

A combination of the Multi-criteria approach and SWOT analysis for the identification of shortcomings in the production and marketing of local food

Jernej PRIŠENK[1*] and Andreja BOREC[1]
[1]University of Maribor, Faculty of Agriculture and Life Sciences, Pivola 10, 2311 Hoče, Slovenia

ABSTRACT

A combination of multi-criteria decision analysis (MCDA) and SWOT analysis was developed by applying the DEX method for the identification of shortcomings of the production and marketing of local food products in Slovenia. Additionally, a plus-minus 1 analysis was introduced and the influences of different attributes on the final assessment of the local food products were examined. The main shortcomings in the production and marketing processes for local foods were found, and results were given in the form of attributes represented as **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats. The joint results of DEX and SWOT analysis gave clear information as to which attributes or factors need to be improved for the success of local food production.

Key words: local food, multi-criteria decision model, DEX, SWOT analysis

INTRODUCTION

There is no precise definition as to what a local food system entails, but according to many literature sources worldwide, local food systems focus on supporting smaller local farms (and thus the local economy), protecting the environment by decreasing food-miles travelled and using fewer synthetic chemicals. Another valid way of thinking about local food is that its environmental impact depends not only on how far the food is transported, but also on how it is transported. Particularly from the consumer perspective, local food is predominantly about distance (Hingley et al. 2010). Furthermore, from an EU policy point of view, it is widely understood that European agriculture's best chance for competing on the world stage is to focus on quality, and to develop local food systems which can help to encourage the production of high-quality food using particular production methods. Indeed, Mintel (2010) indicates that buying locally sourced products is increasingly motivated by support for local farmers, food producers and retailers.

According to many authors (Weatherell et al. 2003, Tregear et al. 2007, Mintel 2010, Vechio 2010), local food marketing could be perceived as a development opportunity, although many obstacles are identified in relation to consumers, retailers' small local business and policy. Hingley (2010) even concludes that according to a study in UK, the lack of definition of local food is a major obstacle for the development of the local concept and its translation to consumers. In Slovenia, the number of studies on local food has increased in recent years (Bratec 2007, 2008, Majkovič and Borec 2010), but there are still no comprehensive frameworks or results which could give us the exact factors hampering the development of the local concept.

The objective of this paper is to determine and understand the main shortcomings in the process of producing local food, as these may be recognised as important factors hindering the development of the local food concept in Slovenia.

To identify these shortcomings, we need to apply a relatively easy, transparent and useful tool to assess the production and marketing of local food. According to some previous research, multi-criteria decision analysis (MCDA) seems to be applicable (Tiwari et al. 1999, Hyde and Maier 2006, Herman et al. 2007, Pažek et al. 2007, Rozman et al. 2009, Pavlovič et al. 2011). The most commonly used MCDA methods are multi-attribute utility theory (MAUT) and the analytical hierarchical process (AHP) (Saaty 1980, Alphonce 1997, Parra-Lopez et al. 2008, Galli et al. 2011), which both use a quantitative assessment of alternatives. In contrast, Bohanec et al. (2000) presented another MCDA method, the DEX system, which deals with qualitative decision models. To support decision making and to analyse environments in a systematic way, the most commonly used tool is SWOT analysis (Kotler 1988, Wheelen and Hunger 1995). According to Kajanus et al. (2012), SWOT analysis is an essential tool for strategic decision making and has been developed in various contexts (Hill and Westbrook 1997, Chang and Huang 2006, Feglar et al. 2006).

For our research proposes, we use a combination of one

*Correspondence to:
E-mail: jernej.prisenk@um.si

MCDA technique (the DEX methodology) and SWOT analysis. Kajanus et al. (2012) note that the rationale for using multiple-criteria decision support (MCDA) and SWOT framework jointly has to do with the systematic evaluation of SWOT factors with a view to making them commensurable in terms of their intensities (Kurttila et al. 2000). Helms and Nixon (2010) described SWOT analysis in research as a practical planning tool, and argued that it is a relevant assessment methodology in many ways. Shrestha et al. (2004) combined a quantitative MCDA method, specifically AHP, and SWOT analysis for the assessment of different silvopasture practices. In our research experience with the DEX method (Pažek et al. 2006, Pažek et al. 2010, Prišenk et al. 2012), we have found that the combination of DEX methodology and SWOT analysis is very compatible and efficient, as both of these approaches are based on qualitative assessments, whereas the combination with other MCDA methods is based on quantitative assessments.

MATERIAL AND METHODS

Methodology and data sources

For our research purposes, the DEX methodology was applied as an approach to qualitative multi-criteria decision modelling and support by Bohanec and Rajkovič (1990) and Tojnko et al. (2011). The DEX method is implemented by the software program DEX-i (Bohanec et al. 2008). For the DEX methodology, quantitative input data were transformed (with MS Office Excel) into qualitative values (for example, 'bad', 'good' and 'excellent'; 'low' or 'higher', etc...) and afterwards further applied for SWOT analysis. Input data for DEX were based on an open questionnaire prepared for compatible local food chains actors and individuals from local action groups (LAGs), mostly from mountainous and hilly regions of Slovenia. The selection of LAGs was based on characteristics such as remoteness, harsh environmental conditions and lack of infrastructure and public services, as well as on negative demographic trends and the unfavourable age structure of inhabitants. The interviews and field work were carried out between July and October 2011. Questionnaires were designed for the analysis of local food products which are typical for small local environments and are included in the development projects of different LAGs. Taking these restrictions into account, we examined 10 different local food products from seven LAGs in mountainous and hilly Slovenian regions. After the interviews were complete, the development of the model followed.

Model development

The first step in multi-criteria method development is the structuring of the decision hierarchy (Rozman and Pažek 2005). A hierarchical tree was created before interweaving began (all attributes based on interview answers). The hierarchical tree represents the process of solving the problem, where each problem is constructed from sub-problems on the first and second levels (the number of levels depends on complexity of the main problems) (Figure 1).

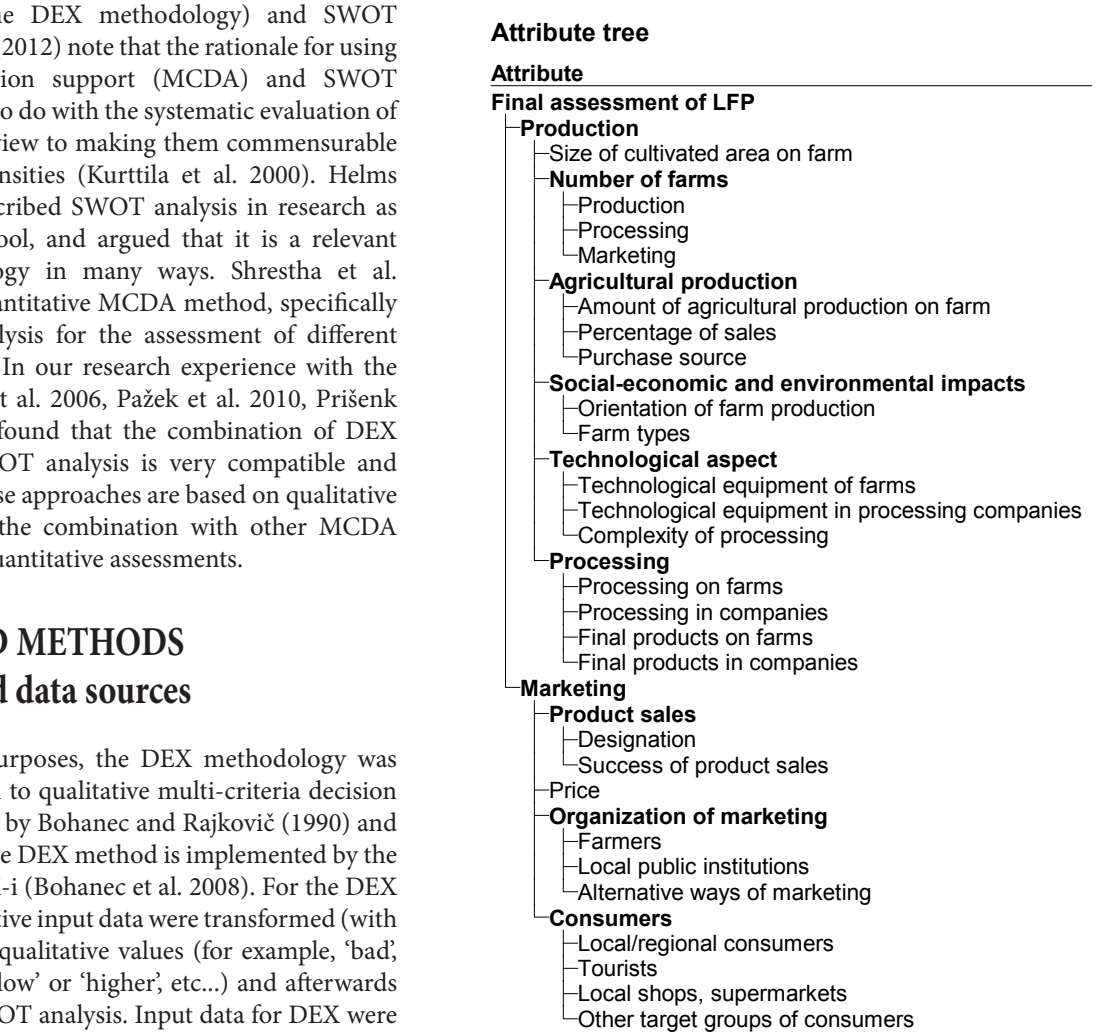

Figure 1: Hierarchical tree of the developed DEX model

Each of these problems and sub-problems is represented as attributes which have defined value scales. For assessment of the production system of local food products, five aggregate attributes were identified: 'Number of farms', 'Agricultural production', 'Social-economic and environmental impacts', 'Technological aspect' and 'Processing'. Furthermore, one non-aggregate attribute was delineated, specifically 'Size of cultivated area on farm'. The 'Marketing' aggregate attribute consists of three aggregate attributes—'Product sales', 'Organisation of marketing' and 'Consumers'—and one non-aggregate attribute, 'Price', on the second level.

The third step in model development was the definition of value scales. With the previous data treatment in MS Office Excel, the numerical values were distributed into three-stage scales, which were given qualitative values after the definition of the utility functions. The last step in the model development was the definition of utility functions (UF1 and UF2) (i.e. decision rules) (Figure 2). The decision rules describe the value of an aggregate attribute for each combination of input attributes and express the relative importance of individual attributes (Rozman and Pažek 2005).

To define the decision rules in the DEX method, two approaches are employed. The first approach uses linear regression with weights; this was adopted in our research. The second approach is based on measuring attributes'

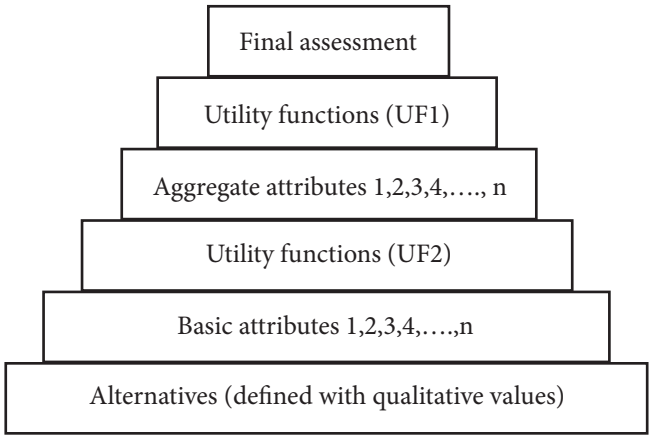

Figure 2: The structure of the DEX model

informativity, as in machine learning methods (Bohanec et al. 2000).

For research purposes, the definitions of the best and the worst decision rules were set out by experts. The scale represents the assessment between the worst ('bad') and best ('excellent') aggregate attributes. In Figure 3, an example of a second-level attribute, 'Technological aspect', is presented. The final assessment was defined as 'bad' if the processing was found to be sophisticated. If the assessment of the third-level attribute 'Technological equipment on the farms and/or companies', as well the attribute 'complexity of processing' had the same grade, e.g., 'excellent', then the final assessment of the aggregate attribute 'Technological aspect' was also 'excellent'. Some decision rules are presented in more complex form, such as '>=', which means 'equal or better' grade.

After the DEX model was finally developed, 'plus-minus 1' analysis was performed in order to identify shortcomings among the attributes previously chosen and used in the DEX model. To obtain a more clear and comprehensible picture of these shortcomings, a combination of MCD and SWOT analysis followed the plus-minus 1 analysis (Figure 4). The combination of these two methods helps us to represent shortcomings in production and marketing more clearly

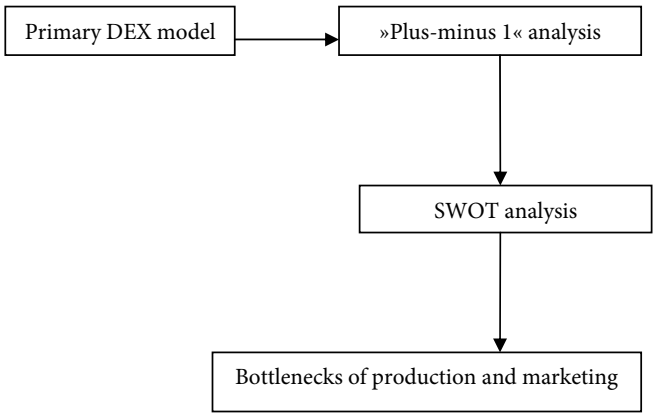

Figure 4: Combination of MCDA and SWOT analysis for the identification of shortcomings in production and marketing processes of local food products

Decision rules

	Technological equipment of farms	Technological equipment in processing companies	Complexity of processing	Technological aspect
	27%	27%	46%	
1	**Bad**	**Bad**	<=Not so complicated	**Bad**
2	**Bad**	<=Good	**Complicated**	**Bad**
3	<=Average	<=Average	**Complicated**	**Bad**
4	<=Good	**Bad**	**Complicated**	**Bad**
5	**Bad**	*	***Simple***	Good
6	<=Average	<=Good	***Simple***	Good
7	<=Good	<=Average	***Simple***	Good
8	*	**Bad**	***Simple***	Good
9	**Bad**	>=Average	>=Not so complicated	Good
10	<=Average	Average:Good	>=Not so complicated	Good
11	<=Good	Average	>=Not so complicated	Good
12	<=Good	>=Average	Not so complicated	Good
13	*	Average:Good	Not so complicated	Good
14	**Bad**	***Excellent***	*	Good
15	<=Good	***Excellent***	<=Not so complicated	Good
16	*	***Excellent***	**Complicated**	Good
17	Average	<=Good	>=Not so complicated	Good
18	Average:Good	<=Average	>=Not so complicated	Good
19	Average:Good	*	Not so complicated	Good
20	>=Average	**Bad**	>=Not so complicated	Good
21	>=Average	<=Good	Not so complicated	Good
22	Average	Good	*	Good
23	Average:Good	>=Good	<=Not so complicated	Good
24	>=Average	Good	<=Not so complicated	Good
25	>=Average	>=Good	**Complicated**	Good
26	Good	Average	*	Good
27	Good	>=Average	<=Not so complicated	Good
28	>=Good	Average:Good	<=Not so complicated	Good
29	>=Good	>=Average	**Complicated**	Good
30	***Excellent***	**Bad**	*	Good
31	***Excellent***	<=Good	<=Not so complicated	Good
32	***Excellent***	*	**Complicated**	Good
33	>=Average	***Excellent***	***Simple***	***Excellent***
34	>=Good	>=Good	***Simple***	***Excellent***
35	***Excellent***	>=Average	***Simple***	***Excellent***
36	***Excellent***	***Excellent***	>=Not so complicated	***Excellent***

Figure 3: Example of decision rules for the 'Technological aspect' aggregate attribute

and transparently, and could further represent a practical planning tool.

Plus-minus 1 analysis upgraded with SWOT analysis

The "Plus-minus 1" analysis describes changes in each basic attribute for one degree upwards and downwards, independent of other attributes (Bohanec et al. 2008). In Figure 5, the plus-minus 1 (PS-1) for a food product ten (X) is presented as an example.

The results of PS-1 represent input data for the further building of SWOT analysis. The attributes on the hierarchical tree were transformed into different factors in SWOT analysis. The attributes with higher and average (neutral) grades from PS-1 analysis are categorised as strengths and those with lower grades are categorised as weaknesses (Figure 5). Opportunities are represented by attributes defined in the +1 column in PS-1, whereas attributes in the -1 column represent threats.

RESULTS AND DISCUSSION

The results of developed model are presented for each food product as a joint or final qualitative assessment of produce and marketing and as assessments of separate aggregate attributes. For the assessment, five different grades ('excellent', 'successful', 'less successful', 'sufficient' and 'not sufficient') were used. Two of 10 food products (20%) were finally evaluated as 'excellent', 5 of 10 (50%) as 'sufficient' and 3 of 10 (33.3%) as 'less successful'. The greatest share of local food

Table 1: Grades for production and marketing of local food with final/joint assessments

Food product	Production grade	Marketing grade	Final assessment
I	Large	Successful	**Excellent**
II	Small	Partially successful	**Sufficient**
III	Small	Partially successful	**Sufficient**
IV	Small	Partially successful	**Sufficient**
V	Small	Not successful	**Not sufficient**
VI	Average	Not successful	**Sufficient**
VII	Large	Successful	**Excellent**
VIII	Small	Successful	**Less successful**
IX	Small	Partially successful	**Sufficient**
X	Average	Not successful	**Sufficient**

Plus-Minus-1 analysis

Attribute	-1	X	+1
Final assessment of LFP		**Sufficient**	
Size of cultivated area on farm	**Not sufficient**; **Sufficient**	3,1-6,5 ha	
Production		***over 350***	]
Processing		***over 350***	]
Marketing		[**0-25**	
Amount of agricultural production on farm		[*	]
Percentage of sales		[**0-25%**	
Purchase source		***Own***	]
Orientation of farm production		6,1-18	
Farm types		Part time	
Technological equipment of farms		Average	
Technological equipment in processing companies		Good	
Complexity of processing		***Simple***	]
Processing on farms	**Not sufficient**	26-50 %	
Processing in companies	**Not sufficient**	26-50 %	
Final products on farms		[**Low**	
Final products in companies	**Not sufficient**	***Yes***	]
Designation		[**No designation**	
Success of product sales		***> 95%***	]
Price		[**< 1%**	Less successful
Farmers		**No**	]
Local public institutions	Less successful	**No**	]
Alternative ways of marketing	Less successful	**No**	]
Local/regional consumers		[***Yes***	
Tourists	Less successful	**No**	]
Local shops, supermarkets		[***Yes***	
Other target groups of consumers	Less successful	**No**	]

Figure 5: Example of plus-minus 1 analysis for food product X

products received bad final grades. Looking more closely at the grades for the separate attributes, we may conclude, that the main reason for the bad final grades was the average or bad grades at the marketing level (Table 1).

The output of SWOT analysis is presented in Figure 6. The examined local food products are presented according to the factors in the SWOT analysis, and mainly show potential in the fields of promotion, marketing and consumer communication. The number of factors under strengths is much higher compared with the distribution of the other attributes. Strengths were found in different categories, specifically the farm characteristics category, the technological category, the food product characteristic category and the consumer category. We may conclude that the farms where local food products are produced are in good condition and with modern technological equipment for production or processing. The categories 'Consumers' and 'Food product characteristics' indicate that the products have a higher price, are sold at the local level to tourists and local inhabitants, and the local marketing environment is quite well developed.

Looking to the factors under the attribute weaknesses, it is evident that the main weaknesses related to the successful production and marketing of local food are connected to the number of farms which are oriented to the production, processing or sale of local food products. Indeed, studying the local food concept mostly in high-valued environments, e.g., mountains, the lack of sufficient quantities of quality local food becomes apparent. In general, many more farms and companies could be involved in the production and processing of local foods and still successfully sell their products. The last two factors are connected to the findings above: The numbers of final products offered on farms and local retail outlets are very small. Thus, the amount of each single product as well the quantity of different types of local products should be increased. Although these factors are outlined as weaknesses, they could also be discussed as

STRENGTHS:
- Amount of agricultural production on farm
- Purchasing sources
- Orientation of farm production
- Farm types
- Technological equipment on farms
- Technological equipment in companies
- Complex processing
- Designation
- Success of product sales
- Price
- Organisation of marketing: farmers
- Consumers: Local/regional consumers
- Consumers: tourists
- Consumers: other target groups of consumers

WEAKNESSES:
- Number of farms: production
- Number of farms: processing
- Number of farms: marketing
- Percentage of sales
- Processing in companies
- Final products on farms
- Final products in companies

OPPORTUNITIES:
- Organisation of marketing: local public institutions
- Organisation of marketing: alternative ways of marketing
- Consumers: local shops, supermarkets

THREATS:
- Size of cultivated area on farm
- Processing on farms

Figure 6: SWOT analysis of local food products

attribute opportunities, as there still is a lot of room in the market for quality mountain products, especially in more extended markets, e.g., regional or national ones.

'Size of cultivated area' and 'Processing on farms' are important as threat factors, and could also be discussed as real weaknesses. For example, if the average size of cultivated area on a farm falls under 6.5 ha, farmers may have problems with production size. For the 'Processing on farms' factor, the interpretation could be similar. If the production of food products on an average small farm is low, the processing of the same food product on the farm could be anticipated to be low.

CONCLUSIONS

In this paper, a combination of multi-criteria and SWOT analysis was used for the evaluation of the production and marketing of local food products. A study of local food from the Slovenian mountain and hilly regions was performed in order to determine the main shortcomings in the production and marketing system that inhibit the development of the local food concept. The results of the research were generated from the DEX methodology and SWOT analysis based on qualitative attribute values, utility functions and final critical expert assessments. Because of its relative simplicity, the model could be employed from by policy decision makers

and extension services to help farmers to improve different production stages, and consequently their economic status. We conclude that a hybrid method of MCDA and SWOT analysis can improve production and marketing, and will have a positive impact on strategic planning when it comes selling local food products.

For farmers, the results of the SWOT analysis can provide clear direction. With identification of the weakest links in the food chain, farmers can react and pay more attention to specific attributes or factors. SWOT analysis is easy to understand and has the advantage of high communicability to individuals. According to previous project experiences and the current research results, more shortcomings have been identified on the side of marketing system, although this is expected since local food products are generally marketed in the local environment and sophisticated marketing strategies are not well developed. To broaden the marked for local food, the quantity of single food products should be increased, as well as the variety of food products.

REFERENCES

1. Alphonce CB. Application of the analytic hierarchy process in agriculture in developing countries. Agr. Syst. 1997;53(1):97-112.
2. Bohanec M, Rajkovič V. DEX: An expert system shell for decision support. Sistemica 1990;1(1):145-57.
3. Bohanec M, Zupan B, Rajkovič V. Applications of qualitative multi-attribute decision models in health care. Int. J. Med. Inform., 2000;58-59:191-205.
4. Bohanec M, Messean A, Scatasta S, Angevin F, Griffiths B, Krogh PH, Žnidaršič M, Dzeroski S. A qualitative multi-attribute model for economic and ecological assessment of genetically modified crops. Ecol. Model. ,2008;215:247-61.
5. Bratec M. Slovenian Gastronomy: Through issues of quality or communication. Assignment for the course of Strategic Communication. University of Southern Denmark, 2007.
6. Bratec M. Aiming towards sustainable (tourism) development: The case of the slow food movement and its impacts in Slovenia. Assignment for the course of Sustainable Tourism Development. University of Southern Denmark, 2008.
7. Chang HH, Huang WC. Application of a quantification SWOT analytical method. Math. Comp. Model., 2006;43:158-69.
8. Feglar T, Levy JK, Feglar T, Feglar TJR. Advances in decision analysis and systems engineering for managing large-scale enterprises in a volatile world: Integrating benefits, opportunities, costs and risks (BOCR) with the business motivation model (BMM). J. Syst. Sci. Syst. Eng., 2006;15:141-53.
9. Galli F, Carbone A, Caswell JA, Sorrentino A. A multi-criteria approach to assessing PDOs/PGIs: An Italian pilot study. Int. J. Food Syst. Dynam., 2011;2(3):219-36.
10. Helms MM, Nixon J. Exploring SWOT analysis—Where are we now? A review of academic research from the last decade. J. Strategy Man., 2010;3(3):215-51.
11. Hermann BG, Kroeze C, Jawjit W. Assessing environmental performance by combining life cycle assessment, multi-criteria analysis and environmental performance indicators. J. Clenear Prod., 2007;15:1787-96.
12. Hill T, Westbrook R. The strategic development of manufacturing: Market analysis for investment priorities. Eur. Manag. J., 1997;15:297-302.
13. Hingley M, Boone J, Haley S. Local food marketing as a development opportunity for small UK agri-food business. Int. J. Food Syst. Dynam., 2010;3:194-203.
14. Hyde KM, Maier HR. Distance-based and stochastic uncertainty analysis for multi-criteria decision analysis in Excel using Visual Basic for Applications. Envir. Model. Soft., 2006;21:1695-1710.
15. Kajanus M, Leskinen P, Kurttila M, Kangas J. Making use of MCDS methods in SWOT analysis—Lessons learnt in strategic natural resources management. Forest Pol. Econ., 2012;20:1-9.
16. Kotler P. Marketing management; Analysis, planning, implementation and control, sixth ed. Prentice-Hall International Edition, New Delhi, 1988.
17. Kurttila M, Pesonen M, Kangas J, Kajanus M. Utilizing the analytical hierarchy process (AHP) in SWOT analysis—A hybrid method and its application to a forest-certification case. Forest Pol. Econ., 2000;1:41-52.
18. Majkovič D, Borec A. Are consumers in Slovenia concerned about the mountain quality food? J. Geography 2010;5(1):115-24.
19. Mintel. Consumer food labelling. Mintel, UK, 2010.
20. Parra-Lopez C, Calatrava-Requena J, De-Haro-Gimenez T. A systemic comparative assessment of the multifunctional performance of alternative olive systems in Spain within an AHP-extended framework. Ecol. Econ. 2008;64(4):820-34.
21. Pavlovič M, Čerenak A, Pavlovič V, Rozman Č, Bohanec M. Development of DEX-HOP multi-attribute decision model for preliminary hop hybrids assessment. Comp. Elect. Agric., 2011;75:181-89.
22. Pažek K, Rozman Č, Borec A, Turk J, Majkovič D, Bavec M, Bavec F. The use of multi criteria models for decision support on organic farms. Biol. Agric. Hortic., 2006;24(1):73-89.
23. Pažek K, Rozman Č, Borec A. The application of simulation and multi-criteria decision models to support decision making on farms with agricultural production in less favoured areas [Scientific monograph]. Faculty of Agriculture and Life Sciences, University of Maribor, Maribor, Slovenia, 2007.
24. Pažek K, Rozman Č, Bavec F, Borec A, Bavec M. A multi-criteria decision analysis framework tool for the selection of farm business models on organic mountain farms. J. Sustain. Agric., 2010;37(7):778-99.
25. Prišenk J, Borec A, Pažek K. Role of public-private partnership by marketing of mountain food products. International conference of agricultural engineering (CIGR-Angeng 2012), July 8-12, Valencia, Spain, 2012.
26. Rozman Č, Pažek K. Application of computer supported multi-criteria decision models in agriculture. Agr.

Consp. Sci., 2005:70(4):127-34.
27. Rozman Č, Potočnik M, Pažek K, Borec A, Majkovič D, Bohanec M. A multi-criteria assessment of tourist farm service quality. Tourism Man., 2009;30:629-37.
28. Saaty TL. The analytic hierarchy process. McGraw-Hill, New York, 1980.
29. Shrestha RK, Alavalapati JRR, Kalmbacher RS. Exploring the potential for silvopasture adoption in south-central Florida: An application of SWOT-AHP method. Agr. Syst., 2004;81:185-99.
30. Tiwari DN, Loof R, Paudyal GN. Environmental-economic decision-making in lowland irrigated agriculture using multi-criteria analysis techniques. Agr. Syst., 1999;60:99-112.
31. Tojnko S, Rozman Č, Unuk T, Pažek K, Pamič S. A qualitative multi-attribute model for the multifunctional assessment of 'Streuobst Stands' in NE Slovenia. Erwerbs Obstbau 2011;53(4):157-66.
32. Tregear A, Arfini F, Belletti G, Marescotti A. Regional foods and rural development: The role of product qualification. J. Rur. Stud., 2007;23(1):12-22.
33. Vecchio R. Local food at Italian farmers' markets: Three case studies. Int. J. Sociol. Agr. Food., 2010;17(2):122-39.
34. Weatherell C, Tregear A, Allinson J. In search of the concerned consumers: UK public perceptions of food, farming and buying local. J. Rur. Stud., 2003;19:233-44.
35. Wheelen TL, Hunger JD. Strategic management and business policy, fifth ed. Addison Wesley, Reading, MA, USA, 1995.

Received: July 19, 2012
Accepted in final form: August 25, 2012