

# MULTICRITERIA ANALYSIS OF PRODUCTION ALTERNATIVES OF RASPBERRY AND BLACKBERRY PRODUCTION RESIDUES

Srećko ĆURČIĆ  
Mališa ŽIŽOVIĆ  
Sandra MILUNOVIĆ KOPRIVICA  
Milan VESKOVIĆ  
Dragan TURANJANIN

***Abstract:** This paper provides a multi-criteria analysis of alternatives to possible products from residues in raspberry and blackberry production. Eight alternatives (out of a number of possible ones) were considered using 7 criteria. The LBWA method determined the weight coefficients of the criteria, and finally ranked the proposed alternatives by the New Weight sum method.*

***Keywords:** multicriteria analysis, raspberry and blackberry cuttings, alternatives, weights, rank.*

## 1. INTRODUCTION

The paper [2] analyzes the possibilities for organizing the production of residues (cuttings) in the production of raspberries and blackberries in the Republic of Serbia. The analysis was made for the production of briquettes and pellets from these residues and pellets were favored over briquettes. Specifically, for a long time working on the project "DEVELOPMENT OF TECHNOLOGY FOR PRODUCTION OF PELLETS AND BRIQUETTES OUT OF RASPBERRY AND BLACKBERRY", the answer to the question was whether these residues must be incinerated or used. The first analysis indicated pellets and briquettes. Further results on this same project, which are now well known, indicate that there are other options besides the two, namely the production of thermal insulation boards from these residues, as explored in the project "DEVELOPMENT OF TECHNOLOGY FOR THE PRODUCTION OF THERMAL AND SOUND INSULATION

BOARDS FROM RASPBERRY AND BLACKBERRY RESIDUES) DEVELOPMENT OF A TECHNOLOGY FOR PRODUCTION OF PELLETS AND BRIQUETTES OUT OF RASPBERRY AND BLACKBERRY ”, as well as the production of compost from these residues.

As for the organization and operation of potential enterprises for these purposes of analysis given in [2] remains currently unused, but now it is possible to give new production opportunities, because now there are two other possible products and of course different combinations of these products.

From an ecological point of view, this production is now more important than at the beginning of work on the aforementioned project because the areas in the Republic of Serbia have increased significantly in recent years - 18000 ha were mentioned in the paper [2], and this information was taken from the project mentioned above.

The latest data from the Statistical Office of the Republic of Serbia as of 19.10.2018. The results of the Orchard Survey [1] for 2017 (published on 13 November 2018) indicate that there were 31851 ha under raspberries and blackberries at that time, but in that year (2017), of the 26937 ha production phase, the rest were newly formed plantations that year.

Thus, we can speak of almost twice the capacity at the beginning of the research, that is, about 300,000 m<sup>3</sup> of wood (because these residues have all the characteristics of wood), which burns "as a technological measure in this agricultural production" (1ha yields about 10m<sup>3</sup> of wood).

## **2. MULTICRITERIA ANALYSIS**

### **2.1 Decision-making alternatives - WHAT TO DO –**

It is specifically suggested that this production be organized by those who buy raspberries and blackberries.

We have opted for the following possible production alternatives from raspberry and blackberry production residues (from raspberry and blackberry residues after pruning):

- A<sub>1</sub>: Raspberry and blackberry cuttings briquettes
- A<sub>2</sub>: Raspberry and blackberry cutlet pellets
- A<sub>3</sub>: Raspberry and blackberry cuttings compost
- A<sub>4</sub>: Compost and thermal insulation boards of raspberry and blackberry cuttings
- A<sub>5</sub>: Raspberry and blackberry briquette briquettes + wood

A<sub>6</sub>: Raspberry and blackberry pellet pellets + wood

A<sub>7</sub>: A<sub>1</sub> + A<sub>3</sub>

A<sub>8</sub>: A<sub>2</sub> + A<sub>3</sub>

It is clear that other combinations are possible, but here, above all, we are interested in the products that can be obtained from the remnants of raspberry and blackberry cuttings after picking raspberries and blackberries (when we receive the largest quantities of these materials). In addition to this "main" pruning, there is spring pruning as a technological measure, but with a small amount of pruning.

## 2.2 Optimization criteria

We will use the following criteria to evaluate the options (or combinations thereof) given above:

C<sub>1</sub>: Investment and maintenance cost (max)

C<sub>2</sub>: Product Price - Investor Profit (max)

C<sub>3</sub>: Time to Get Product (min)

C<sub>4</sub>: Product Acceptance (Compared to Similar Products) (max)

C<sub>5</sub>: Product quality (compared to similar products) (max)

C<sub>6</sub>: Possibility of replenishing production with other materials out of season (max)

C<sub>7</sub>: Product environmental friendliness (max).

All criteria are rated as maximization type although in essence they are not all of this type but the comparison is made in maximalist type.

The LBWA method proposed in [3] for determining weighting coefficients of criteria based on experts' opinions on their values obtained:

$$W_1 = 0,34783$$

$$W_2 = 0,34783$$

$$W_3 = 0,11594$$

$$W_4 = 0,05797$$

$$W_5 = 0,05797$$

$$W_6 = 0,04348$$

$$W_7 = 0,02838$$

The criteria are sorted in order of importance (for example, the former is more significant than the latter despite having the same weighting coefficients).

Important Note: Criterion  $C_7$  does not represent the ecological importance of the whole project, but only the possible ecological difference between the individual alternatives. The ecological importance of the project is far, far more significant.

### 2.3 Final ranking

Table 1 is formed with the statement and based on the opinions of experts in various fields: fruit growing for the technology of raspberry and blackberry production, nutrition of plants using compost, technologists for the production of thermal sound insulation boards and technologists engaged in the production of pellets and briquettes.

Table 1 represents the decision table (based on expert opinion). All criteria were rated maximizing from 1 to 10.

Table 1. Decision table

	$C_1$	$C_2$	$C_3$	$C_4$	$C_5$	$C_6$	$C_7$
$A_1$	4	6	6	6	5	7	9
$A_2$	3	8	6	8	7	8	10
$A_3$	9	1	8	6	6	9	2
$A_4$	8	3	9	2	7	2	4
$A_5$	4	6	6	6	6	7	8
$A_6$	3	8	6	8	7	8	9
$A_7$	4	3	5	6	6	8	5
$A_8$	3	4	5	7	7	9	6

Using the method given in [4] we obtain the following order of alternatives:

$$A_2 \rightarrow A_6 \rightarrow A_3 \rightarrow A_5 \rightarrow A_1 \rightarrow A_8 \rightarrow A_4 \rightarrow A_7$$

### 3. CONCLUSION

In a multi-criteria analysis of production alternatives from raspberry and blackberry residues, 8 production alternatives were compared using 7 criteria. The weighting coefficients of the criteria were determined by the LBWA method and the ranking of the proposed alternatives was determined. From the standpoint of the proposed criteria, the production of pellets from residual raspberries and blackberries is the most promising alternative, while the combined production of briquettes and compost is the worst prospect.

**Note:** The rating in the previous table implied the average capabilities of these resources, mainly from the manufacturer's point of view. Characteristically, compost production is third-ranked, thanks to its relatively simple technology. In the event that organic production is forced into the environment, alternative A<sub>3</sub> will have a higher ranking.

#### Acknowledgement

This study was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, and these results are parts of the Grant No. 451-03-68/2020-14/200132 with University of Kragujevac - Faculty of Technical Sciences Čačak.

#### References

- [1] data.stat.gov.rs/Home/Result/130501?language code=sr\_latn
- [2] Ćurčić S., Žižović M., Milunović Koprivica S., Božić M., Turanjanin D.: Production possibilities of pellets from residues when pruning raspberries and blackberries, UNITECH 2019, Gabrovo, Proceedings, Vol III (2019), pp. III 311-III 314.
- [3] Žižović M., Pamučar D., A New Model for Determining Weight Criteria: A level Based Weight Assessment (LBWA), Model Decision Making: Application in Management and Engineering, Vol. 2, Issue 2, 2019, doi: <https://doi.org/10.31181/dname19021022>
- [4] Miljković B., Žižović M., Petojević A., Damljanović N., New Weighted Sum Model, FILOMAT, Vol. 31, No 10, 2017, pp. 2991-2998, doi:<https://doi.org/10.2298/FIL1710991M>

#### NOTES ON THE AUTHORS

**Srećko ĆURČIĆ**, PhD is a full professor at the University of Kragujevac, in the field of Logistics and Production Technology. Renewed field of research Renewable energy sources - Wood and agricultural biomass waste. In his work so far, Srećko Ćurčić PhD has published over 150 scientific and professional papers. He is the author / co-author of three monographs and the author of two university textbooks. He has a great sense of cooperation with the economy in finding and solving every day, routine, developmental and strategic problems.

Faculty of Technical Sciences in Cacak, University of Kragujevac, Svetog Save 65, 32000 Cacak, Email: [srecko.curcic@ftn.kg.ac.rs](mailto:srecko.curcic@ftn.kg.ac.rs)

**Mališa ŽIŽOVIĆ**, PhD is a full professor at the University of Kragujevac, Serbia. Area of interest mathematics selection principles in Karamata's, theory, Operation research – Multicriteria analysis (theory and application in various fields). He is the member of editorial board of several scientific journals and editor in chief of *Mathematica Moravica*. Email: [zizovic@gmail.com](mailto:zizovic@gmail.com)

**Sandra Milunović KOPRIVICA**, PhD is an Assistant Professor in the Management and Business field at the Faculty of Technical Sciences in Cacak. She obtained PhD from Faculty of Organizational Sciences, University of Belgrade. She has 17 years of teaching,

research and consulting experience. She has published over 70 papers in the area of quality, standardization and logistics.

Faculty of Technical Sciences in Cacak, University Kragujevac, Svetog Save 65, 32000 Cacak E-mail: sandra.milunovic@ftn.kg.ac.rs

**Milan VESKOVIĆ**, PhD is Assistant Professor in the Electronics. So far, there have been more published papers at international and domestic conferences as well as in international and national journals. Most of the work is related to signal processing by electronics processing and the application of electronic systems in environmental protection.

Faculty of Technical Sciences in Cacak, University Kragujevac, Svetog Save 65, 32000 Cacak E-mail: milan.veskovic@ftn.kg.ac.rs

**Dragan TURANJANIN**, PhD, professor Academy Profesional studies South Serbia, Leskovac, Assistent professor Faculty of Management Sremski Karlovci, University UNION-Nikola Tesla. Area of interest: Quality system in education and tourism. E-mail: turanjanindragan@live.com