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APPLICATION OF MULTICRITERIA ANALYSIS IN ECO-LABELING

Abstract: Development of criteria based on life cycle assessment for developing countries, like Republic of Serbia, is an extremely difficult task. Criteria for award of an ecolabel must be based on life cycle considerations. The aim of this paper is to develop a methodology for improving the defining the criteria for product groups based on existing criteria of the EU eco-labeling, which would contribute to the efficient management of the eco-labeling program. The aim of this research is to evaluate the European criteria for awarding rights to use the eco-label using the method of multicriteria decision making.

Keywords: Eco-labeling, Type I, Eco-label, multicriteria analysis, AHP method

1. INTRODUCTION TO ECO-LABELING

Today's production and consumption patterns give rise to largescale environmental impacts, such as global warming, loss of biodiversity, and air and water pollution. Correct, unbiased, relevant, sufficient, and understandable information about the environmental impacts of production and consumption is necessary for any attempt of society to decouple increased environmental impact from growing affluence and population. Information is needed by market actors and governmental bodies to minimize environmental impact from production processes and products. Information is also a prerequisite to making informed decisions related to consumption, including product purchase, use, and subsequent disposal. [1]

Eco-labeling was identified in Agenda 21 as a way of encouraging consumers to alter their consumption patterns and to make wiser use of resources and energy in the drive for sustainable development into the next century. This instrument is needed

because of the generally poor performance of industry in providing sufficient information on the environmental performance of products. [2]

"Eco-labeling" is a voluntary method of environmental performance certification and labelling that is practiced around the world. "Eco-label" is a label that identifies all of the priorities of certain products or services in environmental protection, and the specific products/services based on life cycle consideration. In contrast to "green" symbols and statements developed by manufacturers and service agents, the eco-label is awarded by a non biased, third party in relation to products and services that independently determine compliance with leading environmental criteria. [3]

The ISO 14020 series represents the active answer for producers and consumers sensitive to products and services both competitive on the market and for their environmental performance. The environmental labels and the environmental product declarations are tools that allow one to detect, through the simple presence of a specific logo or by an LCA-based declaration, those

products/services offering the best characteristics in terms of environmental sustainability. [4]

As an answer on appearance huge number of labels and declarations within this area of life cycle considerations, ISO has identified three broad types of voluntary labels [5]:

Type I - a voluntary, multiple-criteria based, third party program that awards a license that authorizes the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations. [6]

Type II - informative environmental self-declaration claims. [6]

Type III - voluntary programs that provide quantified environmental data of a product, under pre-set categories of parameters set by a qualified third party and based on life cycle assessment, and verified by that or another qualified third party. [6]

As has been identified by the International Organization for Standardization (ISO), the overall goal of these labels and declarations is:

"...through communication of verifiable and accurate information, that is not misleading, on environmental aspects of products and services, to encourage the demand for and supply of those products and services that cause less stress on the environment, thereby stimulating the potential for market-driven continuous environmental improvement". [7]

2. ECO-LABELING TYPE I

Standard ISO 14024¹ defining Type I eco-labels, and it was declared in 1999.

¹ International standard ISO 14024 prepared by Tehnical Comitee ISO/TC 207, Managing Environmental protection, Subcomitee SC 3, Environmental labelling.

This international standard is referring on programmes of environmental labelling that awards to those products which satisfied complex previously define conditions. On that way label identifies products, because of that, usually this type is so called „stamps of approval“[8]. Type I label is only given to those products that are in their category classified in range from 15-20 % ecologically the most acceptable. Label point out that product ecologically seen more acceptable than products same category, and purpose is to stimulate buying products that are ecologically acceptable [9].

Type I environmental labeling programmes are voluntary, can be led by public or private agencies and can be national, regional and international. [8]

The aim of this Type I eco-labeling programme is contribution of reducing harmful factors on environment by using products for which is declared are more appropriate for environment.

Type I eco-labeling programme generally involves basic steps [10]:

1. selection of product category,
2. development of criteria and
3. certification and licensing.

Selection of product category is a critical part. This process is a deciding factor for the success of an eco-labeling scheme because it has a major impact on the eligibility of specific products. Although most programmes have some guiding principles to assist in selection, the numbers of factors and prioritisation methods vary significantly from one to another. Apart from the EU Flower and Japan Eco Mark, most schemes have not established comprehensive methodologies and procedures for the prioritisation of product categories. [10]

Selection of methods for defining the criteria for the product group is a difficult task. Any program that uses life cycle assessment, works in different ways. Since no one program is not managed by an extensive evaluation of the life cycle, each

is faced with challenges that each selected criterion is based on a limited number of properties. In this regard it is necessary to compare and give evaluations for different types of impacts.

Development of criteria based on life cycle assessment for developing countries is an extremely difficult task. Specifically, in addition to the complexity and extensiveness of these methods, lack of information is the most common obstacle to scientific research. Accordingly, the results will not give a real, but an approximate picture of the impact of the analyzed parameters on the environment. Therefore, eco-labeling programs, in defining the criteria for the product group should focus on a few key features, such as recycled content, low toxicity, pollution reduction, energy efficiency, recyclability, and thus to evaluate the characteristics of the industry in the selected area.

It is important to note, ISO 14024 standard states that the body responsible for eco-labeling program may consider the application of weights on selected criteria, and if so to explain and justify the reasons for this weighting.[5]

When the specific criteria defined, which the product/service needs to fulfill, it can be conducted the third and final phase of certification and issuance of the license to use the the eco-label for specific group of products.

When all three phases of the eco-labeling program are clearly defined, then the whole program becomes an effective tool for environmental protection.

2.1 Eco-labeling program in Republic of Serbia

The eco-labeling program in Serbia is relatively young. First efforts about this topic in our country are done by bringing up the Environmental Law of Serbian Republic Government, in which paragraphs 53 and 54 are predicted to fortify in other words awards and subtraction eco-label. [9]

Label is fortified for products intended to universal consuming, process and service, except products for food, drinks and pharmaceutical products, and giving right for using give Ministry of Environment. [9]

In March, 2009, was presented and officially published "Rules on detailed conditions and procedure for obtaining the rights to the use of eco-label, elements, form and manner of use of eco-label for products, processes and services", which are fulfilled preconditions for the application. [9]



Figure 1 –Two version of Serbian eco-label

The principles underlying the use of eco-labels are [11]:

1. voluntary;
2. probity, accuracy, clarity and relevance of information about the products that are eco-labeled;
3. compliance with national regulations and national and international standards;
4. compliance procedures and requirements for granting rights to use eco-label with the requirements of international markets;
5. recognizable and measurable characteristics of products that are labeled eco-mark, based on scientific method, which is a complete and comprehensive to the extent that it gives results that are accurate and repeatable;
6. comprehensiveness of the product life cycle;
7. invention, which contributes to environmental protection;

8. equality of specific forms of organizing the application process, regardless of their size and activity;
9. availability of information about the products that are eco-labeled;
10. open participation of all stakeholders;
11. friendly relationship with nature;
12. contribution to protection of human health and the environment.

The right to use eco-label shall be acquired if the product is produced in the territory of the Republic of Serbia, if it fulfills at least one of the following conditions [11]:

1. to reduce consumption of energy resources;
2. to reduce emissions of harmful and hazardous substances into the environment;
3. to reduce waste generation;
4. to reduce consumption of natural resources;
5. the use of secondary raw materials;
6. to use recycled or partially recycled materials;
7. to reduce the emission of noise and vibration;
8. to reduce the emission of radiation into the environment;
9. thus the products obtained after the use of easily decompose, break down or dismantled;
10. such that the end products can be reused;
11. obtained to use such products can be recycled;
12. such that products have obtained a small negative impact on the environment than current market.

Eco-label can not be assigned to substances and preparations which are classified as very toxic, toxic, dangerous to the environment, carcinogenic, toxic for reproduction or mutagenic in accordance with the regulations governing the classification of chemicals. [11]

Exceptionally, the eco-label can be assigned to products containing hazardous materials, if the concentrations of

hazardous substances are within the permissible values according to regulations. [11]

Application for grant of the use of eco-label submitted to the Ministry of Environment, Mining and Spatial Planning. With request is needed documentation that may be important for determining fulfillment of prescribed conditions. [11]

For the assessment of eligibility for the grant of the use of eco-label the Minister of Environment set up the Committee to determine eligibility for the grant of the use of eco-label. [11]

The Commission is composed of five members, one is representative of the Ministry, one representative of the ministry in charge of standardization, one representative of the Serbian Chamber of Commerce responsible for the field of industry, one consumer representative and one expert from the list of experts established for each product group separately. [11]

3. SELECTION OF PRODUCT CATEGORY AND DEVELOPMENT OF CRITERIA FOR EVALUATING

Many European countries have decided to implement the national eco-labeling schemes, and some are from specific reasons accepted the existing program of the European Union. Development of eco-labeling in the Republic of Serbia is a combination of these two approaches.

Developing countries generally develop a national eco-labeling program on the model of programs in developed countries such as Germany, the European Union and others. This is exactly the case with Serbia, which program of eco-labeling is adapted to the program of European Union. This can be considered a rational approach, given the level of development and credibility of the EU

program, not to forget the fact that Serbia aspires to EU integration.

Generally, the most demanding process, in the eco-labeling programs, is to define categories and groups of products (in which will be awarded a license for the use of eco-label) and the development of criteria for them. Selection of product categories is actually the basis for defining the specific criteria which a license is granted for use of the eco-label of the product/service. This is important because the criteria differ between product groups. This means that they must be strictly defined for each product group, as is the practice in developed countries.

Product categories are divided into product groups. For example, in EU eco-labeling covers the product categories *floor coverings* is divided into three groups, namely the *wooden coverings*, *hard floor coverings*, and *textile coverings*. These groups differ in many items, ranging from raw materials that are used to obtain a final product, to the way of production. Thus, the criteria for this group, which the manufacturer must fulfill in order to obtain the right to use eco-label can not be the same, but must be defined for each group separately.

Defining criteria for product groups is difficult and time consuming task, involving a large team of people, experts from various professions.

According to the ISO 14020 series, the criteria for award of an ecolabel must be based on life cycle considerations. It is therefore logical to use Life Cycle Assessment (LCA) as a basis for developing ecolabelling criteria. [12]. LCA can be defined as a tool for helping environmental decision making, by means of identifying the environmental impacts produced by a product or a process. [13]. However, LCA has been criticised for lack of transparency and scientific rigour. Furthermore, neither ecolabelling nor the application of LCA to ecolabelling is well established in developing countries [12].

Apart from the limitations of LCA, the use of LCA also appears to be problematic especially in developing countries. LCA is viewed as a resource- and time-intensive procedure. Limited knowledge in LCA and experience in its potential application is another barrier. Moreover, it is often the case that baseline data, especially describing background systems, are not always available in these countries and thus LCA practitioners have to supplement the missing data by using the databases provided in commercial LCA software, adding to the low confidence level of LCA results. Connected to this, the cost and time associated with the collection of inventory data along the entire life cycle are also seen as constraints to the use of LCA in developing countries. [12].

Eco-labeling criteria are different in the existing programs for eco-labeling. Specific differences are noted between the programs of developed countries and developing countries. Thus, the criteria of developed countries are much stricter, and as such are hardly applicable in developing countries. One of the reasons for that is the presence of less modern technology in developing countries, which have a greater impact on the environment.

Practice has shown that many developing countries established an eco-labeling program modeled on developed countries. Therefore, in development of the criteria, developing countries can rely on existing criteria of developed countries, but it should be reduced, so that manufacturers could fulfill them, but this limit should not be either too low or too severe, but according to the degree of development of the country. The gradual development of eco-labeling, criteria should be revised, as is the case in many programs.

Number of eco-label is growing rapidly and in many cases it is not clear what criteria include in some eco-labeling programs. This increases confusion and decreases the confidence in these labels,

and consumers are faced with the problem of recognizing the difference between the labels and thus become confused in making decisions when purchasing products [5].

Eco-labeling program in the Republic of Serbia is young, and therefore still not well developed, and can not be considered as an effective tool for environmental management. In the regulations for the award of label are prescribed the general (descriptive) criteria for granting a license to use the the eco-label, for any product, except for food, beverage and pharmaceutical products. In these criteria are not defined allowed values of individual compounds, energy consumption, raw material sourcing, ban the use of certain toxic chemicals, and other parameters that are included in the criteria of developed programs. In order to eco-labeling program of the Republic of Serbia became an effective and credible, it is necessary to establish the system of selections of product categories, and define specific criteria that will be adapted to the current level of economic development.

4. RESEARCH AIMS AND METHODS

The aim of this paper is to develop a methodology for improving the defining the criteria for product groups based on existing criteria of the EU eco-labeling, which would contribute to the efficient management of the eco-labeling program. The aim of this research is to evaluate the European criteria for awarding rights to use the eco-label with the method of multicriteria decision making.

Since the LCA results in developing countries based on a number of assumptions, and as such they lose confidence. This causes the application of other tools that will remove the deficiencies. One such tool is multicriteria analysis.

4.1 Multicriteria analysis

Multicriteria decision making and multicriteria analysis are in the area decision making theory. Theory of decision making is an area in which are facing the economy, mathematics, statistics, psychology, sociology, organizational theory, philosophy and other sciences. Basic terms decision making theory are decision, the decision maker, decision making, the general characteristics of the decision and so on.[14]

In multicriteria analysis of the main goal is to consistently overcome the difficulties encountered by the analyst in solving problems with large amounts of complex information. It covers many different techniques that vary in approach to the problem ie. method of aggregation of data given for individual measurable criteria in order to determine the overall performance of alternatives with respect to a set of explicitly defined goals [14]. In doing so, the multicriteria analysis techniques can be used to identify a preferred option, to rank options, to choose a limited number of options or to simply distinguish acceptable from unacceptable option. [15]

In order to make a good decision, it is necessary to define appropriate criteria and alternatives. It is also necessary to define the weights of each criterion, and the importance of each criterion relative to others. Weights are usually numbers that are subjectively chosen. In addition, for each criterion to determine whether it is necessary to choose an alternative criterion is the minimum or maximum (some need to maximize and minimize any) and what is the nature of the criteria. After that, for each criterion separately evaluate alternatives based on the exact set of parameters or subjective assessment. The way to show that assessment depends on the chosen method is used for troubleshooting. [15]

In multiple criteria decision making

can be distinguished the following phases [16]:

- defining the objectives, criteria and alternatives,
- establishment of decision-making matrix (matrix of performance),
- determination of weight of criteria,
- multicriteria decision making,
- obtaining value-ranking alternatives.

The order of execution of the main phase of multiple criteria is shown schematically in Figure 2.

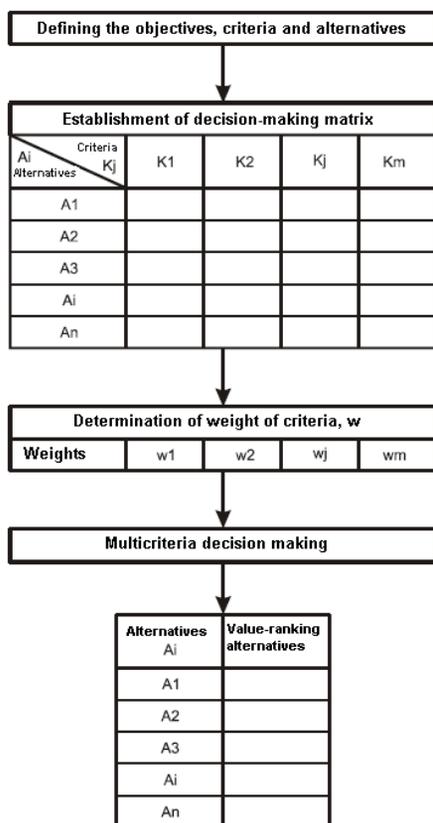


Figure 2 – Application of multicriteria analysis in the process of defining the criteria for award of rights to use the eco-label

4.2 Analytical Hierarchy Process as a tool for decision making

Analytical Hierarchy Process (AHP)

is one of the most scientific method of scenario analysis and decision making with a consistent valuation hierarchy whose elements are the objectives, criteria, subcriteria and alternatives.

AHP is a decision support system. It contains a correct mathematical model and is realized in form of the software for the PC platform with full technical support, generally there is many reason to be, in a computer version of Expert Choice 2000, a commercial general-purpose method in multicriteria decision making. [14]

AHP is extensively used for decision making in the areas of management, allocation and distribution. AHP is one of a class of methods for soft optimization. Basically it is a specific tool for creating and analyzing decision-making hierarchy. AHP primarily enables to create interactive hierarchy problem as the preparation of decision-making scenarios, and then evaluating pairs of elements in hierarchy (goals, criteria and alternatives) in top-down direction. At the end is a synthesis of all evaluations, and according to strictly determined mathematical model is defining weights of all elements of the hierarchy. The sum of weights of elements at each level of hierarchy is equal to 1 which enables the decision maker to rank all the elements in the horizontal and vertical sense. [14]

AHP enables interactive analysis of the sensitivity of the evaluation process on the final ranks of the elements of hierarchy. In addition, in evaluation of the elements of the hierarchy, until the end of the procedure and synthesis results, we examine the consistency of reasoning of decision-makers and determine the correctness of the obtained rankings of alternatives and criteria, and their weight values. [15]

Methodologically speaking, AHP is based on the decomposition of complex problems in the hierarchy. The goal is located at the top of the hierarchy, while the criteria, subcriteria and alternatives at

lower levels. [14]

AHP is flexible because it allows that in the complex problems with many criteria and alternatives is relatively easy to find a relationship between the influencing factors, explicit or recognize their relative influence and importance in the real conditions and to determine the dominance of one factor over another. The method, in fact, anticipates the fact that even the most complex problem can be broken down into a hierarchy so that in further analysis included both qualitative and quantitative aspects of the problem. AHP holds all parts of the hierarchy in a relationship, so it's easy to see how changes in one factor affect on the other factors.

5. CASE STUDY - IMPLEMENTATION MULTICRITERIA ANALYSIS IN THE EVALUATION OF CONCRETE PRODUCT GROUP

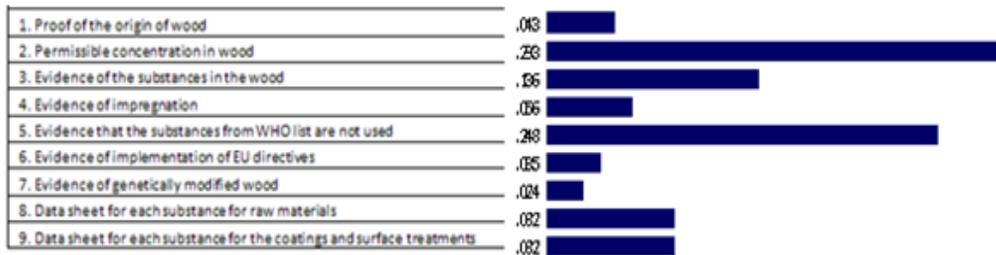
As already mentioned, in this paper is realized evaluation of EU criteria for the award of license on the use of the eco-label for the wood floor coverings, using AHP

multicriteria techniques. The analysis used the software Expert Choice. Processing consists of comparing the criteria with each other. Expert in this area gives subjective evaluation of the importance of criteria, and thus gives weight to the each criterion. The criteria with higher weight are more important than the criteria of lower weight. The results are shown in Figures 3 and 4.

As can be seen, the results show which higher priority criteria are, and on the basis of that, it can be made their ranking. The results can be considered relevant for another reason. Inconsistency is 0.09, and is considered acceptable. The inconsistency is acceptable to the values of 0.1, and if it is more, than is not considered acceptable, and then the analysis would have re-done.

	1	2	3	4	5	6	7	8	9
1. Proof of the origin of wood		(9,0)	(5,0)	(3,0)	(7,0)	(3,0)	(5,0)	(3,0)	(3,0)
2. Permissible concentration in wood			(3,0)	(5,0)	(3,0)	(5,0)	(7,0)	(3,0)	(3,0)
3. Evidence of the substances in the wood				(3,0)	(3,0)	(3,0)	(3,0)	(3,0)	(3,0)
4. Evidence of impregnation					(5,0)	(3,0)	(3,0)	(3,0)	(3,0)
5. Evidence that the substances from WHO list are not used						(5,0)	(7,0)	(5,0)	(5,0)
6. Evidence of implementation of EU directives							(3,0)	(3,0)	(3,0)
7. Evidence of genetically modified wood								(3,0)	(3,0)
8. Data sheet for each substance for raw materials									(1,0)
9. Data sheet for each substance for the coatings and surface treatments									

Figure 3 - Determining the weight of criteria for the eco-label with AHP method



Inconsistency: 0.09

Figure 4 - European criteria with the assigned weights

6. CONCLUSION

From the results it can be concluded that multicriteria decision making method can be applied in the eco-labeling, for the evaluation criteria for the award license to obtain the eco-label. This method should simplify and facilitate the development and implementation of European criteria in the eco-labeling programs in developing countries.

Possible directions for further research

lies in finding new methods for the selection of categories / product groups that are unique to the eco-labeling program of the Republic of Serbia and that do not exist in the eco-labeling of the European Union, and that will give a personal touch and originality of the program, and finding a method for defining the criteria, as well.

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