the total volume of production, as well as the total value and volume of selling. In addition, data on the suppliers of raw materials, as well as the wholesaler, retailer, and consumer were used for research purposes.

The research is related to the **territory** of Limsko FA, which includes the municipalities of Nova Varoš, Priboj and Prijepolje. This FA was chosen due to its exceptional wealth in forest resources. The forest cover in the municipality of Priboj is 55.0%, in Prijepolje is 53.2%, and in Nova Varoš it is 38.6% (Glavonjić et al., 2009), which is significantly higher than the Serbian average (29.1%) (Banković et al., 2009). In addition, with the timber volume at the stump of 20.2 million m3, the share of the three municipalities in the total wood volume of forests in Serbia is 5.6% (Glavonjić et al., 2009).

METHODS

The literature distinguishes several methods to analyze the value chain (Kaplinsky, Morris, 2002; Taylor, 2005; World Bank, 2007; Bellù, 2013). However, it is emphasized that any analysis must be tailored to the individual case being investigated. Given these remarks, but also economic, ecological and social specificities of Serbia, the conducted analysis was adapted to the national conditions.

Accordingly, the analysis of the woody biomass products (briquettes) value chain was conducted in two phases:

1. a description and analysis of the value chain organization ("value chain mapping");
2. a description and analysis of the value creation within the chain, with the identification of the key points of increasing the value.

A "door-to-door survey" was used as a research technique for data collection (Aker et al., 2008). Data collection was carried out during 2013, in Nova Varoš, Prijepolje and Belgrade.

1 The term wood waste relates to *"…a piece of wood that cannot be used in further processing for the same purposes"*. However, the wood has many different uses where its rest could be used, which means that the term "waste" can be only used conditionally (Jovanović, Parović, 2009).

2 According to the Law on energy, biomass is *"…the biodegradable fraction of products, waste and residues of biological origin from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste"* (2014).

Enterprises which were the members of the briquettes value chain in the Limsko FA were included in the research. Thus, the research included the following enterprises (in total 19):

1. The manufacturing enterprise3, engaged in the production of briquettes, which is located in the Limsko FA (1);
2. The suppliers of the manufacturing enterprise (15);
3. The wholesaler (1);
4. The retailer (1);
5. The consumer (1).

The following criteria were applied for the sample creation:

1. for supplier selection: the existence of a contract for the delivery of raw materials to the manufacturing enterprise;
2. for retailer and consumer selection: the amount of sold products (more than 100 t of briquettes per year)4.

Accordingly, for the collection of primary data it was necessary to use several types of questionnaires:

1. the questionnaire for suppliers consisted of 43 questions divided into four groups;
2. the questionnaire for a manufacturing enterprise consisted of 62 questions divided into five groups;
3. the questionnaire for wholesaler consisted of 42 questions divided into five groups;
4. the questionnaire for the retailer and consumer consisted of 31 questions divided into four groups.
5. In all these questionnaires, the questions were grouped in the following way:

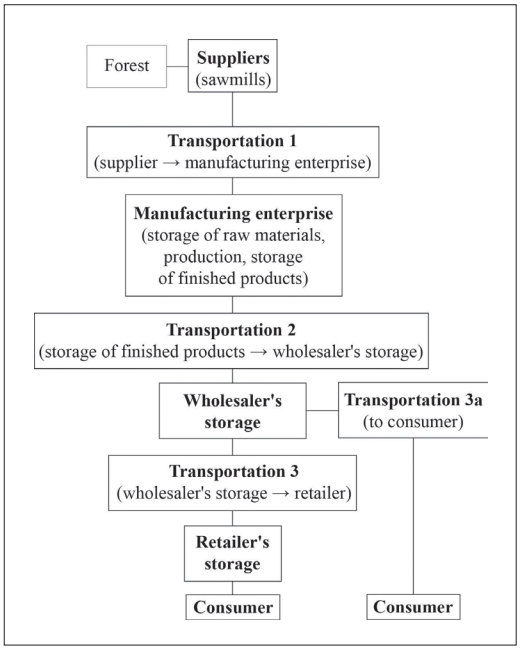
- general information about the respondent and the enterprise;
- internal organization of the enterprise (questionnaire for the manufacturing enterprise and the wholesaler);
- organization of the value chain for briquettes;
- relationship with the competent institutions, legislation and support measures.

After collecting the data, the coding and development of a database were performed. The statistical analysis was conducted in the statistical program SPSS v. 20 (2011), for data collected from suppliers. The data related to the briquettes manufacturer, wholesaler, retailer and consumer were not statistically processed (due to the small sample size). Instead, the content analysis of the questionnaires was performed.

RESULTS

Organisation of briquettes value chain

Manufacturing enterprise, included in the research, exclusively used the raw material produced at sawmills. For this reason, sawmill was taken as the place of raw materials origin. The briquettes value chain in the analyzed FA is shown in scheme 1.



Scheme 1. Organisation of briquettes value chain in the Limsko FA

Source: authors

3 At the time of the research, the analyzed manufacturing enterprise was the only one in the Limsko FA engaged in the production of briquettes.

4 Four customers were chosen based on this criterion. However, because the two of them were from other countries, the analysis included only two customers (retailer and consumer) from Serbia.

The suppliers of raw materials, i.e. sawdust, were sawmills located in the territory of Nova Varoš, Priboj and Prijepolje. Sawdust, which is used as a raw material for briquette production, is produced during the processing of roundwood in all sawmills. It is a residue from the production of the main product, i.e. sawlogs.

The average quantity of roundwood, procured and processed by sawmills, was 1,000.00 m³ per year (Table 1).

Table 1. The quantity of procured raw materials and produced sawdust (2012)

Parameters	*N*
The average quantity of procured wood assortments ($m^3 \cdot yr^{-1}$)	1.000,00
The average quantity of produced raw materials for the briquettes production ($m^3 \cdot yr^{-1}$)	240,00

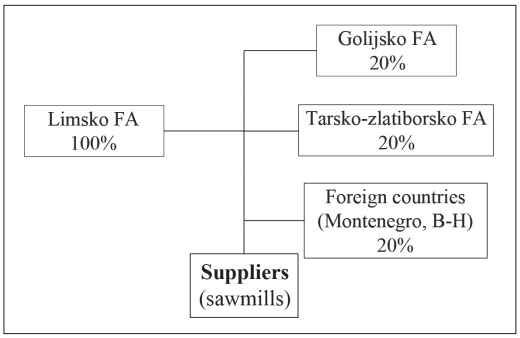
Source: authors

The average quantity of raw materials (sawdust), which sawmills were delivering to the manufacturing enterprise was around 240 m³ of sawdust annually. The lowest recorded quantity, on an annual basis, was 80 m³, while the highest was 2,400 m³ of sawdust. This indicates that suppliers were delivering very unequal quantities (varying up to 30 times) to the manufacturing enterprise.

Enterprise business, in terms of more efficient organization of raw materials procurement, could be improved by reducing the number of suppliers. This could be done in two ways: by business networking of suppliers or by procurement of raw materials directly from the forest, and the development of cooperation of the manufacturing enterprise with the Public enterprise (PE) "Srbijašume".

These facts indicate that the procurement of raw materials was, at that time, the most problematic link in the value chain, because it was not in accordance with the needs of the manufacturing enterprise. In terms of organization of the procurement, the enterprise management had, on the one hand the need for timely securing of the necessary quantities of raw material, and on the other the need for providing business with a profit in such conditions. For these reasons, the focus of the analysis was shifted to the procurement of raw materials.

All sawmills, which were supplying the manufacturing enterprise, procured roundwood from the Limsko FA, while 20%5 of raw materials was procured from the municipalities of Ivanjica and Sjenica (Golijsko FA), and Čajetina (Tarsko-zlatiborsko FA), and 20%6 from the territory of the neighbouring countries: Montenegro and Bosnia and Herzegovina (Table 2; Scheme 2).



Scheme 2. Forest areas from which suppliers procured forest timber assortments

Source: authors

These results suggest that all analyzed sawmills were equally supplied with raw materials from the Limsko FA. However, the ones that probably had much greater processing capacities, procured raw materials from other FAs in its surrounding or from nearby countries.

In relation to the type of raw material suppliers, the majority of respondents (93.3%) stated that the roundwood was procured from the PE "Srbijašume", and about ½ (53.3%) from private forest owners. This means that despite the domi-

5 Results of χ^2 test for goodness-of-fit were χ^2=5.4, df=1, p=0.020. Because p<0,05, it can be concluded that there is statistically significant difference between observed groups (sawmill that procure raw material from Golijsko and Tarsko-zlatiborsko FA and those that do not procure raw materials from these FAs).

6 Results of χ^2 test for goodness-of-fit were χ^2=5.4, df=1, p=0.020. Because p<0,05, it can be concluded that there is statistically significant difference between observed groups (sawmills that import from Montenegro ad Bosnia and Herzegovina and those which do not import).

Table 2. Organization of raw materials procurement (2012.)

Parameters	Frequency	χ^2 test for goodness-of-fit		
	%	χ^2	df	*p**
Locations from which raw materials were procured				
Limsko FA	**100**	/	/	/
Golijsko FA and Tarsko-zlatiborsko FA	20	5.4	1	**0.020**
Import	20	5.4	1	**0.020**
Form of supplier of roundwood				
PE „Srbijašume"	**93,3**	11.3	1	**0.001**
Private forests	53,3	0.1	1	0.796
Methods of payment for raw materials				
Advance payment	**100**	/	/	/
Deferred payment	13.3	8.1	1	**0.005**
Compensation	13.3	8.1	1	**0.005**

***** if $p<0,05$, there is statistically significant difference between the observed groups of enterprises
Source: authors

nance of PE "Srbijašume" in the supply of sawmills with forest timber assortments, there was an increasing share of raw materials originating from private forests.

In terms of payment methods, all interviewed representatives of sawmills indicated that they pay for roundwood in advance, while 13.3%, in addition to the advance payment used "deferred" payment (up to 30 days). In addition, the same number of respondents (13.3%), listed "compensation" as a form of payment. It is important to emphasize that the dominating payment in advance, can be an obstacle for the business of sawmills, because it has a significant (often negative) impact on the flow of financial resources in the enterprise.

The process of briquette production in the analyzed enterprise consists of the following activities:

1. the collection of raw materials;
2. the storage of raw materials:
   - under a roof (around 320 m²);
   - outdoors;
3. the sieving;
4. the drying;
5. the storage of dried raw material;
6. the production of briquettes;
7. the packaging and storage of finished products.

Briquettes are stored in a warehouse of the manufacturing enterprise or in rented warehouses.

The production capacity was about 10,000 tons of briquettes per year. However, representatives of the manufacturing companies stated that *"...the realized capacity was much lower than the potential - around 3,000 tons of briquettes per year"*. As one of the main reasons for the low realization, the representative of the manufacturing enterprise pointed out *"...the lack of raw materials".*

The wholesaler was buying all the produced quantities from the manufacturing enterprise, which amounted to 1,500-2,100 tons per year.

The transportation of briquettes from the manufacturing enterprise to a warehouse of the wholesaler or the retailer was performed by a third party, and in accordance with some basic characteristics of the "city-logistics"7. The goods

7 The concept which solves the organization of logistics in urban areas is called "city-logistics". It involves solving logistic flows within a city. The decisive factors affecting the concept of "city-logistics" include cultural, sociological, demographic characteristics of the city, as well as the habits and attitudes of the population (Zečević, Tadić, 2013).

were brought in, stored and sorted within a single terminal. From there it was transported to retailers or wholesalers. Those terminals were, mainly, located at greater distances from the city, but not too far away to be delivered as efficient as possible. Another form of transportation was to storage goods within trade centres (owned and rented), which were, often, located at the edges of the city or in a suburban area. Big storage facilities, in which the goods were delivered, were located there. From there, the goods were delivered to retailers and wholesalers. In addition, individuals could purchase the necessary goods under favourable terms, without the participation of the reseller.

The wholesaler was selling briquettes in the following ways:

1. through retail chains (tenders);
2. exports (Greece, Austria, Germany, Slovenia and Italy);
3. direct sale to customers.

The research included two customers, buying more than ½ of produced quantity of briquettes from the wholesaler.

The retailer was selling the briquettes in its own retail stores, which were located in major cities and towns in Serbia. This was one of the largest retail chains in this country. The procurement of briquettes was done through „the best offer", which was offered by manufacturers themselves. From the manufacturing enterprise, briquettes were delivered directly to the central warehouse of the retailer. From here, it was transported to retail stores along with other goods. In 2012, the retailer bought around 161 tons of briquettes. The payment was conducted by deferred payment after 60 days.

The consumer is specialized in the heating of buildings, and used briquettes solely for their own purposes. The procurement was done by means of public procurement and the selection of the best bidder. In 2012, the consumer bought around 1,500 tons of briquettes. The delivery of briquettes was organized by using the wholesaler's own transport means. The deferred payment was done after a period of 15 days.

Because of the need for a faster turnover of capital and the increase of profit, in recent years the wholesalers have also been engaged in retail. In this research, it was manifested in the way that the wholesaler was selling briquettes directly to consumers, and not just to retailers.

In this way, the value chain branching is carried out to create values in two directions (Scheme 1). This indicates that the flows of goods and capital are more complex and intertwined, which is an important reason for the study of their structure and systematization.

Increase IN the value within the chain

The average value of the roundwood, which was procured and processed by sawmills, was around 59,000 €8, excluding VAT (table 3).

Table 3. The value of procured raw materials and manufactured sawdust (2012)

Parameters	*N*
The average value of procured raw material ($€ \cdot yr^{-1}$)	59.223,90
The value of units of raw material delivered to briquettes manufacturing enterprise ($€ \cdot m^{3}$)	4,17

Source: authors

The average price of sawdust, at which sawmills were selling it to the manufacturing enterprise, was around 4 $€ \cdot m^{-3}$. However, it should be noted that all the respondents pointed out that in determining the price of 1m³ of sawdust, the cost of production was not included, because sawdust is a "rest". However, the following costs were included:

- construction of silos, containers, buying of "jumbo" bags, procurement or construction of other forms of the inventory for sawdust;
- the cost of electricity used most often for electric motors that drive fans to transport the sawdust through a system of tubes, from the place of timber cutting to the place of storage.

8 According to the National Bank of Serbia, the average middle exchange rate of the EURO in 2012 (the year to which data analyzed refer), was 113.13 RSD. More information can be found at the following address: http://www.nbs.rs/internet/cirilica/scripts/kl_prosecni.html

As participants noted, *"...the initial value of briquettes was from 2.21 €·m–3 to 6.19 €·m–3".* In the process of production, including all costs, *"...this value increases up to 101.65 €·m–3"* (the price at which the briquettes were sold to the wholesaler.

The wholesaler sells the briquettes at the price which ranges *"...from 110.49 €·t–1 to 137.01 €·t–1, without VAT".* The representatives of the wholesaler explained that *"...the price mostly depends on the parity of briquette delivery, but also on the amount that the customer orders".*

To retailer, who sells the briquettes through its own retail stores to end-consumer, the goods were sold *"...at a price of 143.20 €·t–1, without VAT".* But, *„...in this price were included transport costs, logistics in the central warehouse and delivery".* The retailer's average selling price was *"...3.17 €·t–1, for boxes of 20 kg"*. A recalculation shows that the price of one ton would be 158.67 €, without VAT.

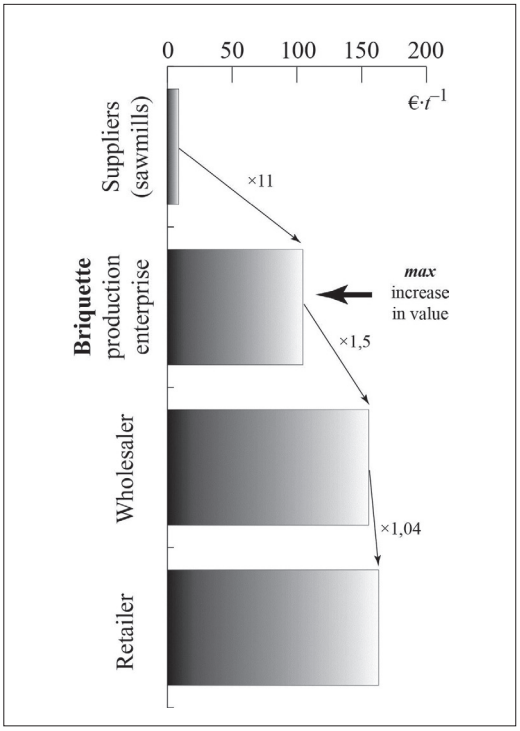


Figure 1. Increase in the briquettes value at the Limsko FA
Source: authors

To consumer, which uses briquettes for their own purposes, the goods are sold *"...at a price of around 159.11 €·t–1".*

After the sawmill the next place of the value increase is the transportation of raw materials from the sawmill to the manufacturing enterprise, and then storing it within the manufacturing enterprise.

In the production process, conducting business activities (drying, storage of dried raw materials, production, packaging, etc.), leads to the repeated increase in value.

The next places of value increase were the following:

- transport of briquettes from the manufacturing company to the wholesaler's warehouse or directly to the consumer's warehouse;
- unloading in the wholesaler's warehouse;
- storage in the wholesaler's warehouse;
- reloading the trucks of the wholesaler or truck of the customers;
- transportation to the warehouse of the customer;
- manipulation of goods in the warehouse of the customer.

The biggest increase in value occurs in the following places:

- supplier (sawmill, raw material);
- briquette manufacturing enterprise (transport, storage and production);
- wholesaler's warehouse (transport, storage and handling);
- retailer's warehouse (transport, storage, handling and retail).

By analyzing the values in these places, it can be seen that the biggest increase is achieved in the production phase (Figure 1), where the value of the goods (briquettes) is increased by about 11 times compared to the starting material (sawdust).

DISCUSSION

In the analyzed briquette value chain, sawmills have a major role in the delivery of raw materials. It is mainly due to the dependence of the manufacturing enterprise on them, because it does not possess the necessary equipment for their own production of raw materials. Previous studies have

shown that close cooperation with key suppliers brings benefits in terms of ensuring good quality of raw materials, reduced costs, increased competitiveness, etc. (Kannan, Tan, 2006; Kulik, 2010). Based on the results of this research, it is observed that the analyzed manufacturing enterprise did not fully accept the business strategy, which involves maintaining close cooperation with key suppliers, because raw material is supplied by a large number of suppliers, who deliver quantities that differ up to 30 times. This may adversely affect the smooth functioning of the procurement process.

A study from 2009, which refers to the potential and possibilities of commercial use of biomass for energy production and economic development of the municipalities of Nova Varoš, Priboj and Prijepolje, showed that sawmills in these municipalities, on average, process between 2,000 m³ and 3,000 m³ of roundwood per year (Glavonjić et al., 2009). This research indicated that, in 2012, sawmills procured and processed, on average, 1,000 m^3 of roundwood, which is significantly below the average determined in the previous research.

Approximately a half of suppliers procured raw materials from private forests. Bearing in mind the total area of private forests in Serbia (47%) and its, mainly, coppice structure (Banković et al., 2009), it is clear that the importance of management of this part of forest resources will increase in future, especially in terms of the use of biomass for energy. Small private forest holdings can be of great importance in solving the problem of supply with raw material, because their wood potential is not used sufficiently. Private forest owners associations can be a potential solution to the problem of mobilization of wood resources from private forests (Nonić, Glavonjić 2012). In addition, previous research suggests that there is great potential of the private forestry sector to mobilize additional quantities of wood on the market and to greatly increase the potential for long-term sustainable timber production (Schmithüsen, Hirsch, 2010; Nonić, Glavonjić, 2012).

The manufacturing enterprise was selling briquettes in the domestic and foreign markets. On the one hand, the products were sold directly to consumers. Another form of selling was through retailers. However, previous research shows that, when products are not sold directly to consumers, but through third parties (retailers), business success depends on the acceptance of business partners, their support and the quality of mutual cooperation (Chris Lin, Chang, 2012). In addition, enterprises can have problems with achieving competitive prices in the single EU market in competition with enterprises coming from member states. However, it is emphasized in the literature that, in order to achieve a competitive advantage in sales on foreign markets, especially the EU, less successful companies need to implement business strategies of enterprises that are leaders in the markets of the "old" EU members, which are aimed at emphasizing product quality, and not the price (Glob, Podnar, 2007).

The results of previous research on this topic at the Limsko FA indicate that the price of 1 m³ of sawdust was 0.5 €·m^{-3} in 2009 (Glavonjić et al., 2009). This means that the value of 1 m³ of sawdust significantly increased in the period 2009-2012, because the average price in 2012 was 4.17 €·m^{-3}.

In addition to woody biomass, residues from agricultural production can be used for the production of briquettes. In the research from 2012 in the territory of Vojvodina, which is related to the development of the market of for energy pellets and briquettes from biomass, it was emphasized that the production price of one ton of briquettes made from agricultural residues is 140 €·t^{-1} (Janić, Brkić, 2012). If this price was compared with the price at which a manufacturing enterprise sells briquettes to the wholesaler (101.65 €·t^{-1}), it may be noted that the production of woody biomass briquettes is more profitable, and therefore allows for better sales in the domestic and foreign markets. The value of briquettes in the international market ranges from 90 €·t^{-1} in Bosnia and Herzegovina, to 260 €·t^{-1} in Slovenia (2006).

CONCLUSIONS

The conducted analysis of briquette value chain at the Limsko FA has led to the following conclusions:

- sawmills mostly procured raw material (roundwood) from the territory of the Limsko FA, although a certain percentage of procurement was made from the neigh-

bouring FAs (Golijsko and Tarsko-zlatiborsko), as well as from imports;
- sawmills were usually procuring raw materials from the PE "Srbijašume" (93.3% of respondents), and about one half of the procurement was taken from private forests, while the most common method of payment was advanced payment;
- none of the sawmills had data on the costs of one unit of produced raw material (sawdust) necessary for briquette production;
- the manufacturing enterprise did not fully use its production capacities, due to the lack of raw materials necessary for production;
- all produced quantities of briquettes were sold to the wholesaler, whereby the transport to the wholesaler's or retailer's warehouse was performed by the third party;
- the wholesaler organized the selling in three ways (retailers, export, direct selling to consumers);
- the retailer, which was selling products in its own retail stores, and consumers who were using the briquettes for their own purposes, were procuring the briquettes through "the best offer";
- the following places of the briquette value increase were identified: sawmill, transportation to the manufacturing enterprise, manufacturing enterprise, transportation to the wholesaler's warehouse, manipulation in the wholesaler's and retailer's warehouses;
- the most important increase in the briquette value was within the manufacturing enterprise.

These conclusions point out the attractiveness of investing into briquette production, as well as the potential for profit. However, this should be confirmed by other economic analyses, especially those related to production costs.

However, it is important to emphasize that, in recent years, the number of enterprises engaged in the briquette and pellet production in Serbia is constantly increasing. These enterprises use identical raw material for their work. This has led to a shortage of raw materials in the territory where the manufacturing enterprise was located. Because of the competition, the price of raw materials was constantly increasing. This situation caused a lot of business problems to these enterprises, which are looking for ways of procurement of qualitative raw materials at affordable prices. One of the ways to overcome these problems includes the provision of equipment for collecting, transporting and milling of forest residues. To assess the economic and organizational effects of this scenario, it is necessary to make detailed studies in this direction.

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