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RISK ASSESSMENT IN HEMP (*Cannabis sativa L.*) PRODUCTION AND PROCESSING

Sandija Zēverte-Rivža*, Dr.oec.; **Aleksandrs Adamovičs**, Dr.agr.
Faculty of Economy and Social Development, Latvia University of Agriculture
Faculty of Agriculture, Latvia University of Agriculture

Abstract. Agriculture (including hemp production and processing) is one of the industries subject to risks due to changing weather conditions, diseases, pests and volatile market prices on inputs and products produced. However, the use of risk assessment methodologies in hemp production and in agriculture as a whole are not widespread. This **article aims** to reflect the preliminary results of the risk evaluation in hemp production and processing. The following **tasks** were set to reach this aim: to analyze the risk evaluation methodology and risk calculation methodology; to determine and systematize risks in hemp production and to carry out a preliminary evaluation for risks in hemp production using semi-quantitative evaluation. For the evaluation purposes the hemp production is divided in five stages - preparation of soil and sowing of hemp; growing of hemp; hemp harvesting; hemp processing; and selling of the produced output. The evaluation of risks was done within a system of 18 risks, divided in six main groups – agro-meteorological; technological and production; personnel; environment; legislative; economic, and market risks. The results indicate that the highest risk level in the entire hemp production and processing process was specific to the group of personnel risks, whereas the lowest – to the group of environmental risks.

Key words: risk management, hemp production, hemp processing, risk evaluation.
JEL code: D81

Introduction

The sector of hemp growing and processing is subjected to significant changes through the past decades. Historically hemp growing was widespread and in Latvia hemp was broadly used in everyday life – in the local cuisine, for feeding animals and also as a building and textile material. In the last decades the amounts of hemp growing reduced but following the global tendencies in agriculture, growing and processing of hemp (*cannabis sativa L.*) is regaining its popularity mainly due to the versatile possibilities of using hemp. Though, the

* Corresponding author. Tel. +371 26387278. E-mail Sandija.Rivza@llu.lv

total number of hemp growers is significantly smaller nowadays as it has been historically, the use of hemp is expanding and within recent years several enterprises have introduced new products that include using hemp in food production, production of ecological construction materials, paper, production of textiles, biodegradable plastics and renewable energy production.

Agriculture, including hemp production and processing, is one of the industries subject to risks due to changing weather conditions, diseases and pests and volatile market prices on inputs and products produced. However, the use of risk assessment methodologies in agriculture is not widespread but it is specific to the financial and investment sector. Risk assessment is a process in which the significance of risk is determined (Ferraris, s.a.). Risks may be managed in various ways, which, to some extent, allows forecasting the emergence of risks and carrying out activities to reduce the level of risks. Nowadays, risk management is understood as a set of methods, techniques and activities that assist in forecasting risks to a certain extent and in designing activities to avoid the risks or to reduce their negative effects (Rurane, 2001).

Materials and methods

After analysing the term risk in scientific literature (Hardaker, Huirne, 2004; Pettere, Voronova, 2004; Arhipova, 2002; Suskevica, 2005; Boading, 2011; Definitions of Risk, s.a. et al.) and the principles in risk definition set by a German sociologist Ortwin Renn (Renn, 2008), risks within the present research are defined as follows: *risk is a combination of the probability of occurrence of an event and the severity level of negative effects caused by it*.

Risk is calculated by the following formula:

$$R_i = V_i \times B_i , \quad (1)$$

where

R_i – numerical value of the i-th risk event;

V_i – probability of occurrence of the i-th risk event;

B_i – severity of losses from the occurrence of the i-th risk event.

Formula 1 includes two components: probability of occurrence of a risk and severity of losses from the occurrence of the risk. To calculate the risk, two mentioned components have to be expressed as quantitative values, and scales are often used to express them, defining each interval of the scale in accordance with the specifics of any research performed. Such an approach is employed further in the present research.

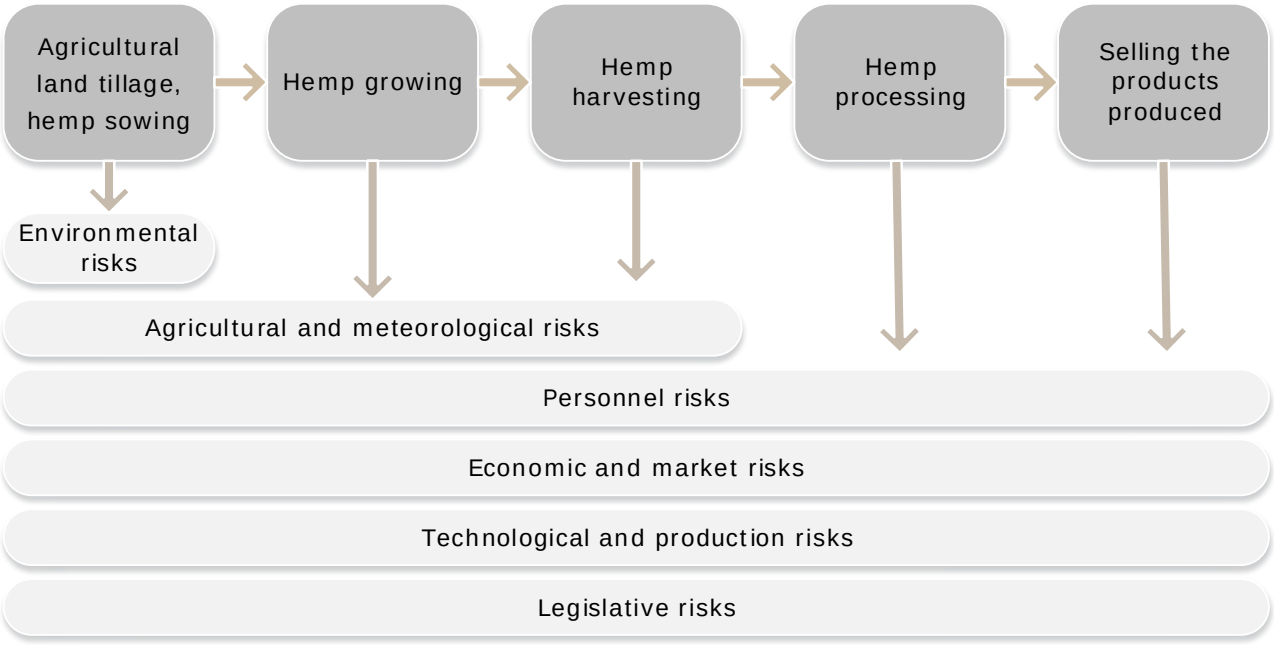
A classification of risks was performed by analyzing risk management studies in agriculture and in production of renewable energy that allowed to identify dominant and specific risk groups for the further evaluation. It can be concluded that technological, environmental, legislative, financial and investment risks prevail (Olivier, s.a.; Financial Risk Management, 2004; Froggatt, Lhan, 2010; Ferraris, s.a.), while such groups of risks as social,

macroeconomic, resource, short-term and long-term operational risks and reputational risks are less frequent (Financial Risk Management, 2004; Froggatt, Lhan, 2010; Aragonés-Beltrán, Pastor-Ferrando, 2009).

Three experts that are connected with growing hemp and/or research in hemp production were questioned to obtain the preliminary risk evaluation results. They determined the probability of occurrence of each risk and the potential severity of losses from these risks. Based on the results, a risk level was calculated for each risk assessed by the experts; from it, in its turn, the average risk level was calculated for all experts' assessments as well as the average risk group level for the six basic groups of risks and for each phase of the production and processing process.

Research results and discussion

Given the above-mentioned, a risk assessment system was developed to assess risks in hemp production and processing; the risks in it were classified into six basic groups: technological and production, personnel, environmental, economic and market, and agricultural and meteorological risks. Within the basic groups of risks, a detailed classification of the specific risks affecting the production process was developed based on the analysis of specific scientific literature (Strazds, et al., 2012; Vilnitis, et al. 2011; Industrial Hemp, 1999; Environmental Risks…, 2013).



Source: author's construction

Fig.1. **Classification of risks for assessing the risks in hemp production and processing**

The process of hemp production and processing is divided into five phases (Fig.1): **agricultural land tillage and hemp sowing** – this phase involves the choice of hemp seed, which is affected by legal provisions on hemp varieties that are entitled to the EU direct

payments, land tillage and hemp sowing. Both these processes are subject to economic and market risks, agricultural and meteorological risks as well as environmental (use of fertilisers), technological and production risks (working condition of machinery, availability and quality of seed); **hemp growing** is subject to agricultural and meteorological, environmental, technological and production as well as personnel risks. To a lesser extent, it is also subject to economic and market and legislative risks.

Hemp harvesting, just like hemp growing, mainly involves agricultural and meteorological, technological and production as well as personnel risks. The other groups of risks can affect this process but to a smaller extent; at the phase of **hemp processing**, there are no effects of agricultural and meteorological risks, while the effects of technological and production risks increase. **However**, sales of the products produced are affected by the demand for these products and their market price; accordingly, economic and market risks affect the sales in the most direct way. Yet, even at this stage legislative risks might have their effects through setting quality standards for product sales and changing taxes and in other cases.

A specific effect area and a risk level were determined for each of these factors. The risks in hemp production and processing were classified based on an analysis of specific scientific literature (Strazds, et al., 2012; Vilnitis, et al., 2011; Industrial Hemp, 1999; Environmental risks..., 2013; Olivier, s.a.; Financial Risk Management, 2004; Froggatt, Lhan, 2010; Ferraris, s.a.). To assess the risks, the mentioned six groups of risks were divided into 18 particular factors (Table 1). According to Formula 1, before assessing the severity of a risk probability of occurrence of the risk and severity of losses from the occurrence of the risk have to be determined. The risk level is calculated by multiplying the two parameters. For each of the 18 factors, a specific effect area was determined and the risk level was calculated using a scale of 1 to 25, where 1-3 points meant acceptable risks, 4-9 – medium significant risks, 10-19 – significant risks, and 20-25 – extreme risks (Guide to Risk Management, 2004).

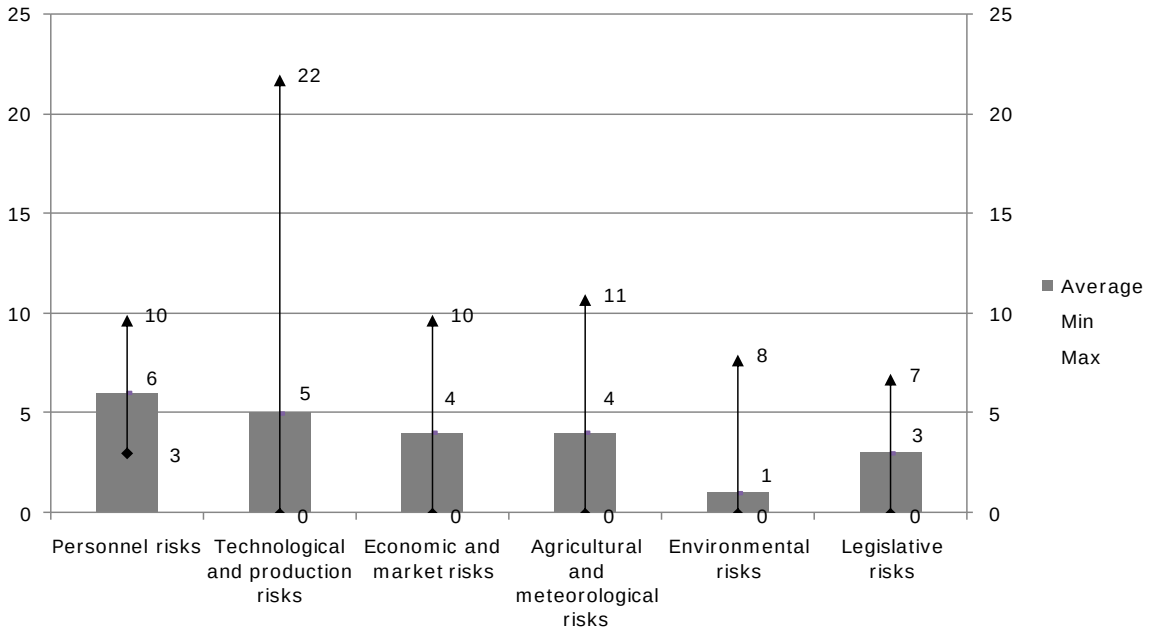
Table 1

Characteristics of the risks in hemp production and processing and their distribution by group of risks

Characteristics of risks	Group of risks
Low qualification of personnel and the lack of their responsibility	Personnel risks
Violations of occupational safety rules	
Low quality of seed	Technological and production risks
Unavailability of machinery	
Machinery operational problems	
Low quality of agricultural and technological operations	
Delayed deliveries of spare parts for equipment and delayed maintenance services	
Changes in sale prices on products	Economic and market risks
Changes in purchase prices on inputs (seed, plant protection chemicals, fertilisers etc.)	
Changes in other fixed and variable costs	
Effects of meteorological conditions	Agricultural and meteorological risks
Effects of pests and birds	
Inadequacy of agricultural land for growing hemp	
Environmental risks when fertilising fields	Environmental risks
Environmental risks when processing hemp	
Limitations of receiving direct payments	Legislative risks
Changes in the tax policy	
Changes in the quality and safety standards for the products produced	

Source: author's construction

The results obtained from the risk assessment showed (Fig.2) that, on average, the highest risk level in the entire hemp production and processing process was specific to the group of personnel risks (6), whereas the lowest – to the group of environmental risks (1). The group of personnel risks was the only group of risks that was homogenously assessed by the experts as medium significant for all the phases of hemp production and processing. However, some risks were assessed as the highest for the group of technological and production risks, for instance, the unavailability of machinery during hemp harvesting and processing.



Source: author's construction

Fig.2. **Dispersion of the significance of risks for the groups of risks for all the phases of hemp production and processing**

After analysing the results for each phase of hemp production and processing (Fig.3), one can find that, on average, the risk effects were assessed as the highest for agricultural land tillage and hemp sowing, while some very significant risks were specific to hemp harvesting and processing, at 22 and 20 points, respectively, and, as mentioned before, this was the risk of unavailability of machinery.

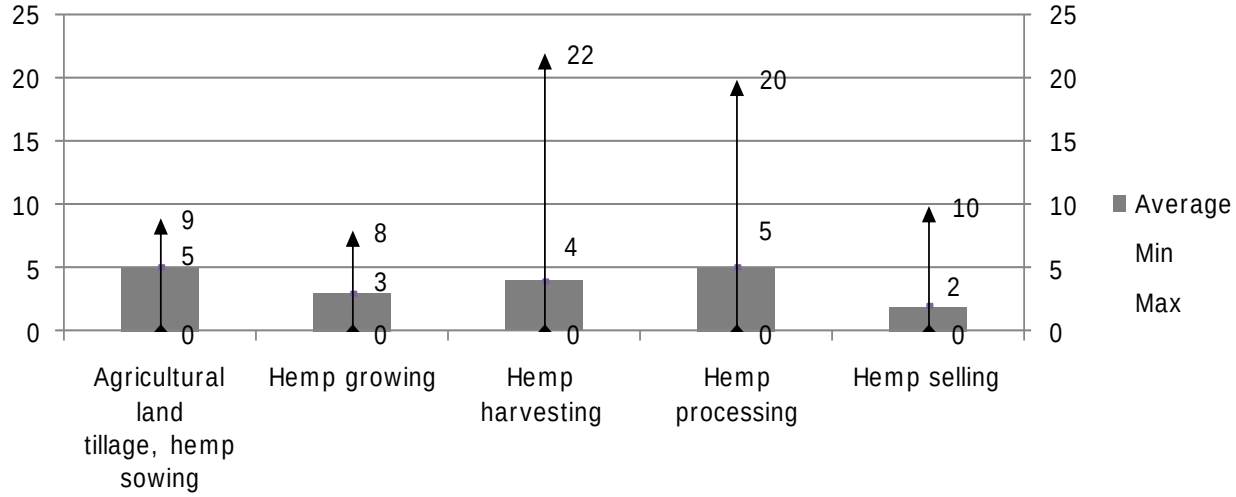


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Fig.3. **Dispersion of the significance of risks for the phases of hemp production and processing**

After analysing individual risks for each phase of hemp production and processing, it can be concluded that the experts' assessments for **agricultural land tillage and hemp sowing** were quite different − on average, the most significant were the risk of changes in purchase prices on inputs (seed, plant protection chemicals, fertilisers etc.) (9), the risk of low quality of seed (7) and the risk of changes in the tax policy (7). For **the phase of hemp growing**, the most significant were agricultural and meteorological risks, especially effects of pests and birds, with the maximum of 20, and the inadequacy of agricultural land for growing hemp; however, this phase does not involve several risks associated with hemp sowing and processing. For **the phase of hemp harvesting**, the risk of unavailability of machinery was extremely significant, 22 points; making this the most significant risk not only for a particular phase but for the entire risk assessment. The following risks, for the same phase, were also significant: effects of meteorological conditions, low quality of agricultural and technological operations and low qualification of personnel and the lack of their responsibility, while machinery operational problems were a medium significant risk. For **the phase of hemp processing**, too, the most significant risks were unavailability of machinery (20) and machinery operational problems (11); the two personnel risks, with 10 points, were also significant. As regards the **phase of sales of products**, the risk effects were comparatively lower; on average, significant risks were: changes in sale prices on products (10) and low qualification of personnel and the lack of their responsibility (7). On the whole, the lowest assessments were given to the groups of environmental and legislative risks − environmental risks quite insignificantly affect the phases, while legislative risks can more affect several phases; yet, since presently no changes are expected regarding legal provisions, standards or taxes, the effects of these risks are small.

Further, the research will focus on the differences in risk effects depending on the ways of using hemp. Since the present results show the distribution of significance of risks for hemp production and processing but the experts, when doing their assessments, admitted that this was a quite complicated and time-consuming activity the further research will omit insignificant risks and will focus only on those presently having medium significant and significant effects.

Conclusions

The obtained results showed that, on average, the highest risk level in the entire hemp production and processing process was specific to the group of personnel risks, whereas, the lowest − to the group of environmental risks. That indicates that the actions and the decisions made by the employees are the one that affect the hemp growing and processing process the most. However, some risks were assessed as the highest for the group of technological and production risks, for instance, the unavailability of machinery during hemp harvesting and processing.

The significance of risk groups and also individual risks differed among the risk groups, for example, for the phase of hemp growing, the most significant were agricultural and meteorological risks, especially effects of pests and birds, with the maximum of 20, and the inadequacy of agricultural land for growing hemp but for the phase of hemp harvesting, the risk of unavailability of machinery was extremely significant, and reaching 22 points.

The process of getting preliminary results showed that making the risk evaluation is rather complicated and time-consuming for the farmers therefore in the further research insignificant risks (following the results of the preliminary evaluation) would need to be omitted.

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Bibliography

1. Aragonés-Beltrán, P., Pastor-Ferrando, J.P., Chaparro-González, F., Bautista, R.P. (2009). Selection of Photovoltaic Solar Power Plant Projects Using ANP. In: *Proceedings of the International Symposium on the Analytic Hierarchy Process.* Pittsburgh, Pennsylvania, USA. p. 11. Retrieved: http://www.isahp.org/2009Proceedings/Final_Papers/4_Aragones-Beltran_SOLAR_REV_FIN.pdf

2. Arhipova, I. (2002). Risk Management Methodology in Latvian Economics. In: Proceedings of the *6th ERC/METU Internationa lConference in Economics*, Ankara, Turkey, pp. 252 – 260.

3. Boading, L. (2011). *Uncertainty Theory.* Department of Mathematical Sciences. Retrieved: http://www.orsc.edu.cn/~liu/ut.pdf

4. *Definitions of Risk* Business Dictionary (s.a.). Retrieved: http://www.businessdictionary.com/definition/risk.html

5. Ferraris, I., De la Canal, M.D., Labriola, C. (s.a.). *Risk Analysis in Renewable Energy: Assessment of the Vulnerability of the Environment and Community*. Retrieved: http://www.icrepq.com/icrepq07/363-ferraris.pdf

6. *Financial Risk Management Instruments for Renewable Energy Projects:* Summary document (2004) United Nations Publication. Oxford, UK: Words and Publications, 52 p.

7. Froggatt, A., Lhan, G. (2010). *Sustainable Energy Security. Strategic Risks and Opportunities for Business:* White Paper. Lloyds 360^0 risk insight. London: Chatman House, 48 p.

8. *Guide to Risk Management* (2004). Australian Capital Territory Insurance Authority. Retrieved: http://www.treasury.act.gov .au/actia/Risk.htm

9. Merna, T., Al-Thani, F. (2005). *Corporate Risk Management. An Organisational Perspective.* West Sussex, England: John Wiley & Sons Ltd, 440 p.

10. Hardaker, J., Huirne, R.B.M., Anderson, J.R., Lien, G. (2004). *Coping With Risk in Agriculture.* Cambridge: CABI, 332 p.

11. Industrial Hemp (1999). *Speciality Crops Factsheet*. British Columbia Ministry of Agriculture and Food. Retrieved: www.agf.gov.bc.ca/speccrop/publications/.../hempinfo.pdf

12. O`Hare, M., Shancez, L., Alstone, P. (2013). Environmental Risks and Opportunities in Cannabis Cultivation. BOTEC analysis corporation. Retrieved: www.liq.wa.gov/.../SEPA/BOTEC_Whitepaper_Final.pdf

13. Olivier, T., Andlug Consulting, Rödl & Partner, (s.a.). *Scoping Study on Financial Risk Management Instruments for Renewable Energy Projects. United Nations Environment Programme:* Reference document Marsh and Mc Lennan Companies, 142p. Retrieved: http://www.sefi.unep.org/ fileadmin/media/sefi/docs/publications/RiskMgt_full.pdf

14. Pettere, G., Voronova, I. (2003). *Riski uznemejdarbiba un to vadiba*: macibu lidzeklis (*Risks in Entrepreneurship*: Study Material). Riga: ``Rasa ABC``, 176 lpp.

15. Renn, O. (2008). Concept of Risk: An Interdisciplinary Review In: *Proceedings of the ISA Conference*, Barcelona, pp. 3 − 10. Retrieved: http://www.riskanduncertainty.net/TG04/ Ortwin_Renn_ concepts.pdf

16. Rurane, M. (2001). *Uznemejdarbibas organizacija un planosana (Planning and organization of entrepreneurship)*. Riga: Business College Turiba. 330 lpp.

17. Strazds, G., Stramkale, V., Laizans, T. (2012). *Ieteikumi Rupniecisko Kanepju Audzetajiem un Parstradatajiem (Recommendations for the Industrial Hemp Growers and Processors).* Business College Turiba, Riga, 52 lpp.

18. Santare, D., Rivza, S. (2007). Risku un Krizu Vadisanas Teorijas Iespejas un Metodes (The Management Methods For Risks And Crisis). No: *Lauksaimniecibas un Partikas Risku Vadisana*: Monografija (Risk Management in Agriculture and Food Production: Monograph). Red. Peteris Rivza. Jelgava: LLU, PVD, RTU, 44. − 70. lpp.

19. Spogis, K. (2005). Risku Ekonomiskas Iespejas vai Draudi un to Seku Novertesana (Economic Oppurtunities and Treats of Risks and the Risk Consequence Management). In: *Riski lauksaimnieciba un privataja mezsaimnieciba:* monografija. (Risks in Agriculture and Private Forestry: Monograph) Red. Peteris Rivza. Jelgava: LLU, RTU, 385. − 389. lpp.

20. Suskevica, J. (2005). *Riska Vadibas Rokasgramata (Risk Management Handbook).* Riga: Dienas bizness, 12. − 38. lpp.

21. Trigilio, S. (2006). *Applying the Principles of Risk Management to Nuclear Plant Safety*. International Foundation for Protection Officers, 12 p. Retrieved: http://www.ifpo.org/articlebank/ Trigilio_Nuclear_Power.pdf

22. Vilnitis, G., Geiba, I., Laizans, T., Stramkale, V. (2011). *Industrialo Kanepju Audzesana: Lidzsineja Pieredze (Experience of Growing Industrial Hemp).* Latvia Hemp Growers Association. Retrieved: lathemp.lv/wp-content/uploads/2010/11/Riga_03.11.11_GV.pdf