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Proizvodnja i obavezna upotreba biodizela u Srbiji sa aspekta ekonomskog uticaja na stanovništvo

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Sažetak: Zbog ekonomskih prilika, u Srbiji postoji značajna potražnja za polovnim dizel vozilima pristiglim iz Evrope i nema naznaka da će u skorijoj budućnosti taj trend biti u opadanju. Ukoliko Srbija sprovede reforme podrazumevane evrointegracijama, koje se između ostalog tiču i primene biogoriva, to će svakako biti konsekventno po građane Srbije na različite načine. Iako biodizel predstavlja biogorivo koje po mnogim karakteristikama predstavlja adekvatan supstitut za fosilni dizel, ono još uvek ima različita fizička i hemijska svojstva koja mogu uzrokovati neočekivane probleme pri upotrebi. To može dovesti do uvećanih troškova održavanja vozila, a time i do povećanja cene transportnih usluga. Uz to, kao produkt prerade biomase uglavnom poreklom iz poljoprivrede, industrija biodizela se pri nabavci sirovina takmiči sa industrijom prehrambenih proizvoda. To ima vrlo ozbiljne implikacije, jer može uticati na dostupnost i cenu hrane na tržištu. Ovaj rad diskutuje ove pojave sa aspekta potencijalnog ekonomskog uticaja na stanovnike Srbije, bilo da spadaju u grupu budućih kupaca i potrošača biodizela ili ne.

Ključne reči: Ekonomski aspekt biodizela; Biodizel u Srbiji; Uticaj biogoriva na tržište hrane; Uticaj upotrebe biodizela na motor; Starost vozila u Srbiji.

Production and mandatory use of biodiesel in Serbia from the aspect of economic impact on the population

Abstract: On account of the economic situation in Serbia, there is a significant demand for European second-hand diesel vehicles and there is no indication that this trend will be declining in the near future. If Serbia implements reforms that are relevant to euro-integrations, which, among other things, include the use of biofuels, this will certainly be consequential for the citizens of Serbia through various aspects. Although biodiesel is biofuel that in many respects represents an adequate fossil diesel substitute, it still has different physical and chemical properties that can cause unexpected problems in use. This can lead to increased vehicle maintenance costs and thus, a general increase in transportation costs. In addition, as a product of biomass processing mostly derived from agriculture, the biodiesel industry competes with the food industry in purchasing raw materials. This has serious implications as it can affect the availability and food price levels on the market. This paper discusses these phenomena from the aspect of potential economic impact on Serbia's citizens, whether they belong to a group of future buyers and consumers of biodiesel or not.

Keywords: Economic aspect of biodiesel; Biodiesel in Serbia; The impact of biofuels on the food market; Impact of biodiesel on the engine, Fleet age in Serbia.

1. Introduction

In 2008, the Republic of Serbia signed the Stabilization and Association Agreement with the European Union, which entered into force on September 1, 2013 (Ministry, 2019). This agreement confirmed the perspective of Serbia's membership in the European Union (EU) and it was the initial phase of relations regulated by a comprehensive agreement between Serbia and the EU. This included certain obligations regarding the increase in the share of renewable energy sources in the total energy balance. Moreover, in 2006, the Republic of Serbia accepted the obligation to submit a plan for the implementation of Directive 2003/30/EC to the European Commission, by ratifying the "Treaty establishing the European Energy Community". This directive implied 5.75% share of biofuels, such as biodiesel and bioethanol, in petroleum fuels, by the end of 2010 (Directive 2003/30/EC). This was regarded as an indicator of a

reliable product placement for biofuel producers, which has led to several significant investments in that direction. One of them was Victoriaoil biodiesel plant in Šid, with a capacity of 100,000 tons of biodiesel per year. However, several moves by the Serbian government have led to a different outcome and almost a complete cut of biodiesel industry in Serbia (Latinović, 2019). Three key reasons were: high excise taxes on biofuels, lack of subsidies for biofuel production and transportation fuel marking regulations. Meanwhile, Directive 2003/30 has been replaced by Directive 2009/28/EC that implies 10% of biofuels in transport fuel by the end of 2020 (Directive 2009/28/EZ). With regards to Serbia's path towards EU integration, as well as the obligations it imposes, it is clear that in the near future, use and production of biofuels will be an important and current topic. Unfortunately, this does not go without inconveniences.

Biodiesel, as a renewable biofuel made of biomass, has numerous advantages over petrodiesel, such as: decreased green-house gas and many other hazardous gas emissions during the combustion; better biodegradability. Its production increases energy security and represents an agriculture and domestic industry boost (Kiš et al., 2005; Lotaro et. al., 2005, Agarwal, 2007; Chauhan, Shukla, 2011; Sinčić, 2014; Knothe, Krahl, Gerpen, 2015). However, there are also many well documented adverse effects of biodiesel production and use, concerning the environment, economy, food availability and price, engine operation and durability, etc. (Chauhan, Shukla, 2011; Knothe, Krahl, Gerpen, 2015, Latinović, 2019).

The aim of this paper is to discuss two of those issues through the prism of economic influence on potential consumers and the total Serbia's population. Also, it is to determine if there is need for a more serious econometric analysis of these effects in the future. The first one is the impact of biodiesel on engine performance, operation and durability (Fraer et al., 2005; Proc et al., 2006; Thornton et. al., 2009; Yüksek et al., 2009; Gili et al., 2011; Suthisripok, Semsamran, 2018) and the second is competition for feedstock between biodiesel and food producers and its impact on feedstock price (Taheripour, Hertel, Tyner, 2010; Du, Yu & Hayes, 2011; Kozumi, 2015; Tomei, Helliwell, 2016; Mensi, Tiwari, Bouri, Roubaud & Al-Yahyaee, 2017).

Effects on engine were discussed based on reviewed studies, chosen among those that correspond to the current state of transport sector in Serbia, in terms of fleet age and technical characteristics. Although they are not conclusive and the majority of them were done on 20% biodiesel fuel blend, they repeatedly pointed towards the existence of adverse effects of biodiesel use that can cause increased maintenance costs. Food market affection was discussed based on several studies, as well as on the experience of other biofuel producing countries. In addition, a recommendation to policymakers was given, regarding the small-scale biodiesel production conducted by agricultural households.

2. Technological aspects of biodiesel application

2.1. Biodiesel as a subject of standardization

Since the engine technology of compression-ignition (diesel) engine is well established and widespread, biodiesel and its blends with petroleum diesel have to be adapted to it. This is done through a comprehensive standardization aimed at providing the appropriate characteristics of such products on the market. Serbian standard SRPS EN 14214:2019, which fully corresponds to the European Standard EN 14214:2019, considers biodiesel as fatty acid methyl ester (FAME) (SRPS EN 14214). It is most often derived from vegetable oils and animal fats and as such, it is a chemical compound of organic origin with different chemical and physical characteristics.

Concerning its use as automotive fuel in Serbia, parameters of biodiesel are defined by standards mentioned in this heading and they only partially coincide with the parameters of quality of petroleum diesel. Some parameters are, because of substantially different chemical composition, completely non-existing (Sinčić, 2014). These standards have to cope with several issues caused by differences of biodiesel compared to petroleum diesel. Some of the most prominent are: high viscosity and loss of fluidity at low temperatures; low oxidation stability; fuel system compatibility issues and injector nozzle coking tendencies; retention of residual byproducts and impurities and increased volumetric fuel consumption (McCarhy, Rasul, Moazzem, 2005; Lotero, Liu, Lopez, Suwannakarn et al., 2005; Nestorović, Jovanović, Manić & Stojiljković, 2012).

On account of its characteristics, price and availability, pure biodiesel is most commonly used as a component in fuel blend with diesel in different ratios. In this case, its characteristics are specified by

the standard SRPS B.H2.133:2015, which is identical to ASTM D6751-15a (SRPS B.H2). Blends are designated as "B" followed by a number that indicates the percentage of biodiesel. B100 represents pure biodiesel while B20 is 20% biodiesel and 80% petroleum diesel. Analogously, B10 is 10% of biodiesel and 90% of petroleum diesel and it is now widespread in the European Union.

Table 1. Part of the SRPS B.H2.133:2015 (B100) fuel marketing specification.

Property	Limits	Units
Methanol Content	≤ 0.2	% mass
Flash Point	≥ 130	degrees C
Water & Sediment	≤ 0.05	% vol.
Kinematic Viscosity,	1.9 - 6.0	$mm^2/sec.$
Cetane Number	≥ 47	
Acid Number	≤ 0.50	mg KOH/g
Total Glycerine	≤ 0.240	% mass
Phosphorus Content	≤ 0.001	% mass
Distillation, T90	≤ 360	degrees C

Source: (Institute for Standardization of Serbia, SRPS B.H2.133:2015).

Serbian standard SRPS EN 16734:2019, which is identical to EN 16734:2016+A1:2018 CEN/TC 19, specifies requirements and test methods for marketed and delivered automotive B10 diesel fuel, containing up to 10,0% (V/V) FAME (SRPS EN 16734). In addition, further biodiesel share increase in the fuel blend, demands additional changes in petroleum diesel standards so that the quality of final blend can pass the environmental and technological requirements (Hart Energy, 2014).

2.2. Effects of biodiesel on engine operations, performance and durability

Although standards aim to reduce differences between biodiesel and petroleum diesel relating to certain parameters, cannot eliminate essential chemical differences. Depending on the engine model and year of production, biodiesel blends may affect engine operation, performance and durability. It is necessary that all the engine components in contact with the fuel are made of compatible materials. This is especially unlikely to be the case in all older cars, as they weren't meant to have used biodiesel to any extent. This particularly impacts fuel injectors, filters and other fuel system components and it was found to be a cause of a significant deterioration in engine performance (Proc, Barnitt, Hayes et al., 2006; Yüksek, Kaleli, Özener & Özoğuz, 2009; Gili, Igartua, Luther & Woydt, 2011; Suthisripok, Semsamran, 2018).

A possibility exists, with all engines, that some amount of fuel will penetrate into the engine's crankcase and dilute the lubricating oil. This leads to its faster aging and engine's durability issues (Thornton, Alleman, Luecke et. al., 2009; Yüksek, Kaleli, Özener & Özoğuz, 2009; Suthisripok, Semsamran, 2018). Gili, Iguartu, Luther & Woydt (2011) stated that the esters are liquids with strong penetration and solvency properties. This leads to a greater penetration of unburned biodiesel into the engine lube oil in the crankcase, resulting in its dilution. Also, as one of the reasons, distillation temperature of the FAME shifted by about 100° K upwards was suggested. They stated that it results in the accumulation of methyl esters in the engine oil and leads to its long-term dilution. Furthermore, they stated that numerous tests have shown that at the end of the conventional oil discharge interval, up to 20% of methyl esters could be found in the engine lube oil, and this percentage was usually between 5% and 10% (Gili et al., 2011). Thornton et al. also found that, during a 750h aging test of lube oil using B20 blend, viscosity of the lube oil decreased and dilution occurred between 5-10%, or 4-8% depending on the system used (Thornton et al, 2009).

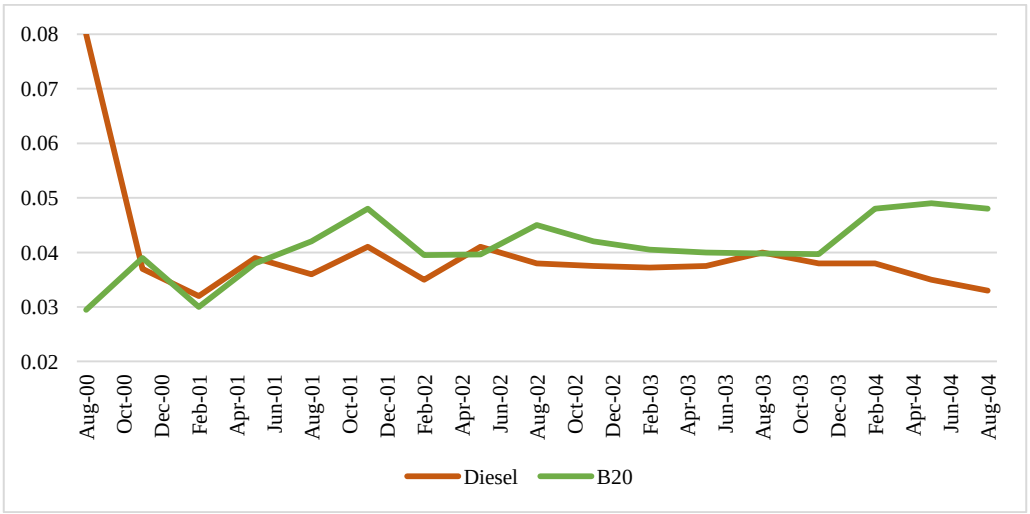
With this in mind, it should be noted that biodiesel is believed to have good lubricity properties. It turned out that the addition of small amounts of biodiesel (1-2%) to petroleum diesel with removed sulphur, returns its original lubrication characteristics (Suresh, Jawahar & Richard, 2018). Agarwal et al. (2004) found that replacing petroleum diesel with biodiesel blends decreased the wear on aluminium, chromium, iron and lead. These particles were reduced by approximately 35%, compared to diesel, during a 512h engine test on B20 (Agarwal, Bijwe, & Das, 2003). However, they tested lubricity of biodiesel compared to petroleum diesel and not compared to engine lube oil (Agarwal et al., 2003). This is only important for the engine parts not lubricated by crankcase oil, but rather with fuel itself. The most important of these components are valve seats in cylinder head and high-pressure fuel pump. The problem of diluted crankcase lube oil for lubricating other vital parts of engine subjected to

high friction remains. Porte et al. (2012) found that during a 280h engine run, on residual frying oil biodiesel, wear metal (Fe, Al, Cu, Cr, Pb and Mn) contamination of crankcase oil was increased with time. Thornton et al. (2009) also found that iron wear was increased by 55 ppm during the test. These phenomena raise the question of durability and maintenance costs. Based on diesel engine technology applied at the time of production and the average age of the fleet in Serbia, which is 17.1 years (see heading 4), several studies were chosen that are believed to be the most appropriate.

In the study conducted by Proc, Barnitt, Hayes et al. (2006), 9 identical buses over a period of two years were followed. Five buses worked exclusively on B20 fuel and four buses worked on diesel fuel. The study showed 1.2% lower fuel costs of group B20 compared to diesel. During the study, there were no significant differences in material wear on buses that used B20 and diesel, and even the soot in engine oil was lower in buses that worked on fuel B20. However, before the end of the study, it was necessary to replace some of the engine parts such as the injectors and the cylinder head, thus increasing the average cost of the B20 group compared to the diesel group.

Unrelated, but similar occurrence appeared in a study conducted by Fraer, Dinh, Mccormick, Chandler & Buchholz (2005). Two groups of Mack tractors were followed for 4 years and more than 600,000 miles. One group used B20 and the other group used petroleum diesel. Near the end of study, engines were torn down for the analysis. For most of the B20 data period, vehicles had essentially identical maintenance costs. However, in November 2003, a B20 tractor had the complete set of six injectors and a fuel pump replacement because of operational problems. The occurrence caused the cumulative average cost of maintaining the two B20 Mack tractors to increase by $0.01/mile or 28%. Figure 1 shows the step change. Also, one group that had started using B20 at the end of year 2000 quickly stopped using it because of the fuel filter-plugging problem (Fraer, Dinh, Proc, Mccormick, Chandler & Buchholz, 2005).

Figure 1: Average cumulative running engine-and fuel-related maintenance costs per mile for the Mack tractors



Source: (Fraer, Dinh, Proc *et al.* 2005)

National Biodiesel Board carried out a longitudinal durability test that lasted for 1000 h on 1987 Cummins NI4 engine. B20 fuel was used. Although the test was planned to last for 1000h, it had to be terminated after 650h due to failure of the engine pump. It was suggested that the experienced operational problems were caused by instability due to oxidation of the B20 fuel. Fuel filters and lines and fuel transfer pump were replaced during this shut-down at 700h. At the end of final 250 h, they dissembled the engine and found substantial deposits on many components. They stated that the source of these deposits appeared to be the lube oil. Cavitation erosion of the injector needle valves had caused injectors to deteriorate to the point that almost no fuel atomization could occur. Deteriorating fuel pump seals were proposed to have introduced microscopic air bubbles into the fuel, causing the cavitation erosion. Elevated soot wear metals in the lubricant, softening of fuel system seals and broken fire and compression rings on several cylinders were observed (Ortech 1995).

Filter clogging was also found to be a major problem in the USA, as increasing animal fat and soybean-based fuels were being introduced nationwide (PTSA 2005; Proc, Barnitt, Hayes, Ratcliff, McCormick,

Ha *et al*., 2006; Dhiraj, Mangesh, 2010). Humberg, Hansen, Schumacher et al. (2004) analysed the experiences of state transportation agencies with B20. They found that around a half of the states using B20 reported more fuel filter plugging issues with B20 than with petroleum diesel. Many states also reported small declines in fuel economy with B20.

3. Biodiesel feedstock market and its impact on the food market

Three basic raw materials used for production of biodiesel are lipid materials (vegetable oil or animal fat), alcohol and catalyst for the reaction, which facilitates and accelerates the reaction between the lipid raw material and alcohol (Stamenković, Banković-Ilić, Stamenković, Veljković, Skala, 2009). Lipid materials are the most important and the most expensive feedstock for biodiesel production, therefore, attention will be paid to them. Since the extensive amounts of biomass feedstock can be provided through the agricultural cultivation of different oilseed crops, vegetable oils are the most common feedstock for biodiesel production. More than 600,000 hectares of arable land are considered available for the production of oilseeds in Serbia, where the most important are: sunflower, soybean and rapeseed. Sunflower is the most popular and covers an area of about 220,000 hectares per year (Babić, Đurišić, 2008). The total area suitable for the cultivation of oilseeds intended for processing into biodiesel was estimated at about 350,000 ha (Tešić, Kiš, Janković, 2008; Tešić, Kiš, Marinković, 2009). Depending on the processing technology, technology of biodiesel production and usage of arable land, Tešić et al. estimated biodiesel production potential on 212,800t up to 250,600 tons of biodiesel *per annum*. This was estimated to be enough to substitute up around 15.5% of Serbia's diesel consumption which is more than enough for domestic needs (Latinović, 2019). This implies that no biodiesel, nor feedstock would need to be imported.

As land is a limited natural resource, it is clear that biodiesel industry is competing for the same processing surface against food manufacturers, and it represents one of its most crucial impediments towards sustainability. Using crops for biofuels production creates concerns with food (Koizumi, 2015) and livestock feed (Taheripour, Hertel, Tyner, 2010) prices and availability and raises the important question of how far along that route Serbia could move. On account of relatively high prices of petroleum products as compared to the relatively low prices of food and livestock feed products, biodiesel producers, boosted by subsidies, are willing to pay a higher purchase price for the feedstock compared to food and livestock feed producers. This provokes the inflation of food and livestock products prices, produced from these plants (Kozumi, 2015; Tomei, Helliwell, 2016). Du, Yu & Hayes (2011) showed the existence of volatility spillover from crude oil to biofuel feedstock. Corn is feedstock for bioethanol, a biofuel substitute for petrol, but the same principle can be applied to biodiesel feedstock. Mensi et al. (2017) stated that "the recent expansion of biofuel cereal production, in light of the US government fuel policy, has further intensified the price linkages between energy and agricultural prices and raised concerns about a stronger volatility linkages and potential adverse impacts on economic actors."

Haixia and Shiping (2013) found double-directional spillovers between the corn market and the bioethanol market, which leads to bioethanol market impact on the corn price levels directly and indirectly. Therefore, they concluded, "fuel ethanol prices seem to also induce an increase in the prices of grain" and that the evidences suggest that there is a closer linkage between the corn and bioethanol markets (Haixia, Shiping, 2013). In Serbia, after the opening of 100,000 t/y Victoriaoil biodiesel plant in Šid, in 2007, in year 2008 food price inflation was noted (Tešić, Kiš, Janković, 2010), although not conclusively to which extent and for what reason. Around the same time, in 2007, Jean Ziegler, a sociologist and UN special adviser for food issues, explained that 280 kg of corn was enough for a one-year diet of a single child. From the same amount of corn, only one tank of 50 litres of bioethanol could be produced. That amount, as he said, would be enough for one SUV car to cross around 200 km. Given that, Jean Ziegler from the UN called for the urgent five-year moratorium on biofuel production. The same example also applies to biodiesel (UN News Centre, 2007).

On the other hand, part of agricultural waste biomass and waste frying oil represent the most suitable feedstock for biodiesel production from the environmental and economic aspect. Their use as feedstock would help solving the problem of their disposal as waste and reduce the share of the agriculture feedstock usable for food production. If such feedstock is used by small-scale production conducted by agricultural households, it is believed to contribute to rural development even more. Unfortunately, such feedstock remains unused on the account of inadequate legislation. Petrol product and biofuel monitoring regulation (Uredba o monitoringu, 2015) and fuel marking regulation (Uredba o

obeležavanju, 2017) introduced fuel marking by specific markers in precisely determined concentration. Market inspectors in Serbia were allowed to control fuel tanks of business entities. Blending marked fuel with unmarked fuel, such is self-made biodiesel, would lead to dilution of markers which means that in a case of market inspection, entities caught with the illicit fuel would face huge penalties. This specifically affects agricultural households since, as business entities, they are subjected to these regulations, thus prevented from producing and using biodiesel from its own production.

4. Potential consumers of biodiesel and state of the fleet in Serbia

Consumers of petroleum diesel fuel represent the most significant group of potential biodiesel consumers. For the purpose of this paper, they were categorized into three most important groups: passenger cars, commercial vehicles and working machines. There were 1,999,771 passenger cars in Serbia in 2018 (Statistical Office, 2019b) with the average age of 16.4 years (Road Traffic Safety Agency, 2019a). Precise data on the ratio of the number of diesel/petrol vehicles was not available at the moment of writing this paper, but the final energy consumption of diesel fuel in Serbia, in 2017, was 1,571,130 t (Table 2). For comparison, only 419,822 t of petrol was used in the same period, which is almost four times less (Statistical Office, 2019).

In 2018, 228,900 freight vehicles, 9,980 buses and 8,979 work machines were registered in Serbia (Statistical Office, 2019b). Owners of these vehicles are primarily interested in price, fuel consumption and biodiesel quality. Any increase in fuel and maintenance costs is expected to be compensated by increased prices of final products and services that include transportation costs. The total average age of Serbian fleet, consisted of all registered vehicles in 2018 was as high as 17.1 years and in South-Eastern Serbia, over 20 years (Road Traffic Safety Agency, 2019).

Table 2: Final energy consumption in Serbia, in 2017.

	Transport diesel	**Heating and other gas oil**
	t	**t**
Final energy consumption	**1,571,130**	**122,571**
Industry	55,932	16,305
Construction	15,083	-
Transport	1,444,026	16,605
Households	-	-
Agriculture	56,089	71,759
Other users	-	17,902

Source: (Statistical Office of the Republic of Serbia 2019).

5. The economic situation in Serbia – latest indicators

In order to gain insight into the economic status of its average citizen, few crucial economic and social indicators of Serbia were given in Table 3. Values represent the official calculations of the Statistical Office of the Republic of Serbia. Values given in RSD were converted to European monetary union currency (€), based on the official middle RSD exchange rate formed on 04/06/2019 by the National Bank of Serbia.

Another indicator that may be used for better understanding the situation of a society is Bloomberg misery index. It is an indicator relied on the age-old concept, which assumes that low inflation and unemployment rate could be taken as a good illustration of how good an economy's residents should feel (Serbian Monitor 2019). The country with the highest ranking is the one with the highest index of misery. It is calculated as the sum of a country's unemployment rates and inflation. (Bloomberg, 2019). In 2019, Serbia was listed in 10th place (Bloomberg, 2019).

Table 3: Economic and social indicators of Serbia

Indicators	Reference	Value	Units
Industrial production index, same month of previous year = 100	2019, April	-0.8	%
Industrial production index by activity, period of the current year compared to the same period of the previous year	2019, April	-1.5	%
Average net earnings	2019, March	460.3	€
Personal household consumption, monthly	2017	528.16	€
Consumer price indices, same month of	2019, April	3.1	%
Consumer price index, previous month = 100	2019, April	0.7	%
Gross domestic product	2017	2	%
Quarterly gross domestic product, same	2019, I	2.5	%
Gross domestic product per capita	2018	6,128.95	€
Unemployment rate	2018	12.7	%

Source: (Statistical Office, 2019a)

In addition to these indicators, the average age of the vehicle fleet discussed in the previous heading (5) is also one of the economic indicators to be considered.

6. Discussion

Regarding the biodiesel effects on engine operation, performance and durability, it is highly likely that overall increased maintenance costs are to be expected. Two main concerns are: compromised fuel system (fuel filter clogging, leakages on rubber sealants and fuel injector coking) and diluted engine lube oil (decreased engine life by the excessive friction and wear). Although serious engine damage can be prevented by timely servicing and decreased service intervals, this directly results in increased maintenance costs. Reviewed studies mostly compared B20 blends to petroleum diesel. B10 is expected to have less impact on engine operation, performance and durability. Cost increase levels were not conclusively determined but they are expected to occur. It is highly likely that all business entities would adjust their product and service prices so as to cover increased transport and processing costs.

The second issue discussed was biodiesel feedstock availability and its impact on food prices on the market. If Serbia at some point achieves the target of 10% share of biodiesel in diesel fuel, around 157,113 tons of biodiesel will be consumed *per annum*. With regards to biodiesel feedstock production capacity of Serbia, as well as to the production capacities of biodiesel producers, it is highly likely that feedstock or biodiesel import would not be needed. However, the biodiesel industry would be able to consume almost all available oilseed feedstock, otherwise intended for food and livestock feed production. Such a level of demand is expected to have a significant impact on the nutrition market. At the same time, agriculture itself, which would use biodiesel from its own production and for its own needs on a voluntary basis, faces legislation ineffectiveness. The problem with policies remains and potential large cumulative effect of a numerous smaller manufacturers (Latinović, 2018) stays neglected. This is a huge hindrance for circular and bio-economy as the agriculture industry is one of the most important sources of pollution and greenhouse gas emissions (Jovanović, Joldžić, Jovanović, 2015). This is exactly where using waste biomass and waste edible oil as feedstock would have the most obvious positive effects on the environment. Around 127,848 tons of transport diesel and heating and gas oil *per annum* is used in agriculture and a large part of that would be substituted by biodiesel made of waste biomass.

Creating jobs and improving living conditions are some of the economic benefits of biodiesel industry. Biodiesel industry would be especially beneficial for producers and, finally for all commercially involved in it. However, their number is negligible in relation to the number of those not involved in the industry. In addition, on account of high feedstock and processing costs of biodiesel, compared to crude oil, the biofuel industry is dependent on state subsidies. If Serbia is to achieve the set target of 10% of the share of biofuels in fossil fuels in the market, it is clear that state incentives and subsidies are to be introduced. Needless to say, these incentives and subsidies would come from taxpayers' money. Considering economic indicators of Serbia, it is clear that the economic power of the average

citizen of Serbia is relatively small and ironically, it would be them who pay for something that then financially burdens them further.

7. Conclusion and recommendations

Based on various studies and global biodiesel industry experiences, this study provided enough evidence for safe conclusion that mandatory use of biodiesel on a large scale would lead to increased overall price levels in Serbia. Although this study did not conclusively determine to which extent, it is likely that production and mandatory use of biodiesel in Serbia would have negative economic impact on the overall population. In the economic context, the biodiesel industry seems to be a "zero-sum game" between producers and citizens.

The ethical question arose as to whether and by what means, the profit of those involved in this industry is more valuable than the burden, borne by all citizens of Serbia, regardless of whether they are consumers of biodiesel or not. With the all economic indicators taken into account, a question arises as how would the overall price level increase affect market activity and standard of living in Serbia. With already a noticeable decline in industrial activity and a low income of an average citizen, this issue should be considered by the state with the utmost seriousness. A more extensive econometric analysis is recommended.

Additionally, this paper suggests that policymakers induce changes in regulations concerning fuel marking and subsidies in such a way to support biodiesel production and use by agricultural households, thus creating truly positive environmental effects.

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