XIV. International Conference

# LOGISTICS IN AGRICULTURE 2020

Conference Proceedings

Andrej LISEC
EDITOR

University of Maribor Press

University of Maribor

Faculty of Logistics

# XIV. International Conference on Logistics in Agriculture 2020

Conference Proceedings

Editor
**Andrej Lisec**

November 2020

**Title** **XIV. International Conference on Logistics in Agriculture 2020**

**Subtitle** **Conference Proceedings**

**Editor** Andrej Lisec
(University of Maribor, Faculty of Logistics)

**Technical editor** Jan Perša
(University of Maribor Press)

**Cover designer** Jan Perša
(University of Maribor Press)

**Graphic material** Authors

**Conference** XIV. International Conference on Logistics in Agriculture 2020

**Date and location** 12th November 2020, on-line, Slovenia

**Scientific Committee** Tomaž Kramberger (University of Maribor, Slovenia), Slobodan Antić (University of Belgrade, Serbia), Andrej Lisec (University of Maribor, Slovenia), Lea – Marija Colarič – Jakše (Landscape Governance College GRM, Slovenia) & Francisco Campuzano Bolarin (Universidad Politécnica de Cartagena, Spain)

**Advisory Committee** Andrej Lisec (University of Maribor, Slovenia), Borut Florjančič (Agriculture cooperative Sevnica, Slovenia), Tone Hrovat (GRM Novo Mesto, Slovenia), Manca Zrinski (University of Maribor, Slovenia), Vid Mlejnik (University of Maribor, Slovenia), Srečko Ocvirk (State Council of the Republic of Slovenia, Slovenia) & Lea – Marija Colarič – Jakše (Landscape Governance College GRM, Slovenia)

**Publihed by** **University of Maribor**
**University Press**
Slomškov trg 15, 2000 Maribor, Slovenia
https://press.um.si, zalozba@um.si

**Co-published by** **University of Maribor**
**Faculty of Logistics**
Mariborska cesta 7, 3000 Celje, Slovenia
http://fl.um.si, info.fl@um.si

**Edition** 1st

**Publication type** E-book

**Available at** http://press.um.si/index.php/ump/catalog/book/518

**Published** Maribor, november 2020

CIP - Kataložni zapis o publikaciji
Univerzitetna knjižnica Maribor

005.51:63(082)(0.034.2)

INTERNATIONAL Conference on Logistics in Agriculture (14 ; 2020 ; On-line)
XIV. International Conference Logistics in Agriculture 2020 [Elektronski vir] : conference proceedings / editor Andrej Lisec. - 1st ed. - E-zbornik. - Maribor : University of Maribor Press, 2020

Način dostopa (URL): https://press.um.si/index.php/ump/catalog/book/518
ISBN 978-961-286-406-4
doi: doi.org/10.18690/978-961-286-406-4
1. Lisec, Andrej
COBISS.SI-ID 36203779



**ISBN** 978-961-286-406-4 (pdf)

**DOI** https://doi.org/10.18690/978-961-286-406-4

**Price** Free copy

**For publisher** prof. dr. Zdravko Kačič,
rector of University of Maribor

University of Maribor Press

# Table of Contents

Proceedings in

# ENGLISH LANGUAGE

# ALRIGHT? - COMMON UNDERSTANDING ON THE ALREADY APPLIED INDUSTRY 4.0 SOLUTIONS, BETWEEN THE HUNGARIAN BEER INDUSTRY SUPPLIERS AND MULTINATIONAL BEER MAKERS

ILONA PAPP[1] & ISTVAN PESTI-FARKAS[2]

[1] University of Gyor, Gyula Kautz Faculty of Business Economics, Gyor, Hungary.
E-mail: pappi@sze.hu
[2] Vodafone, Sopron, Hungary.
E-mail: scientific.pesti@gmail.com

**Abstract** Our paper is aimed to analyze the current situation on the Hungarian beer industry, from the aspect of industry 4.0 understanding within the supply chain, namely between the manufacturers and their suppliers. After a literature review, we had examined the big data, the robotics and the overall digitalization related attitudes and understandings. The key finding is that the multinational companies have to deal with a previously unrecognized problem, namely the prejudices of local suppliers in regards the innovation of industry 4.0 tools.

**Keywords:** industry 4.0, beer industry, cooperation, Hungary, supply chain.

University of Maribor Press

DOI https://doi.org/10.18690/978-961-286-406-4.1
ISBN 978-961-286-406-4

## 1 The aim of the research, its hypotheses and research questions

I would like to measure the future technical developments related plans and attitudes of the participants within the supply chain, the aims shall be summarized in the following table:

**Table 1: Dependencies between the hypotheses and research questions and problems**

| | |
|---|---|
| **Number** | H2 |
| **Research Problem** | The attitude of the suppliers regarding to Industry 4.0 solutions had not been researched yet, therefore it shall be defined as basic level for further improvements. |
| **Research Question** | Does the beer manufacturers and their suppliers share a common understanding on the application of the Industry 4.0 solutions? |
| **Hypothesis** | The suppliers in the beer manufacturing industry – in opposite of the dominant members of the supply chain – do not share the common understanding on the already applied Industry 4.0 solutions. |

Source: own creation

The hypothesis describes the connection of the examined parties of the supply chain (the multinational manufacturers and their direct Hungarian partners), based on the above mentioned industrial knowledge, with the focal point of Industry 4.0.

Understanding the results from the previous points about the industry, the cooperation with the dominant part in the chain and the Industry 4.0 solutions, an other hypothesis would like to determinate the attitude towards the sustainable and future oriented solutions.

The origins of the hypothesizes are the research questions, which are based on the research problems. The problems had been selected after the review of the international literature, the interviews and the author's professional experience.

## 2 Research method

The research had been aimed to examine the research topic, therefore there had been different research methods had been selected from the Hungarian ( Lengyelné and Tóvári, 2001; Majoros, 2006; Boncz, 2015) and international (Babbie, 1995; Huberman and Miles,1995; Mason, 2005; Ghauri és Grønhaug, 2011) literature review, after their careful consideration.

Based on production outputs and consumption data, the analyzed trends made possible to compare the data with the KSH and EUROSTAT data. The visualization had been performed with trendlines, as the values are continuous. In relation to the interviews, there had been context analysis performed in order to make notes on the hidden content, beside of the expresses one.

The performance of the Hungarian companies was sourced from the official annual reports of their, the EBIDTA value had been calculated based on these documents as well, the visualization of the data had been made on column chart. For the analysis of the industry, there had been several industry-analysis models mentioned, but We had applied the Porter one, in order to ensure the international comparison with other research results, beside of its popular nature.

The statistical population had been reached out with online questionnaire in order to collect proper answers in their quantity and quality. The questionnaire had been tested on buyer colleagues, the final one had been created with the consideration of their inputs. The answers for the describing statistics had been visualized with pie charts.

For the examination of the general attitude affinity and for the technological affinity, We had selected the factor analysis from the multivariate statistical analyses. The aim of the application was to reduce the variants and to identify them, beside of understanding the data with the available smallest data loss. As a first step, We had made the covariance matrix of the standardized variants and defined their correlation. Then I made factor extraction, which means the identification of the above. The value of the factors had been decided based on SPSS analysis, the values had been set in decreasing line, only the more-than-one values had been considered.

(The criteria of 1 had been defined by the statistical method itself: the own value of the factor shows its contribution to the total value of variance, so, the less the value of the factor, the less it contributes to the total. The naming of the above reflect to the results: the factors had been identified as data analysis, robotics, logistics, office use and customer service. The table can be divided into three parts:

Initial Eigenvalues, Extraction Sums of Squared Loadings, Rotation Sums of Squared Loadings.

Based on the above mentioned factor analysis – as it was a recommendation of an opponent – we had performed cluster analysis as well, so having predefined nature, We had grouped the examined population, creating new clusters. The common describing fact of the new clusters, obviously, that they show similarities between the members. The new clusters are the following: 3rd Party Logistics Servicer (furthermore: 3PLS) transportation, 3PLS inventory, advisory, administration and high-tech.

The equalization of the standard deviations was performed using the "F" test, I chose the eta square as the effect size indicator, the value of the explained variance is above average in the areas of data analysis and public relations, it is around average in the case of robotics and lower in office and logistics. (The exact values are given in the relevant table).

Analysis of variance of values (i.e., ANOVA analysis) compares different mean values of the population, with the help of which I examined whether the variation of the total standard deviation of the base set can be explained by additional factors. Since it can also be used for the variables with the lowest measurement level, I decided to use a cross-tabulation for the hypotheses, which is a data table suitable for characterizing the relationship between the variables. In the matrix it created, the combined distribution of the values of two nominal or ordinal variables is usually visualized, thus showing cross-combinations of the values belonging to the variables.

Evidently, the table consists of cells that contain the values obtained for each combination of the values of the two variables (column and row variables). The values in these cells provide information about the relationship between the two variables. However, the percentage and numerical values in the cross-tabulation are not sufficient to characterize the relationship between the two variables, I used the chi-square test to test the relationship. The null hypothesis (H0) is basically that there is no correlation between the studied variables. Since the significance level for the chi-square value is lower than 0.05, I rejected the null hypothesis.

## 3 Results of the research

The focus of our research was on the application of industry 4.0 solutions in the supply chain of Hungarian, and more narrowly of Hungarian multinational brewers. I built our hypotheses around industry characteristics, integrity, robotics, and openness to professional advice, and after a statistical analysis of the responses to our questionnaire research, I can say that I have also verified it.

In the light of the collected data, it can be said that multinational manufacturers are mostly in business relations with Hungarian partners, and the proportion of Hungarian SMEs in their supply chain is significant. Most of the answers were given by the representatives of the companies operating in the supply chain, so I managed to get a unique view of our research, which is simultaneously related to a very important area of our economy, the development of small and medium enterprises and logistics service partners.

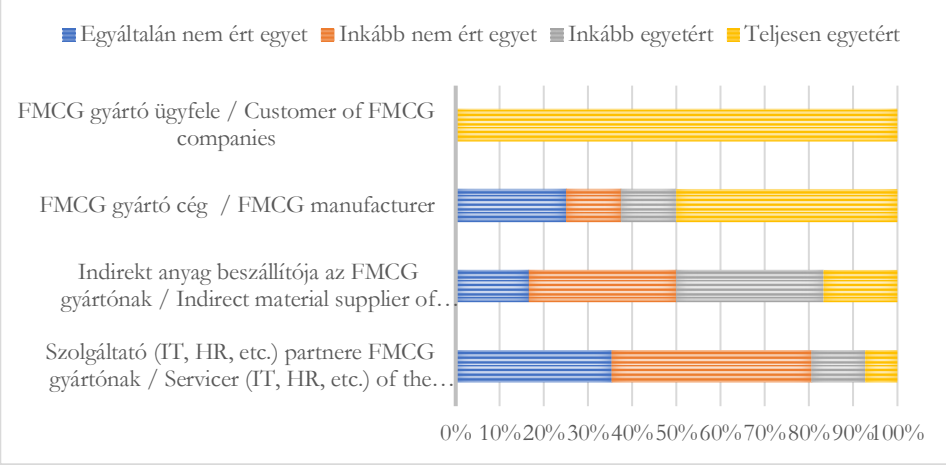
I find the results both frustrating and inspiring. They are frustrating, because a very large part of Hungarian SMEs have not even heard of these solutions, not even to implement them as their own development. The results are encouraging because businesses that have survived post-transition forced labor and the financial crisis of 2010-2012 have already been shown to be able to survive and adapt, so their approach to new technological developments can successfully help them overcome on the challenges that lie ahead of them.

The results of our research are in line with the results of the relevant literature, and the best of them are perhaps the closest to the one examining the e-banking habits of small and medium-sized enterprises (Fodor, Dunay, Illés 2011). It was also confirmed in 2019, ie 8 years after the aforementioned study, that Hungarian small and medium-sized enterprises, which are supplier partners of multinational brewers, are still struggling with digital solutions, they are not fully aware to them.

## 4 Verification of the hypothesis

The three sub-points of the hypothesis (namely big data management, robotics and digitization) were all analyzed with a cross-tabulation and the data obtained from them support the preliminary assumptions of the research: at the next element of the supply chain, customers (whether a wholesaler or a retailer, possibly a HoReCa unit) have a positive picture of industry 4.0 trends, their own experience and answers to questions show that they consider the tripartite discussed above to be real, current processes. as part of their daily lives. I consider this experience to be a lack of knowledge and a lack of basic knowledge on the subject, because even a comparison with competitors can show that even though parts of the daily routine have an online presence or electronic devices, they are not entirely new to industry 4.0. solutions.

**Figure 1: Application of Big Data**



In terms of the number of responses, service providers are over-represented in the cross-tabulations, but it is interesting that, in contrast to the group mentioned above, they explicitly disagree (or in a less pronounced form, "rather not") with the triple trend. Their responses carry information that, due to their size and cross-industry network of contacts and transactions, these firms are more likely to encounter industries that are much more technology-intensive (see, e.g., automotive) and have formed their opinions relative to them.

**Figure 2: Application of robotics**

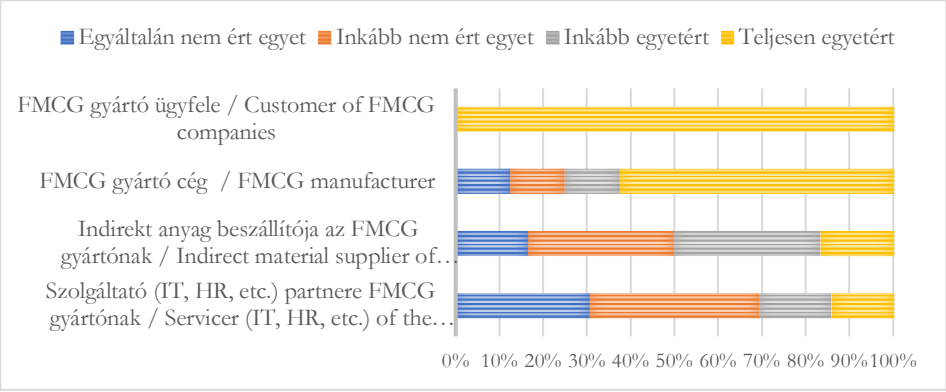
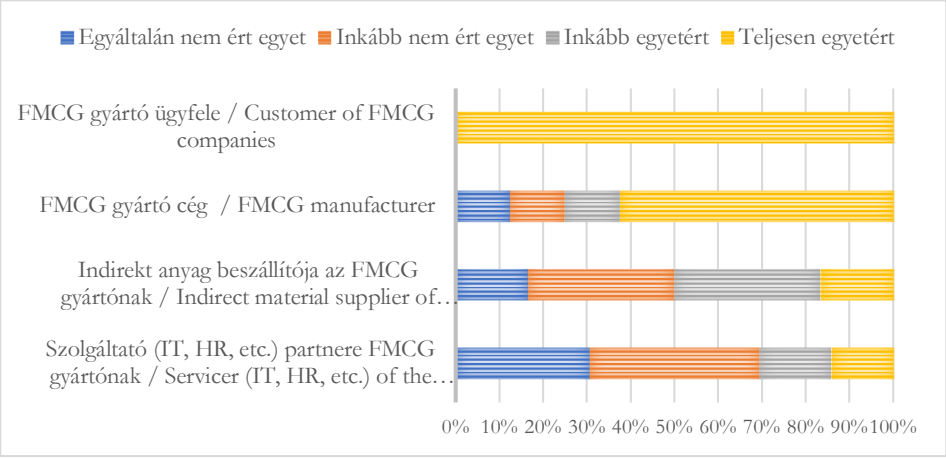



**Figure 3: Digitalization of business and manufacturing processes**



Their views on the beer industry are in line with the trends in the literature (in fact, in a broader context, the CEE region), ie they confirm the fact that Hungarian, Romanian, Slovak, etc. In the economy, only those enterprises in their industry use industry 4.0 assets that the strongest, most dominant player in their supply chain (practically, including the automotive industry already mentioned above) expects and can assert the cost of the investment in their pricing as a supplier. Thus, the hypothesis that industry suppliers, as opposed to the dominant member of the supply chain, do not see Industry 4.0 solutions as being used in the industry has been confirmed and accepted for this purpose.

## 5 Conclusion

Based on the hypothesis ("In the Hungarian beer industry, the non-dominant members of the supply chain, suppliers currently have different, negative opinions on the current application of Industry 4.0 solutions"), our research points out that the Hungarian attitude towards Industry 4.0 solutions contradicts multinational represented by companies, ie the application of solutions that may already be used abroad in Hungary may encounter obstacles, in addition to technical difficulties, companies also have to deal with a previously unrecognized problem, namely the prejudices of local suppliers.

**References**

Babbie, Earl (2000): A társadalomtudományi kutatás gyakorlata. Budapest, Balassi Publisher
Boncz, Imre (2015) Kutatásmódszertani alapismeretek. Pécs, PTE
Ghauri, Pervez - Gronhaug, Kjell (2011): Kutatásmódszertan az üzleti tanulmányokban, Budapest, Akadémiai Publisher
Majoros, Pál (2005): A kutatásmódszertan alapjai : tanácsok, tippek, trükkök : nem csak szakdolgozat-íróknak, Budapest, Perfekt Publisher
Mason, Paul (2005): What Works and Why: Combining Quantitative and Qualitative Approaches in Large-scale Evaluations in International Journal of Social Research Methodology , Volume 8, 2005 - Issue 3
Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook , Sage Publications, Inc.
Tóvári, Judit, Lengyelné Molnár, Tünde (2001) Kutatásmódszertan : Eger, EKF Mediainformatics Institute.

# Impact of Climate Change in Agriculture Sector in India and Action Plans

Raja K. Baisya

Frontier Agro Industries Pvt Ltd, Haryana, India
E-mail: info@ptmfonline.com, rkbaisya@hotmail.com

**Abstract** Climate change is now a reality. Agriculture in India is likely to suffer losses due to heat, erratic weather and decreased availability of irrigation. Adaptation strategies can help minimize the impact. But that will come at a cost although not still accurately measurable and is likely to be high. This also requires new policy support, research and investment. However, cost of inaction will be still higher. Carbon dioxide level is now about 400 ppm which is likely to increase to about 450 to 600 ppm during 2050 and by 2100 it is likely to go up anything above 500 ppm to 1000 ppm if current situation is allowed to continue. This paper attempts to analyse the impact of climate change on Indian agriculture in terms of decreased productivity to be seen in relation to increase in population. And to counter that impact what are the measures being initiated.

**Keywords:** climate change, agricultural productivity, rainfall, global warming, national action plan in climate change.

University of Maribor Press

DOI https://doi.org/10.18690/978-961-286-406-4.2
ISBN 978-961-286-406-4

## Introduction

India is an agrarian country. 50% of the population still depends on agriculture and average farm holding is 1 to 2.5 acres with very low farm yield and over 50% of the country's workforce still engaged in agriculture. About 17% of the country's GDP is contributed by Agriculture. India is also a vast country with 1.3 billion population and have different agro climatic regions. If in some part it is drought, in some other part it could be flood. The weather is thus unpredictable and it has significant effect on agriculture productivity and farm output. Climate Change is a natural phenomenon. Climatic conditions, however, worsening due to human activities. Rapid urbanisation, industrialisation, pollution, and over exploitation of natural resources etc. resulting into drastic changes in climatic conditions and with the change in climatic conditions and increase in global warming, the frequency and quantity of rainfall has become erratic. And as a result agricultural produce has also become variable.

Increase in temperature would also increase requirement of fertilizers for same production target and the result will be higher emissions. Besides, increase in sea and river water temperatures are likely to affect fish breeding, migration and harvests of fish. Coral reefs start declining from 2030. With increase in temperature there will be increase in water, shelter and energy requirement for livestock which will also have implications on milk production. India currently is the world' largest producer of milk and also largest in terms of cattle population. Various sectors contributing to climate change in India are energy use 61 %, Agriculture 28%, industrial processes 8%, wastes 2% and change in land use to the extent of 1%. Climate change is posing a great threat to agriculture and food security. Water is the most critical agricultural input in India, as 55% of the total cultivated areas do not have irrigation facilities. And in India we experience drought almost every year which further aggravates the problem. Currently we are able to secure food supplies under these varying conditions and we have comfortable buffer stock of food grains. However, all climate models predict that extreme conditions like drought, heavy rainfall and storms in agricultural production areas can be expected due to climate change resulting into potential crop failure. In India, this would pose a new problem as our ecological and socio-economic system already under pressure due to rising population. In India, average food consumption at present is 550 g per capita per day, whereas in China and USA are 980 and 2850 g, respectively (IPCC 2001). Wheat

yields are predicted to fall by 5-10% with every increase of 1°C and overall crop yields could decrease up to 30% in South Asia by the mid-21st century (IPCC 2007). India could experience a 40% decline in agricultural productivity by the 2080s ( Goyal, R.K, 2004). Rise in temperatures will affect wheat growing regions, placing hundreds of millions of people at the brink of chronic hunger (Hummington TG, 2003). In India, the growing population is a major concern, and there is a need to understand the availability of water in terms of increase in population growth. A decline has been projected in mean per capita annual freshwater availability and growth of population from 1951 to 2050 (Eckhardt K and Ulbrich U, 2003). The rising population will increase the demand for water leading to faster withdrawal of water and this in turn would reduce the recharging time of the water tables.

**Impact of Climate Change on Crop Productivity in India**

Rainfall in India has a direct relationship with the monsoons which originate from the Indian Ocean and Arabian Sea. Climate change has a direct impact on crop evapotranspiration (ET). In arid regions of north India like Rajasthan and Madhya Pradesh an increase of 15% in total ET demand has been projected. A marginal increase in ET demand due to global warming and climate change will have much larger impact on India's fragile water resources (Allen D.M. et al, 2004) this will result into change in soil moisture, ground water recharge In arid regions of northern states the impact of climate change will result into an increase of and frequency of flood and drought and finally ground water level as well as water cycle (Xu J. et al 2007 ). In addition, rise in sea level will increase the risk of permanent or seasonal saline intrusion into ground water and rivers which will have an impact on quality of water and its potential use of domestic, agricultural and industrial uses as well as threatening the aquatic life. Climate change will thus have number of effects on agriculture (Gautam H.R and Sharma H.L 2012).

Higher temperatures and changing precipitation patterns will also severely affect the production patterns of different crops. Increased carbon dioxide content will also impact agricultural productivity and all these changes will increase the vulnerability of the landless farm workers and the poor. There were several studies conducted in recent times show that coming years will disproportionately affect agriculture in the planets lower latitudes where most of the world's poor live and in that context

agriculture needs to be better managed for the natural resources like land, water and other resources to be more resilient.

**Countermeasure by Government**

India has a National Action Plan on Climate Change which was unveiled in 2008. There are eight national missions that would form the core of the national plan. These include national missions for solar energy, enhanced energy efficiency, sustainable habitat, conserving water, sustaining the Himalayan ecosystem, a "Green India", sustainable agriculture and strategic knowledge platform for climate change. In addition there are some innovative responses by water utilities to address these risks arising out of climate change resulted in pushing the frontiers in a number of areas. This includes desalination, re-use and storm water harvesting and aquifer recharge. It would be worthwhile to give high priority to "more crops per drop" approach, rainwater harvesting, aquifer recharge, revival of water bodies and conservation technologies. In the last decade, the Central Government has tried to address the issue through several initiatives such as subsidies for micro-irrigation (which optimizes water usage for agriculture), drip irrigation, national watershed development project for rain fed areas and artificial recharge to ground water through dug wells in hard rock areas and rural water supply enhancement programmed through the catchment area approach.

In 2007, Union Ministry of Water Resources of the country initiated a Farmer Participatory Action Research Programmed in over 2000 villages all over the country to assess the impact of water saving technologies on agriculture production. It has been found that yield and income can be increased by 50 to 100 per cent in most of the crops by using water saving technologies. Additional yield of 1 ton per hectare can be realized through supplemental irrigation. Our agriculture is more prone to monsoon rains as we are growing high water requiring crops like rice and sugarcane. We should increase area under low water requiring but high value crops like pulses and oilseeds to counter the erratic monsoons.

## Conclusion

Global climate change is not a new phenomenon. Several studies have predicted the disastrous consequences that mankind will face in varied degrees by world population. While developed countries have the record of over exploiting the natural resources but the impact on developing and under-developed as well as poor countries will be significant in spite of the fact that they are less polluters. A collective action plan to neutralise the impact of the climate change needs to be undertaken. India is self-sufficient in terms food production and supply. With successful Green revolution India has very comfortable position in terms of food stock. Even during pandemic, India had over 80 million MT of buffer stock of grains to be distributed free to poor section of the society and agricultural logistics service and supply chain functions were kept in operation to avoid any crisis situation. However, India is not insulated from the impact of climate change. The effect of climate change poses many threats; one of the important consequences is bringing about changes in the quality and quantity water resources and crop productivity. It can be concluded that the Indian region is highly sensitive to climate change. Agriculture sector is the most prone sector as it will have a direct bearing on the lives of 1.3 billion people. India has set a target of halving greenhouse gas emissions by 2050. There is an urgent need for coordinated efforts to strengthen the research to assess the impact of climate change on agriculture, forests, animal husbandry, aquatic life and other living beings.

### References

IPCC (2001) Climate Change 2001: Impacts, Adaptation & Vulnerability: Contribution of Working Group II to the Third Assessment Report of the IPCC. Cambridge University Press, Cambridge, UK.

IPCC (2007) Summary for Policy-makers, Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the IPCC. Cambridge University Press, Cambridge, United.

Goyal RK (2004) Sensitivity of evapotranspiration to global warming: a case study of arid zone of Rajasthan (India). Agric Water Manage 69: 1-11.

Huntington TG (2003) Climate warming could reduce runoff significantly in New England. Agric For Meteorol 117: 193-201.

Eckhardt K, Ulbrich U (2003) Potential impacts of climate change on groundwater recharge and streamflow in a central European low mountain range. J Hydrol 284: 244-252.

Allen DM, Mackie DC, Wei M (2004) Groundwater and climate change: a sensitivity analysis for the Grand Forks aquifer, southern British Columbia. Hydrogeol J 12: 270-290.

Xu J, Shrestha AB, Vaidya R, Eriksson M, Hewitt K (2007) The Melting Himalayas-Regional Challenges and Local Impacts of Climate Change on Mountain Ecosystems and Livelihoods. ICIMOD

Technical Paper. International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal.

Gautam HR, Sharma HL (2012) Environmental degradation, climate change and effect on agriculture. J Kurukshetra 60: 3-5.

# LEAN SIX SIGMA: METHODOLOGY AND PRACTICE IN OPERATIONS MANAGEMENT CASE: BOTTLE WATER DISTRIBUTION IN SERBIA

SLOBODAN ANTIĆ

University of Belgrade, Faculty of Organizational Sciences, Belgrade, Serbia.
E-mail: slobodan.antic@fon.bg.ac.rs

**Abstract** Six Sigma and Lean Manufacturing are the two most popular and successful programs espoused by the industries over the last few decades. Many companies such as Toyota, Danaher Corporation, General Electric, Motorola and many others have achieved impressive results by implementing either a Lean or Six Sigma methodology in their organisation. Six Sigma, originated in Motorola in mid 1980s, brought revolution in the industries worldwide and has become the long term business strategy to achieve competitive advantage and to excel in operations excellence. Six Sigma is widely recognized as a methodology that employs statistical and non-statistical tools and techniques to maximize an organization's Return on Investment (ROI) through the elimination of defects in processes (Antony et al. 2011). Lean Manufacturing, on the other hand, was another quality initiative proposed by Americans in response to compete with Japanese manufacturers and its superior manufacturing techniques (following the concept of Toyota Production System (TPS) to resolve quality problems in their organization) as their import became serious concern to western producers.

**Keywords:**
lean
six
sigma
methodology,
KPI,
distribution,
TQM,
operations
management

University of Maribor Press

DOI https://doi.org/10.18690/978-961-286-406-4.3
ISBN 978-961-286-406-4

# 1 Introduction

Operations Management is the activity of managing the resources which produce and deliver goods and services (Slack et al., 2010). Operations can be seen as one of many functions (e.g. marketing, finance, personnel) within the organisation. The operations function can be described as that part of the organisation devoted to the production or delivery of goods and services. This means all organisations undertake operations activities because every organisation produces goods and/or services.

## 1.1 Operations priorities

Operations should focus on specific capabilities that give it a competitive edge which may be termed competitive priorities. Four operations priorities or measures of these capabilities can be termed cost, time, quality and flexibility (Porter, 2011).

### 1.1.1 Cost

If an organisation is competing on price, then it is essential that it keeps its cost base lower than the competition. Then it will either make more profit than rivals, if price is equal, or gain market share if price is lower. Cost is also important for a strategy of providing a product to a market niche, which competitors cannot provide. Thus cost proximity (i.e. to ensure costs are close to the market average) is important to maximise profits and deter competitors from entering the market. The major categories of cost are staff, facilities (including overheads) and material with the greatest scope for cost reduction lies with reduction of the cost of materials. A relatively small proportion of costs are usually assigned to direct labour.

### 1.1.2 Time

The time delay or speed of operation can be measured as the time between a customer request for a product/service and then receiving that product/service. Speed is an important factor to the customer in making a choice about which organisation to use.

The concept of P:D ratios (Shingo, 1989) compares the demand time D (from customer request to receipt of goods/services) to the total throughput time P of the purchase, make and delivery stages. Thus in a make-to-stock system D is basically the delivery time, but for a customer-to-order system the customer demand time is equal to the purchase, make and delivery stages (P). In this case the speed of the internal processes of purchase and make will directly effect the delivery time experienced by the customer. Thus the advantage of speed is that it can either be used to reduce the amount of speculative activity and keep the delivery time constant or for the same amount of speculative activity it can reduce overall delivery lead time. Thus in competitive terms speed can be used to both reduce costs (making to inaccurate forecasts) and reduce delivery time (better customer service).

### 1.1.3 Quality

Quality covers both the quality of the product/service itself and the quality of the process that delivers the product/service. Quality can be measured by the '*cost of quality'* model were costs are categorised as either the cost of achieving good quality (the cost of quality assurance) or the cost of poor quality products (the costs of not conforming to specifications). The advantages of good quality on competitiveness include increased dependability, reduced costs and improved customer service.

### 1.1.4 Flexibility

There are a number of areas in which flexibility can be demonstrated. For example, it can mean the ability to offer a wide variety of products/services to the customer and to be able to change these products/services quickly. Flexibility is needed so the organisation can adapt to changing customer needs in terms of product range and varying demand and to cope with capacity shortfalls due to equipment breakdown or component shortage. Types of flexibility include product flexibility which is the ability to be able to quickly act in response to changing customer needs with new product/service designs and volume flexibility which is the ability to be able to decrease or increase output in response to changes in demand. Volume flexibility may be needed for seasonal changes in demand as services may have to react to demand changes minute by minute.

## 1.2 JIT and lean systems

Just-In-time (JIT) is a philosophy originating from the Japanese auto maker Toyota where Taiichi Ohno developed the Toyota Production system (Ohno, 1988). The basic idea behind JIT is to produce only what you need, when you need it. This may seem a simple idea but to deliver it requires a number of elements in place such as the elimination of wasteful activities and continuous improvements.

### 1.2.1 Eliminate waste

Waste is considered in the widest sense as any activity which does not add value to the operation. Seven types of waste identified by Toyota are as follows (Ohno, 1988):

- *Over-Production*. This is classified as the greatest source of waste and is an outcome of producing more than is needed by the next process.
- *Waiting Time*. This is the time spent by labour or equipment waiting to add value to a product. This maybe disguised by undertaking unnecessary operations (e.g. generating work in progress (WIP) on a machine) which are not immediately needed (i.e. the waste is converted from time to WIP).
- *Transport*. Unnecessary transportation of WIP is another source of waste. Layout changes can substantially reduce transportation time.
- Process. Some operations do not add value to the product but are simply there because of poor design or machine maintenance. Improved design or preventative maintenance should eliminate these processes.
- *Inventory*. Inventory of all types (e.g. pipeline, cycle) is considered as waste and should be eliminated.
- *Motion*. Simplification of work movement will reduce waste caused by unnecessary motion of labour and equipment.
- *Defective Goods*. The total costs of poor quality can be very high and will include scrap material, wasted labour time and time expediting orders and loss of goodwill through missed delivery dates.

### 1.2.2 Continuous improvement and JIT pull systems

Continuous Improvement or Kaizen, the Japanese term, is a philosophy which believes that it is possible to get to the ideals of JIT by a continuous stream of improvements over time.

The idea of a pull system comes from the need to reduce inventory within the production system. In a push system a schedule pushes work on to machines which is then passed through to the next work centre. A production system for an automobile will require the co-ordination of thousands of components, many of which will need to be grouped together to form an assembly. In order to ensure that there are no stoppages it is necessary to have inventory in the system because it is difficult to co-ordinate parts to arrive at a particular station simultaneously.

The pull system comes from the idea of a supermarket in which items are purchased by a customer only when needed and are replenished as they are removed. Thus inventory co-ordination is controlled by a customer pulling items from the system which are then replaced as needed (Ohno, 1988).

To implement a pull system a kanban (Japanese for 'card' or 'sign') is used to pass information through the production system. Each kanban provides information on the part identification, quantity per container that the part is transported in and the preceding and next work station. Kanbans in themselves do not provide the schedule for production but without them production cannot take place as they authorise the production and movement of material through the pull system. Kanbans need not be a card, but something that can be used as a signal for production such as a marked area of floorspace.

There are two types of kanban system, the single-card and two-card. The single-card system uses only one type of kanban card called the conveyance kanban which authorises the movement of parts. The number of containers at a work centre is limited by the number of kanbans. A signal to replace inventory at the work centre can only be sent when the container is emptied. Toyota use a dual card system which in addition to the conveyance kanban, utilises a production kanban to authorise the production of parts.

This system permits greater control over production as well as inventory. If the processes are tightly linked (i.e. one always follows the other) then a single kanban can be used. In order for a kanban system to be implemented it is important that the seven operational rules that govern the system are followed. These rules can be summarised as follows (Ohno, 1988):

- Move a kanban only when the lot it represents is consumed.
- No withdrawal of parts without a kanban is allowed.
- The number of parts issued to the subsequent process must be the exact number specified by the kanban.
- A kanban should always be attached to the physical product.
- The preceding process should always produce its parts in the quantities withdrawn by the subsequent process.
- Defective parts should never be conveyed to the subsequent process.
- A high level of quality must be maintained because of the lack of buffer inventory. A feedback mechanism which reports quality problems quickly to the preceding process must be implemented.
- Process the kanbans in every work centre strictly in order in which they arrive at the work centre.
- If several kanbans are waiting for production they must be served in the order that they have arrived. If the rule is not followed there will be a gap in the production rate of one or more of the subsequent processes. The system is implemented with a given number of cards in order to obtain a smooth flow. The number of cards is then decreased, decreasing inventory and any problems which surface are tackled. Cards are decreased, one at a time, to continue the continuous improvement process.

## 2 Total quality management (TQM) as a part of operations management

Total Quality Management (TQM) requires that the principles of quality management are applied in all aspects and at every level in an organisation (Hill, 2005). TQM has evolved over a number of years from ideas presented by a number of quality Gurus. Deming (1985) proposed an implementation plan consisting of 14 steps which emphasises continuous improvement of the production process to achieve conformance to specification and reduce variability. This is achieved by

eliminating common causes of quality problems such as poor design and insufficient training and special causes such as a specific machine or operator. He also places great emphasis on statistical quality control techniques and promotes extensive employee involvement in the quality improvement program. Juran (2001) put forward a 10 step plan in which he emphasises the elements of quality planning - designing the product quality level and ensuring the process can meet this, quality control - using statistical process control methods to ensure quality levels are kept during the production process and quality improvement - tackling quality problems through improvement projects. Crosby (1996) suggested a 14-step programme for the implementation of TQM. He is known for changing perceptions of the cost of quality when he pointed out that the costs of poor quality far outweigh the cost of preventing poor quality, a view not traditionally accepted at the time.

Six Sigma is one of the most important and popular developments in the quality field. It has saved huge amounts of money and improved the customer experience for a large number of organizations across the world, yet it is applied in an inconsistent and often reductive fashion in many companies.

## 2.1 The cost of quality

All areas in the production system will incur costs as part of their TQM program. For example, the marketing department will incur the cost of consumer research in trying to establish customer needs. Quality costs are categorised as either the cost of achieving good quality - the cost of quality assurance or the cost of poor-quality products - the cost of not conforming to specifications.

### 2.1.1 The cost of achieving good quality

The costs of maintaining an effective quality management program can be categorised into *prevention costs and appraisal costs* (Knowles, 2011). Prevention reflects the quality philosophy of "doing it right the first time" and includes those costs incurred in trying to prevent problems occurring in the first place. Examples of *prevention costs* include:

- The cost of designing products with quality control characteristics.
- The cost of designing processes which conform to quality specifications.

– The cost of the implementation of staff training programmes.

*Appraisal costs* are the costs associated with controlling quality through the use of measuring and testing products and processes to ensure that quality specifications are conformed to. Examples of appraisal costs include:

– The cost of testing and inspecting products.
– The costs of maintaining testing equipment.
– The time spent in gathering data for testing.
– The time spent adjusting equipment to maintain quality.

### 2.1.2 The cost of poor quality

This can be seen as the difference between what it actually costs to provide a good or service and what it would cost if there was no poor quality or failures. This can account for 70% to 90% of total quality costs and can be categorised into *internal failure costs and external failure costs* (Knowles, 2011). Internal failure costs occur before the good is delivered to the customer. Examples of *internal failure costs* include:

– The scrap cost of poor quality parts that must be discarded.
– The rework cost of fixing defective products.
– The downtime cost of machine time lost due to fixing equipment or replacing defective product.

*External failure costs* occur after the customer has received the product and primarily relate to customer service. Examples of external failure costs include:

– The cost of responding to customer complaints,
– The cost of handling and replacing poor-quality products,
– The litigation cost resulting from product liability,
– The lost sales incurred because of customer goodwill affecting future business.

Although anyone who works in an organization will be familiar with many examples of these issues, business accounting systems are not set up to capture these costs. Traditional accounting approaches are designed to track the inflow and outflow of money in an organization (and, by extension, to product lines or departments). There is little emphasis on whether the money in the department is spent effectively.

Figure 1. shows Fiegenbaum's Prevention-Appraisal-Failure (P-A-F) model of costs of poor quality, although there are others.

| **Cost Area** | **Cost of Control (Cost of Conformance)** | | **Cost of Failure of Control (Cost of Non-Conformance)** | |
|---|---|---|---|---|
| Sub-Category | Prevention Costs | Appraisal Costs | Internal Failure Costs | External Failure Costs |
| Description | Arise from efforts to keep defects from occurring at all | Arise from detecting defects via test, audit, inspection | Arise from defects caught internally and dealt with by discarding or repairing the affected items | Arise from defects that actually reach the final customer. |
| Examples | Quality planning<br>Statistical Process Control<br>Quality training and workforce development<br>Product design verification<br>Market research | Test and inspection of purchased materials<br>Inspection<br>Testing<br>Quality audit | Scrap<br>Rework costs<br>Management of rework systems<br>Rejection paperwork | Warranty costs<br>Out of warranty complaints<br>Product recall<br>Product liability claims<br>Loss of customer goodwill |

**Figure 1: Cost of Quality types and examples**
(adapted from Feigenbaum, 1961)

The lack of clarity of the cost of poor quality in organizations led to a lack of focus on improvement for many years It was only with the advent of the "Cost of Quality" approach in the 1950's (Defoe and Juran, 2010) that organizations had a financial tool to assess the costs associated with quality failures and thus focus on the most important areas for improvement.

The basic logic is that a relatively small increase in spending on prevention activities will deliver a more than compensating reduction in appraisal and failure costs (see figure 2.)

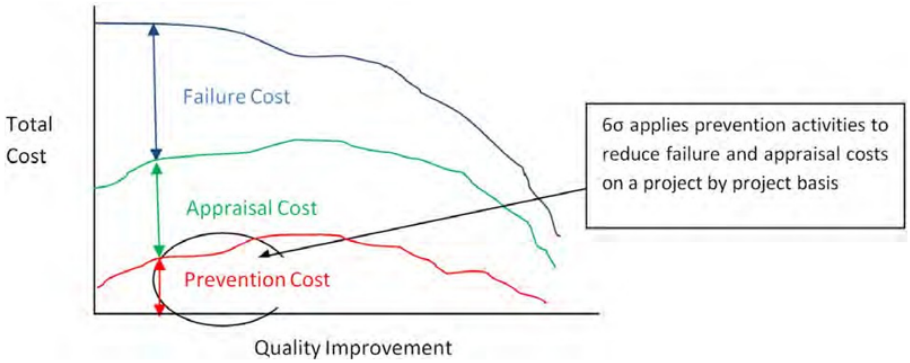



**Figure 2: Quality costs during improvement**
(adapted from Businessballs.com, 2011)

The concept of waste is fairly generic in nature and has been around for a long time. Many organisations refer to 'non- value added activities' and 'process waste'. However, these are rather broad terms and, whilst it is easy to agree that waste is bad and should be eradicated (or at least reduced) it does not much help in the process of improvement. The Seven Wastes were identified by Ohno as part of the Toyota Production System (Ohno, 1988) and have since been widely applied to process improvement, becoming particularly associated with the principles of lean manufacturing.

| Type of Waste | Potential Associated Costs |
|---|---|
| **Waiting** | ***Labour cost associated with idle time.***<br>***Value of lost production (if units are lost) or cost of overtime if this has to be worked to catch up.***<br>Cost of late delivery if overall process time affected. |
| **Correction** | Rework cost (direct and overhead if applicable).<br>Cost of delays (as above).<br>Inspection costs.<br>Disposal costs if correction is not possible.<br>Paperwork system costs. |
| **Over-Production** | ***Storage costs (inc. handling costs & capital tied up).***<br>***Extra material costs if excess cannot be sold.***<br>Deterioration/depreciation costs (if appropriate).<br>Cost of delays (as above). |
| **Processing** | Additional processing costs (direct and overhead if applicable).<br>Transportation costs. |
| **Conveyance** | ***Additional cost of unnecessary conveyance system.***<br>***Cost of late delivery if overall process time affected.***<br>Deterioration/damage costs. |
| **Inventory** | ***Storage costs (inc. handling costs & capital tied up).***<br>***Deterioration/depreciation costs (if appropriate).***<br>***Obsolescence costs (if appropriate).*** |
| **Motion** | ***Additional labour costs (including absenteeism).*** |

**Figure 3: Types of waste and associated costs**
(adopted from Ohno, 1988)

Lean Six Sigma directly assesses costs of poor quality on a project by project basis, providing clear motivation for improvement and an indication of expected gains.

## 3 Lean six sigma (LSS)

During late 1980s, two other business improvement strategies evolved (namely Lean and Six Sigma) that were cynosure for resolving quality or process related problems in manufacturing and service industries and having significant impact on the bottom-line of corporations globally. Six Sigma and Lean Manufacturing are the two most popular and successful programs espoused by the industries over the last few decades. Many companies such as Toyota, Danaher Corporation, General Electric, Motorola and many others have achieved impressive results by implementing either a Lean or Six Sigma methodology in their organisation (Knowles, 2011).

Before we study the subject of Six Sigma in any depth, we need to define the term. Perhaps unusually, Six Sigma has 3 distinct elements to its definition (Knowles, 2011):

- A Measure: A statistical definition of how far a process deviates from perfection.
- A Target: 3.4 defects per million opportunities.
- A Philosophy: A long term business strategy focused on the reduction of cost through the reduction of variability in products and processes.

Accordingly, it is defined in a variety of ways by several authors, but for the purposes of these notes the definition from (Pande et al. 2000) focused on the more comprehensive philosophy of Six Sigma will be used: *"A comprehensive and flexible system for achieving, sustaining and maximising business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes."*

The use of Lean Six Sigma (LSS) as a business improvement methodology has increased significantly over the last decade and its usage has broadened from the manufacturing sector to virtually every industry sector and developed country there is. Its ability to be applicable in this way is quite probably unique as it continues to spread out and grow in more diverse business sectors including pharmaceutical and banking (Wiesenfelder 2009).

LSS has evolved during a journey that can be traced back well over a century. This family tree, depicted in Figure 4., clearly demonstrates how LSS followed two completely different paths and only converged in recent years to become what is now the most accepted methodology namely Lean Six Sigma (Antony et al.2011).

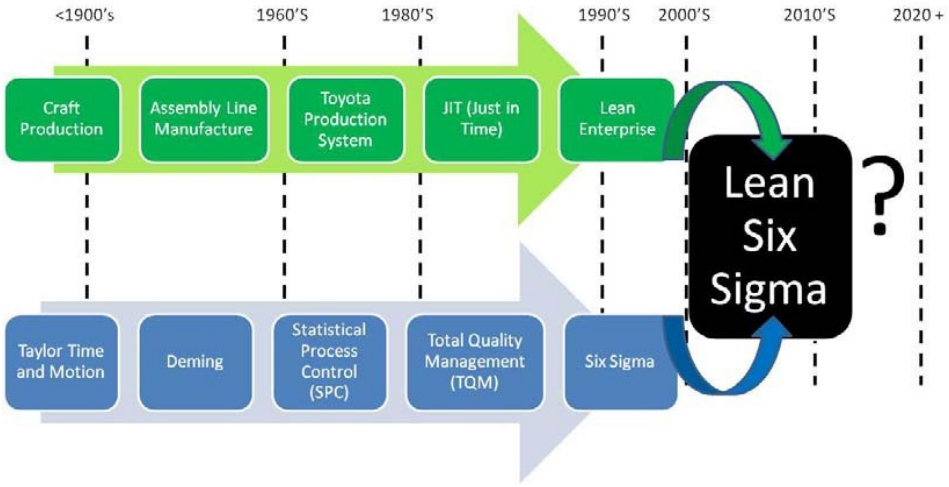



**Figure 4: Evolution of Lean Six Sigma**
(adopted from Antony et al.2011)

Lean and Six Sigma are both business improvement methodologies but they have some important fundamental differences. These differences are well documented in numerous academic research papers e.g. (Antony and Escamilla 2003), but can be summarised in Figure 5. below:

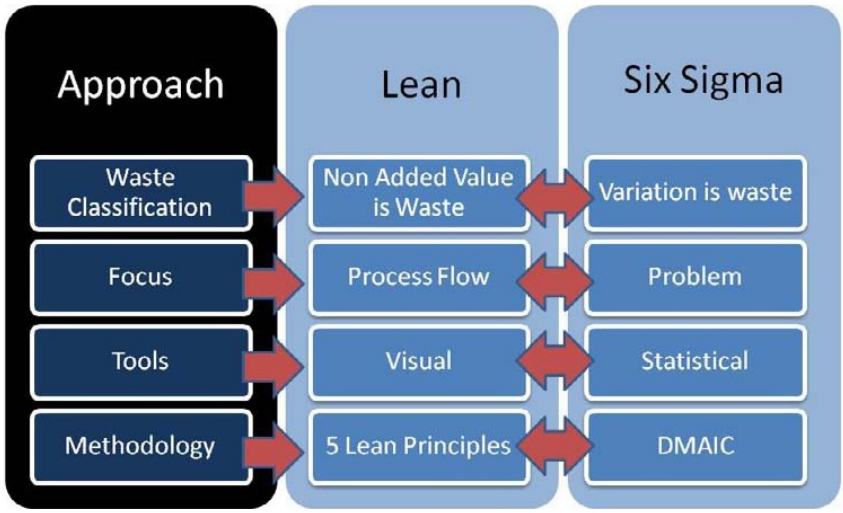



**Figure 5: Key differences between Lean and Six Sigma Approaches**
(adopted from Antony and Escamilla 2003)

What is well known however, is that when implemented correctly the benefits of combining Lean and Six Sigma makes it a formidable business improvement methodology (Snyder and Peters 2004).

Lean is much more than just about reducing and eliminating process wastes, it is a philosophy than can be applied in a continuous form for years if not decades. Toyota was the leaders in this philosophy which is still highly relevant today. Six Sigma meanwhile concentrates on the reduction/elimination of problems, which could manifest themselves in the form of defects or variation. The Six Sigma approach tends to be much more finite than Lean and mostly last over a period of weeks to months.

## 4 Planning tools for lean and Six sigma: case study in water distribution – case Serbia

The performances are defined in the context of measuring company's ability to determine/plan and accomplish goals, so that importance of objectives represents a key factor in the choice of performance indicators. According to Rameshwar (2011), it can be identified links between strategic planning and (measurable) performance indicator in distribution, in order to provide logistics processes involved in planned objectives achievement. Priority objectives in distribution management are:

(1) Orders fulfil-ment,
(2) Target Customer Service,
(3) Flexibility and rate of response,
(4) Customer service innovation, and
(5) Costs.

Rameshwar (2011) proposed a group of performances that apply regardless of business strategy and logistics strategy in a company: time, cost and quality.

Leong et al. (1990) identified role of production function and key indicators of manufacturing performance defined in terms of performance: quality, delivery speed, delivery reliability, cost and flexibility. Johnston et al. (2003) identifies scope and speed of response as performance "flexibility", where range of responses represents number of various possibilities for changes in the production system,

while speed of reaction is the time required to change the production system. After selection of performances, it is important to define appropriate categories of indicators and/or concrete, measurable performance indicators, shown in Figure 6.

| Performances | Indicators |
|---|---|
| Cost | Cost to satisfy customer requirements |
| | Cost with continuous improvement activities |
| | Cost of safety stocks |
| | Cost of reverse logistics |
| Flexibility | Responsiveness to customer requirements |
| | Logistics system responsiveness to especial orders |
| | Logistics system responsiveness to environmental changes |
| | Customer satisfaction available |
| Quality | Stock data accuracy |
| | Level of stock out |
| | Percentage of orders fulfilment |
| | Percentage of order without quality problems |
| Time | Delivery lead time |
| | Order cycle time |

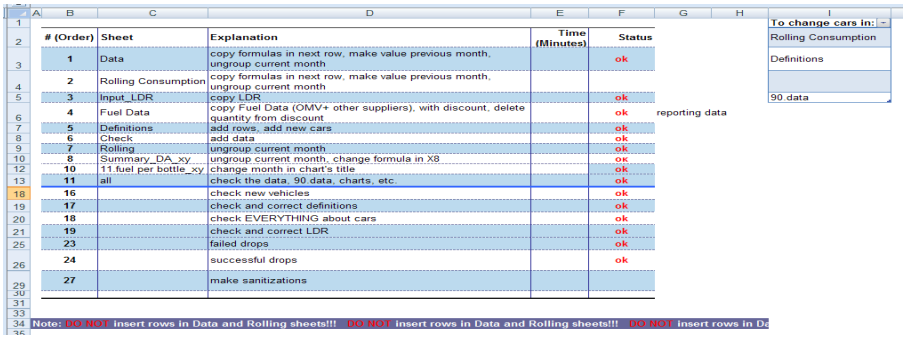
**Figure 6: Performances and indicators in physical distribution systems**
(adopted from Rameshwar, 2011)

KPIs (Key Performance Indicators) represent selected indicators used for measuring and planning MQI (and increasing business performance). KPIs are quantifiable key performance attributes, those that directly affect quality of company management and achievement of goals. KPI are defined in accordance with the importance of business processes for different participants (stakeholders) in business. Each KPI is related to a single measurable attribute (indicator) of the observed performance, while complex KPI can represent successfulness of more business entities (functions, processes, products). Performance indicators are defined and used by applying business intelligence techniques and through monitoring of activities, called BAM (Business Activity Monitoring). KPIs represent the key "package" of measurable properties of a (business) system and, therefore, important planning tools. They are defined by the rules, indicators, targets and time dimensions. KPIs dynamics should illustrate planned and actual states of observed entities of business system, thus they constitute a model for quality management system measuring.

LSS model for monitoring distribution using key performance indicators, in water distribution company *La Fantana,* Serbia. This company, with about 160 employees, is a leader in the field of bottling and distribution of water and water coolers in Serbia. Today, company has more than 10.000 clients with 25.000 installed water cooler devices at companies and individuals. La Fantana produces and distributes yearly over 16.000.000 liters of natural noncarbonated mineral water. Diversity of company offer is reflected in subscription packages adapted to various requests of our clients, as well as in the functionality of water cooler devices, enabling to enjoy cold, hot, carbonated or water heated to room temperature. La Fantana carries out water production and bottling in its own modern factory located in Mitrovo Polje, near Aleksandrovac Zupski in Serbia. La Fantana has 6 logistics distribution centers (LDC), positioned in different parts of a country. From these LDCs La Fantana company is supplying customers with small truck fleet (about 30 vehicles). All deliveries are done in 24h, and company has 99, 6 % rate of success deliveries in 24h. Full truck loads (FTL) are supplying LDC, from the plant and less than full trucks loads (LTL) shipments are supplying customers.

La Fantana company's KPIs system (as it is presented in this paper) is modelled and used in spreadsheets, in accordance with defined problems. The main method for data processing is simulation, "what-if" analyse that is significantly cheaper than with standard software packages. As shown in figures below, KPIs of logistics (distribution) model are developed in spreadsheet software and built from real data, collected in the Company in 2011 and 2012. KPI model was created in spreadsheet workbook, which contains eight different sheets with input data formats and forms for indicators calculation. Spreadsheet KPI model consists of the following sheets:

– Procedure sheet - which presents instructions for making KPI model and which verified steps of model development.



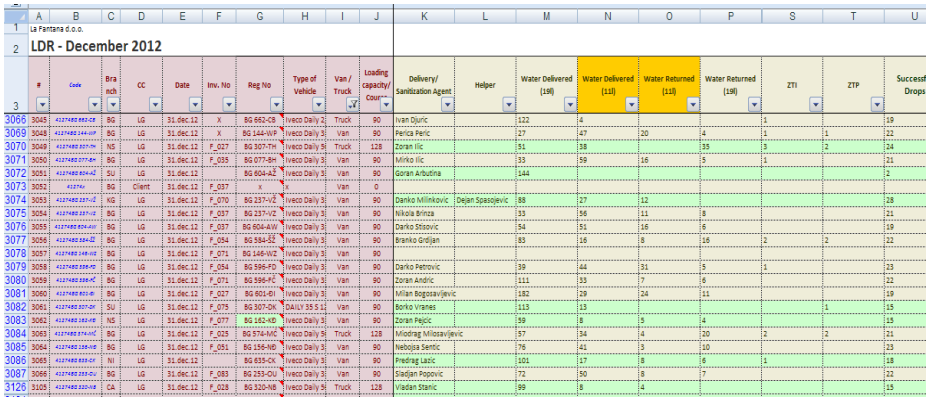
| # (Order) | Sheet | Explanation | Time (Minutes) | Status | |
|---|---|---|---|---|---|
| 1 | Data | copy formulas in next row, make value previous month, ungroup current month | | ok | |
| 2 | Rolling Consumption | copy formulas in next row, make value previous month, ungroup current month | | | |
| 3 | Input_LDR | copy LDR | | ok | |
| 4 | Fuel Data | copy Fuel Data (OMV+ other suppliers), with discount, delete quantity from discount | | ok | reporting data |
| 5 | Definitions | add rows, add new cars | | ok | |
| 6 | Check | add data | | ok | |
| 7 | Rolling | ungroup current month | | ok | |
| 8 | Summary_DA_xy | ungroup current month, change formula in X8 | | ok | |
| 10 | 11.fuel per bottle_xy | change month in chart's title | | ok | |
| 11 | all | check the data, 90.data, charts, etc. | | ok | |
| 16 | | check new vehicles | | ok | |
| 17 | | check and correct definitions | | ok | |
| 18 | | check EVERYTHING about cars | | ok | |
| 19 | | check and correct LDR | | ok | |
| 23 | | failed drops | | ok | |
| 24 | | successful drops | | ok | |
| 27 | | make sanitizations | | | |

To change cars in:
Rolling Consumption
Definitions
90.data

Note: DO NOT insert rows in Data and Rolling sheets!!! DO NOT insert rows in Data and Rolling sheets!!! DO NOT insert rows in Da

**Figure 7: Procedure sheet**

– Input LDR sheet - represents Logistic delivery report for daily base input of distribution data (about vehicles, delivery agent, number of bottles, new cooler installations, successful delivery etc.)



La Fantana d.o.o.

LDR - December 2012

| # | Code | Branch | CC | Date | Inv. No | Reg No | Type of Vehicle | Van / Truck | Loading capacity/ Count | Delivery/ Sanitization Agent | Helper | Water Delivered (19l) | Water Delivered (11l) | Water Returned (11l) | Water Returned (19l) | ZTI | ZTP | Successf Drops |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3045 | 4127482.883-CE | BG | LG | 31.dec.12 | X | BG 662-CB | Iveco Daily 2 | Truck | 90 | Ivan Djuric | | 122 | 4 | | | 1 | | 19 |
| 3048 | 4127482.144-UP | BG | LG | 31.dec.12 | X | BG 144-WP | Iveco Daily 3 | Van | 90 | Perica Peric | | 27 | 47 | 20 | 4 | 1 | 1 | 22 |
| 3049 | 4127482.837-TH | NS | LG | 31.dec.12 | F_027 | BG 307-TH | Iveco Daily 5 | Truck | 128 | Zoran Ilic | | 51 | 38 | | 35 | 3 | 2 | 24 |
| 3050 | 4127482.077-BH | BG | LG | 31.dec.12 | F_035 | BG 077-BH | Iveco Daily 3 | Van | 90 | Mirko Ilic | | 33 | 59 | 16 | 5 | 1 | | 21 |
| 3051 | 4127482.824-AZ | SU | LG | 31.dec.12 | | BG 824-AZ | Iveco Daily 3 | Van | 90 | Goran Arbutina | | 144 | | | | | | 2 |
| 3052 | 412784 | BG | Client | 31.dec.12 | F_037 | X | X | Van | 0 | | | | | | | | | |
| 3053 | 4127482.237-VZ | KG | LG | 31.dec.12 | F_070 | BG 237-VZ | Iveco Daily 3 | Van | 90 | Darko Milinkovic | Dejan Spasojevic | 88 | 27 | 12 | | | | 18 |
| 3054 | 4127482.237-VZ | BG | LG | 31.dec.12 | F_037 | BG 237-VZ | Iveco Daily 3 | Van | 90 | Nikola Brinza | | 33 | 56 | 11 | 8 | | | 21 |
| 3055 | 4127482.824-AW | BG | LG | 31.dec.12 | F_037 | BG 824-AW | Iveco Daily 3 | Van | 90 | Darko Stosvic | | 54 | 51 | 16 | 6 | | | 19 |
| 3056 | 4127482.584-SZ | BG | LG | 31.dec.12 | F_054 | BG 584-SZ | Iveco Daily 3 | Van | 90 | Branko Grdijan | | 83 | 16 | 8 | 16 | 1 | 2 | 22 |
| 3057 | 4127482.148-WZ | BG | LG | 31.dec.12 | F_071 | BG 148-WZ | Iveco Daily 3 | Van | 90 | | | | | | | | | |
| 3058 | 4127482.596-PD | BG | LG | 31.dec.12 | F_054 | BG 596-PD | Iveco Daily 3 | Van | 90 | Darko Petrovic | | 39 | 44 | 31 | 5 | 1 | | 23 |
| 3059 | 4127482.596-PC | BG | LG | 31.dec.12 | F_071 | BG 596-PC | Iveco Daily 3 | Van | 90 | Zoran Andric | | 111 | 33 | 7 | 6 | | | 22 |
| 3060 | 4127482.601-BI | BG | LG | 31.dec.12 | F_027 | BG 601-BI | Iveco Daily 3 | Van | 90 | Milan Bogosavljevic | | 182 | 29 | 24 | 11 | | | 19 |
| 3061 | 4127482.307-DK | SU | LG | 31.dec.12 | F_075 | BG 307-DK | DAILY 35 S 12 | Van | 90 | Borko Vranes | | 113 | 13 | | | | 1 | 15 |
| 3062 | 4127482.162-KB | NS | LG | 31.dec.12 | F_077 | BG 162-KB | Iveco Daily 3 | Van | 90 | Zoran Pejcic | | 59 | 8 | 5 | 4 | | | 15 |
| 3063 | 4127482.674-MC | BG | LG | 31.dec.12 | F_025 | BG 674-MC | Iveco Daily 5 | Truck | 128 | Miodrag Milosavljevic | | 57 | 34 | 4 | 20 | 2 | 2 | 21 |
| 3064 | 4127482.158-NB | BG | LG | 31.dec.12 | F_051 | BG 158-NB | Iveco Daily 3 | Van | 90 | Nebojsa Sentic | | 76 | 41 | 3 | 10 | | | 23 |
| 3065 | 4127482.833-CF | NI | LG | 31.dec.12 | | BG 655-CK | Iveco Daily 3 | Van | 90 | Predrag Lazic | | 101 | 17 | 8 | 6 | 1 | | 18 |
| 3066 | 4127482.253-CU | BG | LG | 31.dec.12 | F_083 | BG 253-CU | Iveco Daily 3 | Van | 90 | Sladjan Popovic | | 72 | 50 | 8 | 7 | | | 22 |
| 3105 | 4127482.322-HB | CA | LG | 31.dec.12 | F_028 | BG 320-NB | Iveco Daily 5 | Truck | 128 | Vladan Stanic | | 99 | 8 | 4 | | | | 15 |

**Figure 8: Logistic delivery report (LDR)**

– Fuel data sheet - refers to a report of fuel consumption in the distribution and consumed fuel values, per vehicle and each distribution center.

| | A | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Grup | Ukupno sa PDV-om | Neto | PDV | Br Fakture | Datum fakturisanja | ACCOUNT | DED/NED | REG. NO. | CC | ROUTE X_4 CHR | Account | Accounted Values | Accounted Values | Supplier - fake | Check new cars |
| 2 | 3186 | 2.153,88 | 1.794,90 | 358,98 | 8912342525 | 17.dec.12 | fuel | NED | BG 110-BD | SL_NS | 3186 | 5131 | 2.153,88 | 18,97 | OMV | BG 110-BD |
| 3 | 3855 | 654,63 | 545,53 | 109,11 | 8912342525 | 17.dec.12 | gas | DED | BG 401-CC | SZ_BG | 3855 | 5131 | 545,53 | 4,81 | OMV | BG 401-CC |
| 4 | 3574 | 2.593,58 | 2.161,32 | 432,26 | 8912342525 | 17.dec.12 | fuel | DED | BG 237-KZ | DA_NI | 3574 | 5131 | 2.161,32 | 19,04 | OMV | BG 237-KZ |
| 5 | 4028 | 1.643,99 | 1.369,99 | 274,00 | 8912342525 | 17.dec.12 | gas | NED | BG 517-UD | SZ_BG | 4028 | 5131 | 1.643,99 | 14,48 | OMV | BG 517-UD |
| 6 | 3699 | 5.159,97 | 4.299,98 | 860,00 | 8912342525 | 17.dec.12 | fuel | DED | BG 320-NB | DA_CA | 3699 | 5131 | 4.299,98 | 37,88 | OMV | BG 320-NB |
| 7 | 3947 | 7.214,79 | 6.012,33 | 1.202,47 | 8912342525 | 17.dec.12 | fuel | NED | BG 525-JY | PW | 3947 | 5131 | 7.214,79 | 63,55 | OMV | BG 525-JY |
| 8 | 3400 | 7.991,74 | 6.659,78 | 1.331,96 | 8912342525 | 17.dec.12 | fuel | NED | BG 161-WJ | SW | 3400 | 5131 | 7.991,74 | 70,39 | OMV | BG 161-WJ |
| 9 | 3392 | 3.619,50 | 3.016,25 | 603,25 | 8912342525 | 17.dec.12 | fuel | NED | BG 149-NU | SL_BG | 3392 | 5131 | 3.619,50 | 31,88 | OMV | BG 149-NU |
| 10 | 3319 | 4.454,65 | 3.712,21 | 742,44 | 8912342525 | 17.dec.12 | fuel | NED | BG 136-NT | SL_BG | 3319 | 5131 | 4.454,65 | 39,24 | OMV | BG 136-NT |
| 11 | 3335 | 4.370,83 | 3.642,36 | 728,47 | 8912342525 | 17.dec.12 | fuel | NED | BG 131-NR | SL_BG | 3335 | 5131 | 4.370,83 | 38,50 | OMV | BG 131-NR |
| 12 | 3640 | 3.180,59 | 2.650,49 | 530,10 | 8912342525 | 17.dec.12 | fuel | NED | BG 307-FS | SL_BG | 3640 | 5131 | 3.180,59 | 28,02 | OMV | BG 307-FS |
| 13 | 3723 | 7.000,91 | 5.834,09 | 1.166,82 | 8912342525 | 17.dec.12 | fuel | NED | BG 347-IG | SL_CA | 3723 | 5131 | 7.000,91 | 61,67 | OMV | BG 347-IG |
| 14 | 3491 | 1.545,54 | 1.287,95 | 257,59 | 8912342525 | 17.dec.12 | fuel | NED | BG 214-PG | SL_BG | 3491 | 5131 | 1.545,54 | 13,61 | OMV | BG 214-PG |
| 15 | 4002 | 1.534,00 | 1.278,33 | 255,67 | 8912342525 | 17.dec.12 | fuel | DED | BG 293-CĐ | SL_CA | 4002 | 5131 | 1.278,33 | 11,26 | OMV | BG 293-CĐ |
| 16 | 4002 | 3.287,11 | 2.739,26 | 547,85 | 8912342525 | 17.dec.12 | gas | DED | BG 293-CĐ | SL_CA | 4002 | 5131 | 2.739,26 | 24,13 | OMV | BG 293-CĐ |

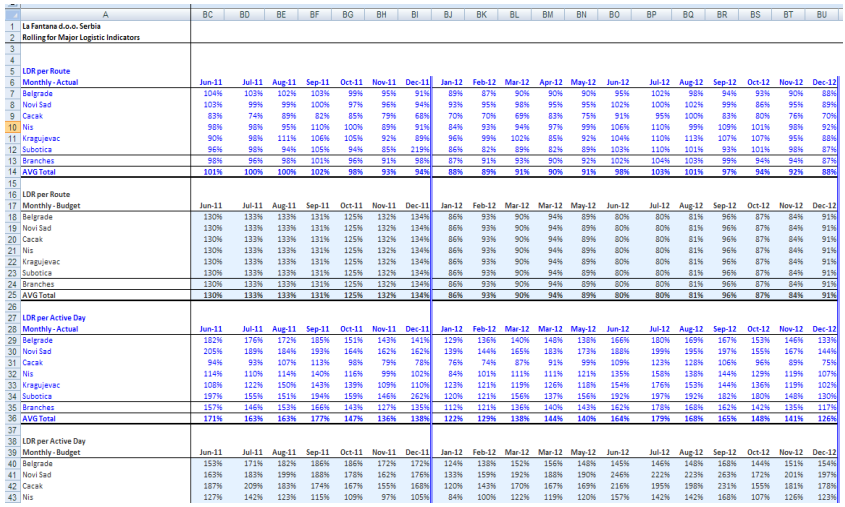
**Figure 9: Fuel consumption data sheet**

– Data sheet - which includes a monthly based data about bottle sales and bottles delivery, vehicle capacity, vehicle capacity per active days, number of routes, number of kilometres, number of vehicles, number of undelivered orders, spent fuel, number of installed and withdrawn coolers, number of sanitizations and service.

| | A | BG | BH | BI | BJ | BK | BL | BM | BN | BO | BP | BQ | BR | BS | BT | BU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | La Fantana d.o.o. Serbia | | | | | | | | | | | | | | | |
| 2 | Rolling for Major Logistic Indicators | | | | | | | | | | | | | | | |
| 3 | | working days budget | | | | | | | | | | | | | | |
| 4 | Working Days | | | | | | | | | | | | | | | |
| 5 | Monthly | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 |
| 6 | Total | 21 | 22 | 22 | 21 | 20 | 22 | 19 | 21 | 21 | 22 | 23 | 20 | 23 | 21 | 21 |
| 7 | | | | | | | | | | | | | | | | |
| 8 | Water Delivered 19l | | | | | | | | | | | | | | | |
| 9 | Monthly - Actual | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 |
| 10 | Belgrade | 38.967 | 39.147 | 38.050 | 30.787 | 33.178 | 39.615 | 36.506 | 42.626 | 49.862 | 54.440 | 52.628 | 44.831 | 47.602 | 40.770 | 36.707 |
| 11 | Novi Sad | 12.270 | 11.887 | 11.140 | 7.239 | 10.205 | 12.740 | 11.320 | 13.910 | 14.579 | 15.692 | 18.007 | 14.427 | 12.433 | 12.455 | 10.508 |
| 12 | Cacak | 2.681 | 2.332 | 2.191 | 2.052 | 1.711 | 2.567 | 2.327 | 2.796 | 3.491 | 3.773 | 4.111 | 2.977 | 3.080 | 2.614 | 2.316 |
| 13 | Nis | 3.931 | 3.753 | 3.939 | 2.849 | 3.268 | 3.976 | 3.399 | 4.565 | 5.346 | 4.849 | 5.960 | 5.177 | 5.354 | 4.398 | 4.233 |
| 14 | Kragujevac | 3.500 | 3.645 | 4.204 | 3.110 | 3.471 | 4.699 | 4.071 | 4.472 | 6.377 | 7.913 | 9.471 | 7.636 | 8.082 | 6.616 | 4.962 |
| 15 | Subotica | 6.185 | 4.090 | 3.955 | 4.311 | 4.120 | 5.760 | 5.499 | 6.043 | 7.339 | 7.712 | 7.727 | 6.894 | 6.630 | 5.728 | 4.566 |
| 16 | Branches | 28.567 | 25.707 | 25.409 | 19.561 | 22.775 | 29.742 | 26.616 | 31.786 | 37.132 | 39.939 | 45.276 | 37.111 | 35.579 | 31.811 | 26.585 |
| 17 | Total | 67.534 | 64.854 | 63.459 | 50.348 | 55.953 | 69.357 | 63.122 | 74.412 | 86.994 | 94.379 | 97.904 | 81.942 | 83.181 | 72.581 | 63.292 |
| 18 | | | | | | | | | | | | | | | | |
| 19 | Water Delivered 19L+11L by LaF | | | | | | | | | | | | | | | |
| 20 | Monthly - Budget | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 |
| 21 | Belgrade | 48.380 | 46.767 | 50.678 | 30.759 | 35.206 | 44.005 | 37.455 | 39.186 | 38.442 | 40.535 | 42.869 | 42.412 | 43.460 | 41.640 | 42.411 |
| 22 | Novi Sad | 14.031 | 13.378 | 14.480 | 10.890 | 12.354 | 16.395 | 13.879 | 15.500 | 20.013 | 18.929 | 19.887 | 20.398 | 15.344 | 16.407 | 16.043 |
| 23 | Cacak | 3.286 | 3.196 | 3.465 | 2.449 | 2.781 | 3.640 | 3.086 | 3.454 | 4.394 | 4.166 | 4.407 | 4.477 | 3.469 | 3.698 | 3.627 |
| 24 | Nis | 4.278 | 4.015 | 4.340 | 3.423 | 3.879 | 5.200 | 4.398 | 4.903 | 6.398 | 6.041 | 6.317 | 6.522 | 4.805 | 5.149 | 5.023 |
| 25 | Kragujevac | 4.581 | 4.391 | 4.755 | 3.516 | 3.990 | 5.276 | 4.468 | 4.993 | 6.422 | 6.078 | 6.397 | 6.545 | 4.962 | 5.301 | 5.188 |
| 26 | Subotica | 5.749 | 5.404 | 5.841 | 4.587 | 5.199 | 6.964 | 5.889 | 6.568 | 8.561 | 8.085 | 8.457 | 8.728 | 6.441 | 6.901 | 6.734 |
| 27 | Branches | 31.925 | 30.385 | 32.881 | 24.865 | 28.204 | 37.476 | 31.721 | 35.418 | 45.788 | 43.300 | 45.465 | 46.670 | 35.021 | 37.456 | 36.616 |
| 28 | Total | 80.305 | 77.151 | 83.558 | 55.624 | 63.411 | 81.480 | 69.176 | 74.604 | 84.230 | 83.835 | 88.334 | 89.082 | 78.481 | 79.095 | 79.027 |
| 29 | | | | | | | | | | | | | | | | |
| 30 | Real Capacity | | | | | | | | | | | | | | | |
| 31 | Monthly - Actual | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 |
| 32 | Belgrade | 39.548 | 41.224 | 41.814 | 34.688 | 38.052 | 43.982 | 40.398 | 47.610 | 52.720 | 53.606 | 53.442 | 47.508 | 51.276 | 45.170 | 41.480 |

**Figure 10: Logistics Data Sheet**

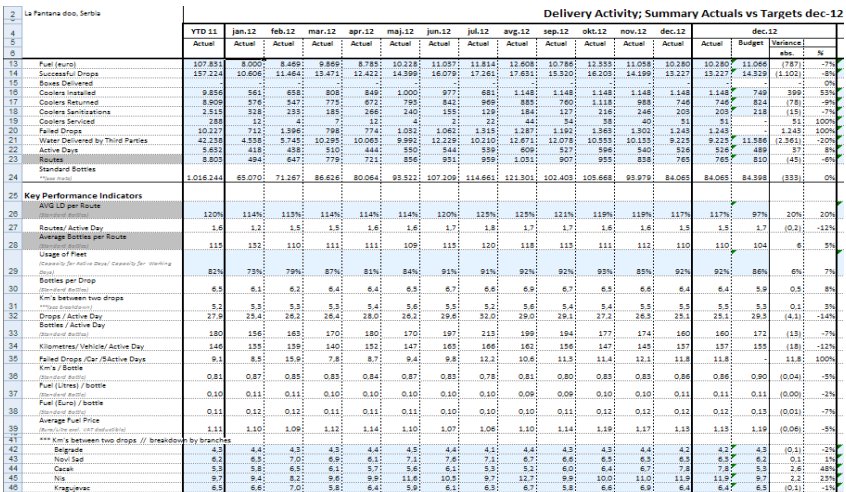
– Rolling sheet - which presents plan realization, or percentage of achieved in comparison with scheduled from a sheet Data.



| | A | BC | BD | BE | BF | BG | BH | BI | BJ | BK | BL | BM | BN | BO | BP | BQ | BR | BS | BT | BU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | La Fantana d.o.o. Serbia | | | | | | | | | | | | | | | | | | | |
| 2 | Rolling for Major Logistic Indicators | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | |
| 5 | LDR per Route | | | | | | | | | | | | | | | | | | | |
| 6 | Monthly - Actual | Jun-11 | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Apr-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 |
| 7 | Belgrade | 104% | 103% | 102% | 103% | 99% | 95% | 91% | 89% | 87% | 90% | 90% | 90% | 95% | 102% | 98% | 94% | 93% | 90% | 88% |
| 8 | Novi Sad | 103% | 99% | 99% | 100% | 97% | 96% | 94% | 93% | 95% | 98% | 95% | 95% | 102% | 100% | 102% | 99% | 86% | 95% | 89% |
| 9 | Cacak | 83% | 74% | 89% | 82% | 85% | 79% | 68% | 70% | 70% | 69% | 83% | 75% | 91% | 95% | 100% | 83% | 80% | 76% | 70% |
| 10 | Nis | 98% | 98% | 95% | 110% | 100% | 89% | 91% | 84% | 93% | 94% | 97% | 99% | 106% | 110% | 99% | 109% | 101% | 98% | 92% |
| 11 | Kragujevac | 90% | 98% | 111% | 106% | 105% | 92% | 89% | 96% | 99% | 102% | 85% | 92% | 104% | 110% | 113% | 107% | 107% | 95% | 88% |
| 12 | Subotica | 96% | 98% | 94% | 105% | 94% | 85% | 219% | 86% | 82% | 89% | 82% | 89% | 103% | 110% | 101% | 93% | 101% | 98% | 87% |
| 13 | Branches | 98% | 96% | 98% | 101% | 96% | 91% | 98% | 87% | 91% | 93% | 90% | 92% | 102% | 104% | 103% | 99% | 94% | 94% | 87% |
| 14 | AVG Total | 101% | 100% | 100% | 102% | 98% | 93% | 94% | 88% | 89% | 91% | 90% | 91% | 98% | 103% | 101% | 97% | 94% | 92% | 88% |
| 15 | | | | | | | | | | | | | | | | | | | | |
| 16 | LDR per Route | | | | | | | | | | | | | | | | | | | |
| 17 | Monthly - Budget | Jun-11 | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Mar-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 |
| 18 | Belgrade | 130% | 133% | 133% | 131% | 125% | 132% | 134% | 86% | 93% | 90% | 94% | 89% | 80% | 80% | 81% | 96% | 87% | 84% | 91% |
| 19 | Novi Sad | 130% | 133% | 133% | 131% | 125% | 132% | 134% | 86% | 93% | 90% | 94% | 89% | 80% | 80% | 81% | 96% | 87% | 84% | 91% |
| 20 | Cacak | 130% | 133% | 133% | 131% | 125% | 132% | 134% | 86% | 93% | 90% | 94% | 89% | 80% | 80% | 81% | 96% | 87% | 84% | 91% |
| 21 | Nis | 130% | 133% | 133% | 131% | 125% | 132% | 134% | 86% | 93% | 90% | 94% | 89% | 80% | 80% | 81% | 96% | 87% | 84% | 91% |
| 22 | Kragujevac | 130% | 133% | 133% | 131% | 125% | 132% | 134% | 86% | 93% | 90% | 94% | 89% | 80% | 80% | 81% | 96% | 87% | 84% | 91% |
| 23 | Subotica | 130% | 133% | 133% | 131% | 125% | 132% | 134% | 86% | 93% | 90% | 94% | 89% | 80% | 80% | 81% | 96% | 87% | 84% | 91% |
| 24 | Branches | 130% | 133% | 133% | 131% | 125% | 132% | 134% | 86% | 93% | 90% | 94% | 89% | 80% | 80% | 81% | 96% | 87% | 84% | 91% |
| 25 | AVG Total | 130% | 133% | 133% | 131% | 125% | 132% | 134% | 86% | 93% | 90% | 94% | 89% | 80% | 80% | 81% | 96% | 87% | 84% | 91% |
| 26 | | | | | | | | | | | | | | | | | | | | |
| 27 | LDR per Active Day | | | | | | | | | | | | | | | | | | | |
| 28 | Monthly - Actual | Jun-11 | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Mar-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 |
| 29 | Belgrade | 182% | 176% | 172% | 185% | 151% | 143% | 141% | 129% | 136% | 140% | 148% | 138% | 166% | 180% | 169% | 167% | 153% | 146% | 133% |
| 30 | Novi Sad | 205% | 189% | 184% | 193% | 164% | 162% | 162% | 139% | 144% | 165% | 183% | 173% | 188% | 199% | 195% | 197% | 155% | 167% | 144% |
| 31 | Cacak | 94% | 93% | 107% | 113% | 98% | 79% | 78% | 76% | 74% | 87% | 91% | 99% | 109% | 123% | 128% | 106% | 96% | 89% | 75% |
| 32 | Nis | 114% | 110% | 114% | 140% | 116% | 99% | 102% | 84% | 101% | 111% | 111% | 121% | 135% | 158% | 138% | 144% | 129% | 119% | 107% |
| 33 | Kragujevac | 108% | 122% | 150% | 143% | 139% | 109% | 110% | 123% | 121% | 119% | 126% | 118% | 154% | 176% | 153% | 144% | 136% | 119% | 102% |
| 34 | Subotica | 197% | 155% | 151% | 194% | 159% | 146% | 262% | 120% | 121% | 156% | 137% | 156% | 192% | 197% | 192% | 182% | 180% | 148% | 130% |
| 35 | Branches | 157% | 146% | 153% | 166% | 143% | 127% | 135% | 112% | 121% | 136% | 140% | 143% | 162% | 178% | 168% | 162% | 142% | 135% | 117% |
| 36 | AVG Total | 171% | 163% | 163% | 177% | 147% | 136% | 138% | 122% | 129% | 138% | 144% | 140% | 164% | 179% | 168% | 165% | 148% | 141% | 126% |
| 37 | | | | | | | | | | | | | | | | | | | | |
| 38 | LDR per Active Day | | | | | | | | | | | | | | | | | | | |
| 39 | Monthly - Budget | Jun-11 | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 | Jan-12 | Feb-12 | Mar-12 | Mar-12 | May-12 | Jun-12 | Jul-12 | Aug-12 | Sep-12 | Oct-12 | Nov-12 | Dec-12 |
| 40 | Belgrade | 153% | 171% | 182% | 166% | 166% | 172% | 172% | 124% | 138% | 152% | 156% | 148% | 145% | 146% | 148% | 168% | 144% | 151% | 154% |
| 41 | Novi Sad | 163% | 183% | 199% | 188% | 178% | 162% | 176% | 133% | 159% | 192% | 188% | 190% | 246% | 222% | 223% | 263% | 172% | 201% | 197% |
| 42 | Cacak | 187% | 209% | 183% | 174% | 167% | 155% | 168% | 120% | 143% | 170% | 167% | 169% | 216% | 195% | 198% | 231% | 155% | 181% | 178% |
| 43 | Nis | 127% | 142% | 123% | 115% | 109% | 97% | 105% | 84% | 100% | 122% | 119% | 120% | 157% | 142% | 142% | 168% | 107% | 126% | 123% |

**Figure 11: Rolling sheet**

– Summary distribution sheet - is used to represent and calculate distribution indicators.



| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | La Fantana doo, Serbia | Delivery Activity; Summary Actuals vs Targets dec-12 | | | | | | | | | | | | | | | | | | |
| 4 | | YTD 11 | jan.12 | feb.12 | mar.12 | apr.12 | maj.12 | jun.12 | jul.12 | avg.12 | sep.12 | okt.12 | nov.12 | dec.12 | dec.12 | | | | | |
| 5 | | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Actuel | Budget | Variance | | | |
| 6 | | | | | | | | | | | | | | | | | abs. | % | | |
| 13 | Fuel (euro) | 107.851 | 8.000 | 8.469 | 9.869 | 8.785 | 10.228 | 11.057 | 11.814 | 12.608 | 10.786 | 12.553 | 11.058 | 10.280 | 10.280 | 11.066 | (787) | -7% | | |
| 14 | Successful Drops | 157.224 | 10.606 | 11.464 | 13.471 | 12.422 | 14.399 | 16.079 | 17.261 | 17.631 | 15.320 | 16.203 | 14.199 | 13.227 | 13.227 | 14.329 | (1.102) | -8% | | |
| 15 | Boxes Delivered | | | | | | | | | | | | | | | | | 0% | | |
| 16 | Coolers Installed | 9.856 | 561 | 658 | 808 | 849 | 1.000 | 977 | 681 | 1.148 | 1.148 | 1.148 | 1.148 | 1.148 | 1.148 | 749 | 399 | 53% | | |
| 17 | Coolers Returned | 8.909 | 576 | 547 | 775 | 672 | 793 | 842 | 969 | 885 | 760 | 1.118 | 988 | 746 | 746 | 824 | (78) | -9% | | |
| 18 | Coolers Sanitisations | 2.515 | 328 | 233 | 185 | 266 | 240 | 155 | 129 | 184 | 127 | 216 | 246 | 205 | 205 | 218 | (13) | -7% | | |
| 19 | Coolers Serviced | 288 | 12 | 4 | 7 | 13 | 4 | 2 | 22 | 44 | 54 | 38 | 40 | 51 | 51 | - | 51 | 100% | | |
| 20 | Failed Drops | 10.227 | 712 | 1.396 | 798 | 774 | 1.082 | 1.062 | 1.315 | 1.287 | 1.193 | 1.363 | 1.302 | 1.243 | 1.243 | - | 1.243 | 100% | | |
| 21 | Water Delivered by Third Parties | 42.238 | 4.538 | 5.745 | 10.295 | 10.063 | 9.992 | 12.229 | 10.210 | 12.671 | 12.078 | 10.553 | 10.133 | 9.225 | 9.225 | 11.586 | (2.361) | -20% | | |
| 22 | Active Days | 5.632 | 418 | 458 | 510 | 444 | 550 | 544 | 539 | 609 | 527 | 596 | 540 | 526 | 526 | 489 | 37 | 8% | | |
| 23 | Routes | 8.803 | 494 | 647 | 779 | 721 | 856 | 951 | 959 | 1.051 | 907 | 955 | 838 | 765 | 765 | 810 | (45) | -6% | | |
| 24 | Standard Bottles *Theo Hold | 1.016.244 | 65.070 | 71.267 | 86.626 | 80.064 | 93.521 | 107.209 | 114.661 | 121.301 | 102.408 | 105.668 | 93.979 | 84.065 | 84.065 | 84.398 | (333) | 0% | | |
| 25 | Key Performance Indicators | | | | | | | | | | | | | | | | | | | |
| 26 | AVG LD per Route (Standard Bottles) | 120% | 114% | 113% | 114% | 114% | 114% | 120% | 125% | 125% | 121% | 119% | 119% | 117% | 117% | 97% | 20% | 20% | | |
| 27 | Routes/ Active Day | 1,6 | 1,2 | 1,5 | 1,5 | 1,6 | 1,6 | 1,7 | 1,8 | 1,7 | 1,7 | 1,6 | 1,6 | 1,5 | 1,5 | 1,7 | (0,2) | -12% | | |
| 28 | Average Bottles per Route (Standard Bottles) | 115 | 132 | 110 | 111 | 111 | 109 | 115 | 120 | 118 | 113 | 111 | 112 | 110 | 110 | 104 | 6 | 5% | | |
| 29 | Usage of Fleet Capacity for Active Days/ Capacity for Working Days | 82% | 73% | 79% | 87% | 81% | 84% | 91% | 91% | 92% | 92% | 93% | 85% | 92% | 92% | 86% | 6% | 7% | | |
| 30 | Bottles per Drop (Standard Bottles) | 6,5 | 6,1 | 6,2 | 6,4 | 6,4 | 6,5 | 6,7 | 6,6 | 6,9 | 6,7 | 6,5 | 6,6 | 6,4 | 6,4 | 5,9 | 0,5 | 8% | | |
| 31 | Km's between two drops **Theo Standard Bottles | 5,2 | 5,3 | 5,3 | 5,3 | 5,4 | 5,6 | 5,5 | 5,2 | 5,6 | 5,4 | 5,4 | 5,5 | 5,5 | 5,5 | 5,3 | 0,1 | 3% | | |
| 32 | Drops / Active Day | 27,9 | 25,4 | 26,2 | 26,4 | 28,0 | 26,2 | 29,6 | 32,0 | 29,0 | 29,1 | 27,2 | 26,3 | 25,1 | 25,1 | 29,5 | (4,1) | -14% | | |
| 33 | Bottles / Active Day (Standard Bottles) | 180 | 156 | 163 | 170 | 180 | 170 | 197 | 213 | 199 | 194 | 177 | 174 | 160 | 160 | 172 | (13) | -7% | | |
| 34 | Kilometres/ Vehicle/ Active Day | 146 | 155 | 139 | 140 | 152 | 147 | 165 | 166 | 161 | 156 | 147 | 145 | 157 | 157 | 155 | (18) | -12% | | |
| 35 | Failed Drops /Car /5Active Days | 9,1 | 8,5 | 15,9 | 7,8 | 8,7 | 9,4 | 9,8 | 12,1 | 10,6 | 11,3 | 11,4 | 12,1 | 11,8 | 11,8 | - | 11,8 | 100% | | |
| 36 | Km's / Bottle (Standard Bottle) | 0,81 | 0,87 | 0,85 | 0,83 | 0,84 | 0,87 | 0,83 | 0,78 | 0,81 | 0,80 | 0,83 | 0,83 | 0,86 | 0,86 | 0,90 | (0,04) | -5% | | |
| 37 | Fuel (Litres) / bottle (Standard Bottle) | 0,10 | 0,11 | 0,11 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,09 | 0,09 | 0,10 | 0,10 | 0,11 | 0,11 | 0,11 | (0,00) | -2% | | |
| 38 | Fuel (Euro) / bottle (Standard Bottle) | 0,11 | 0,12 | 0,12 | 0,11 | 0,11 | 0,11 | 0,10 | 0,10 | 0,10 | 0,11 | 0,12 | 0,12 | 0,12 | 0,12 | 0,13 | (0,01) | -7% | | |
| 39 | Average Fuel Price Euro/Litre excl. VAT (Indicative) | 1,11 | 1,10 | 1,09 | 1,12 | 1,14 | 1,10 | 1,07 | 1,06 | 1,10 | 1,14 | 1,19 | 1,17 | 1,15 | 1,15 | 1,19 | (0,06) | -5% | | |
| 41 | *** Km's between two drops // breakdown by branches | | | | | | | | | | | | | | | | | | | |
| 42 | Belgrade | 4,3 | 4,4 | 4,3 | 4,3 | 4,4 | 4,5 | 4,4 | 4,1 | 4,4 | 4,3 | 4,3 | 4,4 | 4,2 | 4,2 | 4,3 | (0,1) | -2% | | |
| 43 | Novi Sad | 6,2 | 6,5 | 7,0 | 6,9 | 6,1 | 7,1 | 7,6 | 7,1 | 6,7 | 6,6 | 6,5 | 6,5 | 6,5 | 6,5 | 6,4 | 0,1 | 1% | | |
| 44 | Cacak | 5,3 | 5,8 | 6,5 | 6,1 | 5,7 | 5,6 | 6,1 | 5,3 | 5,2 | 6,0 | 6,4 | 6,7 | 7,8 | 7,8 | 5,3 | 2,6 | 48% | | |
| 45 | Nis | 9,7 | 9,4 | 8,2 | 9,6 | 9,9 | 11,6 | 10,5 | 9,7 | 12,7 | 9,9 | 10,0 | 11,0 | 11,9 | 11,9 | 9,7 | 2,2 | 23% | | |
| 46 | Kragujevac | 6,5 | 6,6 | 7,0 | 5,8 | 6,4 | 5,8 | 6,1 | 5,8 | 6,5 | 6,6 | 6,9 | 6,4 | 6,4 | 6,4 | 6,5 | (0,1) | -1% | | |
| 47 | Subotica | 8,7 | 7,8 | 7,0 | 7,6 | 9,6 | 8,1 | 8,2 | 9,1 | 8,7 | 9,2 | 9,3 | 9,5 | 9,3 | 9,3 | 8,7 | 0,7 | 8% | | |
| 48 | ** Note: (Estandard Bottles + (Water Delivered with LoF Fleet + Boxes Delivered + (Coolers Installed + Coolers Returned + Coolers Sanitisations + Coolers Serviced) x 3) | | | | | | | | | | | | | | | | | | | |

**Figure 12: Summary distribution sheet**

– Summary KPI sheet - which presents crucial KPI for understanding success of distribution. Observed report is one of the most important reports for distribution management. If we observe indicator km/bottle, we can see that this is one of the most important indicators for distribution management in the company. It shows how many kilometers are passed for one bottle delivery. As distribution of water is one of the most difficult types of distribution, it can be said that the expansion of the market for distribution is based on this indicator.

La Fantana doo, Serbia

**Delivery Activity; Summary Actuals vs Targets dec-12**

| KPI Logistic | dec.12 | | | | dec.11 | | | YTD dec-12 | | | | YTD dec-11 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Actual | Budget | Variance abs. | Variance % | Actual | Variance abs. | Variance % | Actual | Budget | Variance abs. | Variance % | Actual | Variance abs. | Variance % |
| No. of Vehicles | 28 | 27 | 1 | 4% | 27 | 1 | 4% | 28 | 27 | 1 | 3% | 26 | 1 | 5% |
| Water Delivered by LAF Fleet [19l + 11l] | 77.621 | 79.027 | (1.406) | -2% | 63.459 | 14.162 | 22% | 1.054.654 | 926.378 | 128.276 | 14% | 826.738 | 227.916 | 28% |
| Failed Drops | 1.243 | - | 1.243 | 100% | 834 | 409 | 49% | 13.476 | - | 13.476 | 100% | 10.227 | 3.249 | 32% |
| AVG LD per Route (Standard Bottles) | 117% | 97% | 20% | 20% | 102% | 15% | 15% | 118% | 93% | 25% | 27% | 105% | 13% | 13% |
| Routes/ Active Day | 1,5 | 1,7 | (0,2) | -12% | 1,5 | (0,0) | -3% | 1,6 | 1,7 | (0,1) | -4% | 1,6 | 0,0 | 1% |
| Average Bottles per Route (Standard Bottles) | 110 | 104 | 6 | 5% | 95 | 15 | 16% | 114 | 103 | 11 | 10% | 101 | 13 | 12% |
| Km's between two drops ***(see breakdown) | 5,5 | 5,3 | 0,1 | 3% | 5,2 | 0,3 | 5% | 5,4 | 5,2 | 0,2 | 4% | 5,2 | 0,2 | 4% |
| Drops / Active Day | 25,1 | 29,3 | (4,1) | -14% | 27,1 | (2,0) | -7% | 27,6 | 28,4 | (0,8) | -3% | 27,9 | (0,3) | -1% |
| Bottles / Active Day (Standard Bottles) | 160 | 172 | (13) | -7% | 142 | 18 | 13% | 180 | 170 | 10 | 6% | 158 | 22 | 14% |
| Km's / Bottle (Standard Bottle) | 0,86 | 0,90 | (0,04) | -5% | 0,99 | (0,14) | -14% | 0,83 | 0,87 | (0,04) | -4% | 0,92 | (0,09) | -10% |
| Fuel (Litres) / bottle (Standard Bottle) | 0,11 | 0,11 | (0,00) | -2% | 0,13 | (0,02) | -16% | 0,10 | 0,11 | (0,01) | -6% | 0,11 | (0,01) | -9% |

**Figure 13: Summary KPI sheet**

– Diagram distribution sheet - refers to the graphical presentation of the most important KPIs in water distribution.

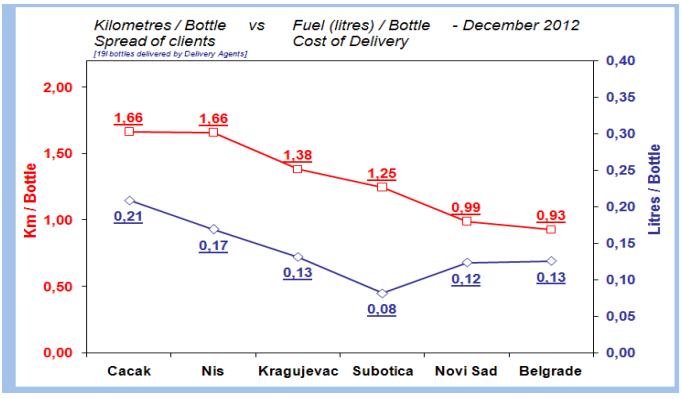



**Figure 14: Diagram distribution sheet**

The application is automated by procedures (macros), created in *Visual Basic for Application*, designed specifically to work in MS Office. Macros, made in this application, enable automation of data entry, linking tables (data) and formation of output reports. In order to prove superiority of spreadsheets for modelling, conclusion can be: this case is more convenient than standard software packages, at least in terms of development speed and user training for observed software. Finally, we can say that spreadsheets can be necessary LSS tool for simple, quick and easy processing and data analysis or in activities of planning, modelling and control of inventories.

## 5 Conclusion

LSS has developed and broadened its range of appeal both globally and by industry sector. Its ability to reduce costs, improve quality and reduce customer delivery time has sealed its place as a leading methodology for improvement of our businesses in the past, present and hopefully the future.

Also, according to the competition analysis, company is the only one in this kind of industry that has the organization for distribution operation described in this paper, and that has shortest time to customer in delivery

**Acknowledgements**

Realization of this project was significantly supported by company employees. Employees have seriously understood Lean & Kaizen and Six Sigma methodology in pllaning. There is also great contribution of company management, who dare to start the project and financially support its realization. Students from the Faculty of Organizational Sciences, Department of Operations Management ware actively involved in all phases of project. At the end of project one of students became employee in the company.

**References**

Antony, J., & Escamilla JL., (2003), Blending the Best of Lean Production and Six Sigma for Achieving and Maintaining Operational Excellence pp 5.

Antony, J., Kumar, M., (2011), Lean Six Sigma: Research and Practice Ventus Publishing ApS ISBN 978-87-7681-768-8.

Businessballs.com, (2011) http://www.businessballs.com/dtiresources/performance_measurement_management.pdf, Accessed August, 2020.

Crosby, P.B. (1996), Quality is Free: Making Quality Certain in Uncertain Times, McGraw-Hill.

Defoe, J.A. and Juran, J.M., (2010), Juran's Quality Handbook: The Complete Guide to Performance Excellence. McGraw-Hill, New York.

Deming, W.E., (1985), Transformation of Western-Style Management, Interfaces, 15(3), 6-11.
Feigenbaum, A.V., (1961) Total Quality Control, McGraw Hill.
Hill, T., (2005), Operations Management, 2nd edn, Palgrave Macmillan, Basingstoke.
Juran, J.M., (2001), Juran's Quality Handbook, 5th Edition, McGraw-Hill.
Johnston R., Chambers S., Harland C., Harrison A., Slack N., (2003), Cases in Operations Management, Financial Times Prentice Hall, UK.
Knowles, G., (2011)., Six Sigma, Ventus Publishing ApS ISBN 978-87-7681-852-4
Leong G., Snyder D., (1990), Research in the process and content of manufacturing strategy, Omega International Journal of Management Science, Vol 18, No 2.
Ohno, T., (1988), Toyota Production System: Beyond Large-Scale Production, Productivity Press.
Pande, P.S., Neuman, R.P. and Cavanagh, R.R., (2000), The Six Sigma way: How GE, Motorola, and Other Top Companies are Honing Their Performance, McGraw-Hill, NY.
Porter, A., (2011), Operations Management, Ventus Publishing ApS ISBN 978-87-7681-464-9.
Rameshwar D., (2011), Improving Firm Performance through Logistics Acitivities: A Research Framework, Indian Journal of Commerce & Management Studies, Vol 2 , No 1.
Slack, N., Chambers, S., Johnston, R., (2010), Operations Management, 6th edn, Pearson Education Limited, Harlow.
Shingo, S., (1989), A Study of Toyota Production System, Productivity Press.
Snyder, K & Peters, N., (2004), 'Lean Six Sigma in the public sector: Applying proven methodologies to improve quality, remove waste, and uncover hidden opportunities in state and local government', White Paper, Xerox Global Services Inc., September 2004.
Wiesenfelder, H., (2009), Advantages and disadvantages of Six Sigma, eHow.com Feb. 05 2009. http://www.ehow.com/ facts_4760705_advantages-disadvantages-six-sigma.html.

# POTENTIAL OF BENFORD'S LAW AND MACHINE LEARNING BASED VERIFICATION IN AGRICULTURAL LOGISTICS

STANISLAV LEVIČAR

Vocational College Brežice, Brežice, Slovenia.
E-mail: stanko.levicar@gmail.com

**Abstract** Food supply chains are becoming increasingly more complex, contributing to emergence of new threats and risks for the involved stakeholders. Additionally, the information technology accelerated development of new and more productive ways of collaboration among organizations (members of supply chains) and helped to optimize their processes. Tighter collaboration among those companies is only possible if sufficient level of trust is established among them, which is often an obstacle that is not easily overcome. Since individual companies (which are part of supply chain) are unable to verify and rely on the data that is provided by third parties, the potential advantages are not fully realized. In this article we try to identify a possibility to remove one important element of this obstacle by using Benford's law as the basis for general-purpose verification tool that is additionally enhanced by statistics based methods of machine learning algorithms that can be implemented in IT supported business operations. The potential usefullness of those methods lies in the fact that they are able to identify the patterns and correlations without explicit users' input.

**Keywords:** Benford's law; fraud detection; machine learning; supply chain, food.

University of Maribor Press

DOI https://doi.org/10.18690/978-961-286-406-4.4
ISBN 978-961-286-406-4

## 1 Introduction

Since the members of food supply chain are relatively fragmented and on average smaller in size, the synchronization of their activities has turned out to be more and more complex and vulnerable to factors that were previously considered minor relatively to the costs of production and distribution. The IT solutions successfully addressed many of the additional problems that surfaced with such complexity. Tight integration of the IT systems of various companies that form a supply chain has resulted in substantial cost minimizing and time savings, as well as removal of various opportunities for human-based errors and data tampering. The focal point has then shifted towards setting up algorithms for data analysis, and reviewing the resulting output information. More and more of those decisions regarding logistics activities depend on the quality and timeliness of information provided by these information systems. In such environment the concept of 'trust-but-verify' where collaborating parties in the supply chain are generally trusting each other, but at the same time check the information they receive, is being increasingly used for monitoring internal processes as well.

Another important impact that is being felt by SME in agriculture is the changing business as well as natural environment which has multifaceted repercussions for those companies. Globalization and the long-term trend of removal of trade barriers among and inside various economic trade blocs as well as between individual countries has lowered barriers to entry for many foreign producers, and have also caused the environment to be more fluid and unpredictable. Firstly, it is getting ever more difficult for those small producers to assess the risks that are emanating from the environment, and therefore they are unable to make optimal decisions that would maximize their ROI. Secondly, they are usually working in conditions of information asymmetry relatively to larger competitors, as well as other partners and their suppliers (such as insurance providers, larger supply-chains, etc.) (OECD, 2019). Local SMEs in agriculture therefore do not dispose of many good options to absorb the consequences of market volatilities and variabilities within their supply chains.

## 2 Business model adaptation

Frequently offered solution for the struggling SMEs in agriculture has been for years that they should adapt their business model which usually included finding a niche market and refocusing on produce with higher margins. While such business pivoting surely is a solution for a lot of those companies, it cannot be universal panacea for the majority of businesses in the agricultural sector (Alsos *et al.*, 2011).

Such solutions imply that the existing business models of those SMEs are inherently flawed and are not sustainable, which in many cases is not true. Some of the underlying root causes for diminishing ROI can be eliminated or neutralized – and this way business models of those companies do not need to be substituted, but only enhanced.

The primary component of business model as a concept is usually the value proposition – which is tightly dependent on the price and cost structure of the products and services. The identification of the factors that are influencing them enables companies to better predict the future dynamics in the markets and what measures should they undertake to maximize the probability of achieving the business goals.

## 3 Reasons for information asymmetry

The problem that many SMEs in agriculture are facing is that they do not have sufficient resources to gain access to data sources as well as know-how needed to process them and transform them into actionable information. One reason is their size which does not permit them to efficiently collect sufficient amount of data, and another is the cost which is usually too high for them to be able to develop their own methods and algorithms which would transform the input data into clear results which would help them make more optimal decisions.

Part of the problem is that each SME has specific business characteristics and features, meaning that it is difficult in advance to prepare IT solutions which would be suitable for large number of SMEs at the same time without modifications which are usually costly and time consuming. Since the environment is constantly changing

those modifications would also require yearly adjustments, thus eliminating important part of the benefits they would supposedly bring.

The information asymmetry is therefore not induced only because of the lack of the quality information sources, but also due to the costs of constant adjustments which would have to be implemented continuously.

## 4 Data driven decision making

To be able to regain the competitive advantage it is thus not feasible for SMEs to emulate their larger competitors. The decision making process of SMEs should instead be supported by solutions that can produce useful information even if the data sources are limited and raw. Another important aspect of these type of solutions is that it has to be able to automatically adapt without constant intervention and modification from its users.

On the other hand, the process of decision making should still be supported by evidence based on correct data which is collected externally or internally (inside the company). The described problem of limited availability of quality data and the need for constant modifications of the model (without the necessary interventions from the users) can be resolved with the use of solutions that are incorporating statistical or machine learning methods (Finlay, 2018).

Those methods are part of statistics studies that address the before mentioned issue with development of computer algorithms that search for patterns and transform data in usable information. The algorithms of machine learning use advanced statistical methods for analyzing datasets to identify patterns and predict probable outcomes (Lantz, 2015, pp. 3).

The field of machine learning consists of several methods, such as regression algorithms, instance-based algorithms, regularization algorithms, decision tree algorithms, Bayesian algorithms, clustering algorithms, association rule learning algorithms, deep learning algorithms, artificial neural network algorithms, ensemble algorithms, dimensionality reduction algorithms, etc. (Brownlee, 2013). Some of the algorithms are trying to imitate natural processes. Their ability to discover patterns is relatively better in comparison to other types of algorithms, but the complexity of

the rules that it develops "automatically" by learning from real-world experience is often greater than what humans are able to comprehend. This is usually not a problem for most of the fields where such methods can be applied, but there are use cases where the inability to give details of the process and the reasoning that was developed by the algorithm in sufficiently exhaustive manner might prevent the ability of humans to verify it and gauge its reliability.

Nevertheless, this approach still produces the results that are of higher precision in comparison to other techniques – especially if the ROI is taken into account. Examples of machine learning use in agricultural sector are many, especially regarding the production and to an extent regarding market forecast (Razmjooy and Vieira Estrela, 2019), but much less so in the field of business integration within the supply chain, where the correct and robust implementation of the concept of 'trust-but-verify' is the key factor of the success of the supply chain.

## 5 Benford's law

One way to develop sustainable and cost effective way of 'trust-but-verify' approach is by incorporating the Benford's law based verification into the communication protocols of the agents of the supply chain. The Benford's law is based on the phenomenon of certain significant digits of real numbers probability distribution that was discovered by Simon Newcomb in 1881 and later as well by Frank Benford (1983), by whom the law is named. The main idea of the law is that the digits of certain position in a number in the lists of numbers from many real-life sources of data, appear in a specific proportions. As it follows those proportions are inherent to the numeral system that we use – ie. decimal, but can easily be applied also to any other numeral system. The general formulation that Benford's law presents is that in numeral system with the base $b$, the lead digit $d$ occurs with the following probability:

$P(d) = \log_b(1 + d^{-1})$, where $d = 1,..., b - 1$

In case of decimal numeral system, that probability would be:

$P(d) = \log_{10}(1 + d^{-1})$, where $d = 1,..., 9$

The above formula is derivated from universal concept, where probability for any significant digit position can be calculated (Hazewinkel 1997). But for most cases the proportions of first digits are useful the most. The leading significant digit is the one which comes first when all preceding zeroes are omitted (regardless of degree), since they do not affect the probabilities of proportions.

The following Figure 1 shows us the Benford's distribution of the leading digits in base 10:

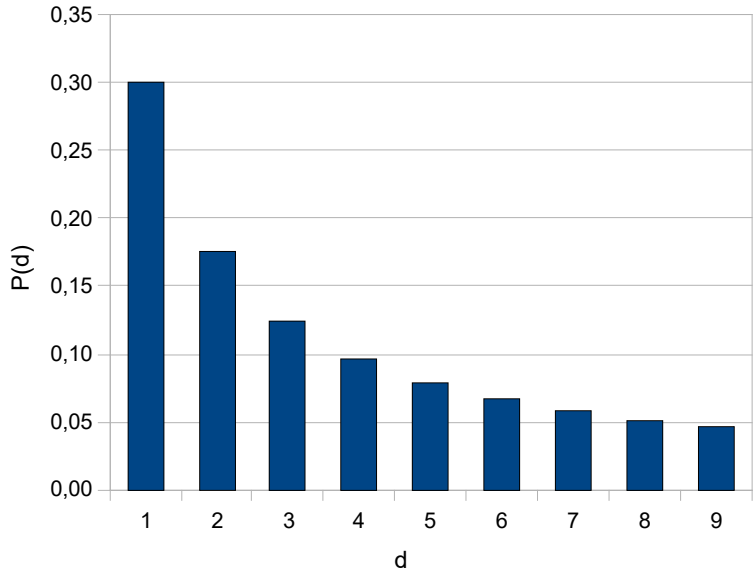



**Figure 1: Benford's distribution**

In the Table 1 are listed probabilities of first digits according to Benford's law that follows its logarithmic formula:

Table 1: Probability of first digits according to Benford's law formula

| First digit | Probability |
|---|---|
| 1 | 0.30103 |
| 2 | 0.17609 |
| 3 | 0.12494 |
| 4 | 0.09691 |
| 5 | 0.07918 |
| 6 | 0.06695 |
| 7 | 0.05799 |
| 8 | 0.05115 |
| 9 | 0.04576 |

Those expected proportions of frequencies in which usually digits appear, are then compared to obtained data series (from information systems that are in place). The differences that are detected point us to possible error which can be caused by intentional data manipulation, faulty measurement systems or other occurencies that provoke systematic alterations in collected data (Hales *et al.* 2008). Until the law was discovered, scientists believed that the digit probabilities were evenly distributed and that the natural assignments were random (Brown 2005), but with revelation of this Law new way of detecting was introduced that is resistant to more advanced data forging which includes producing values that have many statistical (even derivative) variables similar or equal to accurate data series.

Most famous incorporation of Benford's law is in forensic accounting used by tax collecting agencies in the U.S. (Nigrini 1996) and also for uncovering fraudulent declaration records (Browne 1998). The evidence based on analysis that derives from Benford's law is now considered as valid and legaly admissible in the U.S. There is no reason its use could not be extended as well in other fields and sectors such as agriculture, where certain aspects in this regard were discussed (Hales *et al.* 2009) and were being recognized as viable alternative to other forms of validation procedures, such as statistical sampling (Hales *et al.* 2008), but this area still lacks more concrete proposals of how to efficiently include the law in the information systems that are used for monitoring logistics processes.

## 6 Requirements for potential use of Benford's law

The Benford's law is valid in situations where set of numbers follows to a logarithmic uniform distribution, which is common to values adherent to many real-world phenomena, like stock prices, birth rates, invoices values, accounting reports, atomic weights of elements, sports statistics (Leemis *et al.* 2000) as well as to certain physical and mathematical constants (Burke and Kincanon 1991). According to Hales *et al.* (2009), the assumptions which have to be met, for the law to be valid, are:

- Numbers must occure naturally, and can not be generated by human intervention.
- The values of the phenomena must not have pre-set limits, breakpoints or other artificial limitations.
- Values must have probability distributions that follow Weibull-like shape.

There are two additional properties of the Benford's law that can be deduced from those assumptions: the first is scale invariance and the second is the validity of the law in multiple probability distributions. Since the law is based on probability proportions of certain digits, and is independent of the numeral base, this means that the units in which the values are measured are not relevant. Another interesting observation regarding the law is that it is still present, even when we mix the values that correspond to previously mentioned assumptions with the ones that are distributed differently (Hill 1995).

## 7 Machine learning enhancement of Benford's law based verification

Although the Benford's law significantly narrows the testing that is required to identify potentially fraudulent behaviour of the partners in the supply chain, it is often not viable enough if the samples of data are too small, which is often the case with SME in agriculture. This issue can be addressed with the use of the algorithms of machine learning which can have a role as an additional filter in the search for anomalies in the data provided by partners (which may be the result of data tampering). The input of the chosen algorithm would consist of anomalies raised by Benford's law testing, which were subsequently proven to be either false positives or valid fraud attempts. Those algorithms would also take into account the various possible factors that are not processed by Benford's law (like the measurements of

various external and internal variables). After the training phase those algorithms are able to significantly diminish the false positives raised by Benford's law, and therefore enable even smaller businesses in agriculture to efficiently and effectively avoid the costs related to data tampering (or frauds), and would reduce their cost of taking part in the supply chain.

Below is the sample code (for the purposes of demonstration) in programming language Python with installed library *scikit-learn*. The aim of the code is to be able to detect false positives of the Benford's law, and is the following:

```
from sklearn import tree

X = [[input_variable_1, input_variable_2, input_variable_3], […], […]]

Y = ['result', …, …]

clf = tree.DecisionTreeClassifier()

clf = clf.fit(X,Y)

example = [[65, 12, 1, 6, 1]]

prediction = clf.predict(example)

print(prediction)

probability = clf.predict_proba(example)

print(probability)
```

The input variables provide the information about the possible data tampering agent, their characteristics, conditions in which the data was entered in the information system, and the various other external and internal factors that might have an influence on the case. The training phase of the example above also expects to get the information about the proven results of the provided cases. After the training part, it is possible to verify new input data and get the results from the algorithm.

## 8 Conclusion

For the members of supply chain to be able to integrate more tightly and to gain the competitive advantage it is necessary for them to establish sufficient level of trust among themselves. But even though the relationships and transactions among partners are secured with contracts, the real-time nature of data exchange and just-in-time deliveries require higher level of trust. If a member of supply chain is to rely directly on the data that is provided by its suppliers, he has to have means to verify the validity of those data. But since there are many different sources of data, it would be difficult for them to pre-analyze and define acceptable ranges of the values that are coming from those sources. In this regard the implementation of Benford's law much more directly addresses the problem of data tampering, since it is quite difficult to reproduce the "randomness" of the distribution of individual digits of various values. But since small companies do not have means to collect vast amount of data, which is suitable for Benford's law based verification, this challenge can be significantly amended by applying machine learning algorithms to discern valid anomalies which require additional examination. Additionally, the example shows that even though small and medium sized companies in agriculture do not have the capacity to develop customized solutions, they might nevertheless benefit from machine learning algorithms which can even at a rudimentary level significantly improve the results of the Benford's law based verification and provide clear and provable results that can directly be taken into account during the decision making process. The models used can certainly be expanded and modified, but there are nevertheless many areas where it is not necessary as a first step. More important for SMEs (in the early stages of introducing such methods) is to develop systematic ways of data collection (Kashyap, 2017). One characteristic of agricultural sector is that its performance is influenced by variety of factors, that are often interdependent in many complex relations, especially in supply chains. But the combination of Benford's law and the machine learning algorithms have the potential to decrease

the risks that are emanating from data tampering and effectively lower the costs even for small and medium sized companies in this sector, and thus increase their competitive advantage in the current economic environment.

**References**

Alsos, G. A., Carter, S., Ljunggren, E., Welter, F. (2011). *The Handbook of Research on Entrepreneurship in Agriculture and Rural Development*. Cheltenham: Edward Elgar Publishing.

Benford, F. (1938). The law of anomalous numbers, *Proceedings of the American Philosophical Society* 78, pp.551–572.

Brown, R. J. C. (2005). Benford's law and the screening of analytical data: the case of pollutant concentrations in ambient air, *The Analyst* 130, pp.1280–1285.

Browne, M. (1998). Following Benford's Law or looking out for number 1, *New York Times* 147 (5), pp.1239–1243.

Brownlee, J. (2013). A Tour of Machine Learning Algorithms. *Machine Learning Mastery*. (Date of publication: 25. 11. 2013.) [WWW] <URL: https://machinelearningmastery.com/a-tour-of-machine-learning-algorithms/> [Accessed 10 October 2019].

Burke, J., and Kincanon, E. (1991). Benford's law and physical constants: the distribution of initial digits, *American Journal of Physics* 59 (10), pp.952.

Finlay, S. (2018). *Artificial Intelligence and Machine Learning for Business*. Great Britain: Relativistic.

Hales, D. N., Chakravorty, and S.S., Sridharan, V. (2009). Testing Benford's Law for improving supply chain decision-making: A field experiment, *International Journal of Production Economics* 122 (2), pp.606-618.

Hales, D. N., Sridharan, V., Radhakrishnan, A., Chakravorty, S., and Siha, S. (2008). Testing the accuracy of employee-reported data: an inexpen- sive alternative approach to traditional methods, *European Journal of Operational Research* 189 (3), pp.583–593.

Hazewinkel, M. (1997). *Encyclopaedia of mathematics: Supplement*. Norwell, MA: Kluwer Academic Publishers.

Hill, T. P. (1995). A Statistical Derivation of the Significant-Digit Law, *Statistical Science* 10 (4), pp.356-363.

Kashyap, P. (2017). *Machine Learning for Decision Makers*. Bangalore: Apress.

Lantz, B. (2015). *Machine Learning with R*. Birmingham: Packt Publishing.

Leemis, L. M., Schmeiser, B. W., and Evans, D. L. (2000). Survival Distributions Satisfying Benford's Law, *The American Statistician*, 54 (4), pp.236-241.

Newcomb, S. (1881). A note on the frequency of use of the different digits in natural numbers, *American Journal of Mathematics* 4 (1), pp.39–40.

Nigrini, M. (1996). A taxpayer compliance application of Benford's law. *Journal of the American Taxation Association* 18 (1), pp.72–91.

OECD (2019). *Digital Opportunities for Better Agricultural Policies*. Paris: OECD Publishing.

Razmjooy, N., Vieira Estrela, V. (2019). *Applications of Image Processing and Soft Computing Systems in Agriculture*. Hershey: IGI Global.

# REVERSE LOGISTICS IN AGRICULTURE

IHAR BARANAU[1] & ANDREJ LISEC[2]

[1] Warsaw University of Life Sciences, Faculty of Economics, Warsaw, Poland.
E-mail: igorbaranov2017@gmail.com
[2] University of Maribor, Faculty of Logistics, Celje, Slovenia.
E-mail: andrej.lisec@um.si

**Abstract** Reverse logistics is a relatively new research area, both in theoretical and empirical terms. Due to the requirements of modern civilization, the present society produces more and more material goods that satisfy it different needs. The consequences of these actions include a huge amount of waste both during production of these goods as well as after their use. The article defines the concept of reverse logistics. Consider problems in reverse logistics in agriculture, organization of reverse logistics operations and ways to improve reverse logistics operations.

**Keywords:** logistics, agriculture, reverse logistics costumer, food, logistics organization.

University of Maribor Press

DOI https://doi.org/10.18690/978-961-286-406-4.5
ISBN 978-961-286-406-4

## 1 Introduction

Due to the requirements of modern civilization, today's society produces more and more material goods that meet various requirements. The consequence of these activities is a huge amount of waste generated both during the production of these goods and after their use. These wastes have become an inseparable factor of human living and economic activity. Technologies of production are changing and the variety of waste is changing[1].

The object of interest of modern logistics is increasingly solving problems and looking for new paths related to waste management.

Because of this reverse logistics developed. It covers all processes related to waste and information flows from places where they arise to their final destination[2].

## 2 Reverse logistics

Reverse logistics is a field of logistics dealing with the examination of the patterns associated with the flows of products whose life cycle has ended. Waste management can be significantly supported through logistic activities- hence the concept of reverse logistics[3]. Reverse logistics is a quite young term in the literature, and perhaps that is why there is no final clear definition. Reverse logistics is also known by the concepts waste logistics, disposal logistics, recycle logistics. The concept of reverse logistics appeared already in the 1980s. Lambert and Stock (1981) defined reverse logistics as the flow direction is opposite to the traditional flow materials in the logistics chain. In the 1980s, Murphy and Poist (1989), inspired by the reverse direction of product flows, defined reverse logistics as the products flow in the supply chain from consumers to producers. Polen and Farris agreed with this definition (1992), they defined the final consumer and emphasized the reverse nature of the product flow in the supply chain, but did not define the main activities of reverse logistics. The concept of reverse logistics continued to evolve in the 1990s. Stock (1992) formulated a definition that emphasized the role of recycling in the logistics of waste disposal and reuse. This definition was summarized by Kopicki (1993): 'adding information flow to the reverse supply chain keeps it functioning'. In the late nineties, Rogers and Tibben-Lembke defined goals and logistics processes, defining reverse logistics as a planning process, design, implement and

control, cost effective flows of raw materials, production inventories, finished products and related information from destination to origin for restoration or total disposal. Reverse logistics applies to flows where there is the possibility of reimbursing the cost of used products and where the release of these products creates a new supply chain. The full definition of reverse logistics, as according to The Council of Logistics Management, is the process of implementing, controlling, and planning the cost-effective flow of finished goods, raw materials, and in-process inventory. The flow is from the point of consumption (i.e. the customer) to the point of origin (i.e. the manufacturer), to properly dispose of these or to recapture value. Included in this definition is any re-manufacturing or refurbishment of goods.[4]

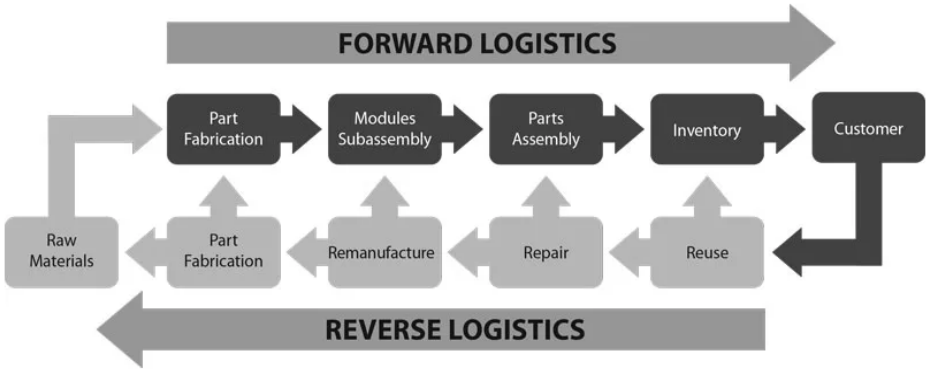



**Figure 1: Reverse logistics scheme**

Some reverse logistics examples are: Return of goods by customers, Return of unsold goods by distribution partners due to contract terms, Re-use of packaging, Refurbishment of goods, Repairs and maintenance as per guarantee agreements, Re-manufacturing of goods from returned or defective items, Selling of goods to a secondary market in response to returns or overstocking and Recycling and disposal of end-of-life goods.[5]

## 3 Reverse logistics in agriculture

Reverse logistics can be used in agribusiness to reduce food waste and provide consumers with quality and safe food without posing a serious threat to human health, well-being and the environment. A chain of over-purchasing, premature harvesting, inappropriate labelling and storage instructions, poor storage and

transportation, manufacturing errors, trial runs, packaging defects and incorrect weight and size which directly affect stock forecasting, continuous food supply, quality management, return and waste management.

### 3.1 Reverse logistics problems in agriculture

The biggest problem with reverse logistics processes for agro-food products is their perishable nature, which can become unsafe even due to small failures in process control, which creates a food safety incident and can subsequently pose a possible threat to the health of consumers.

Agribusiness companies try to avoid returns and rejects whenever possible. If a return does occur, the process usually consists of checking the batch number, writing off the shipment, and making a trip to the nearest food dump. Which is the second problem of reverse logistics in the agriculture industry: lack of experience, networks and manpower to safely return products.

Each return that occurs in the food supply chain is treated as a unique, separate transaction, and therefore, these returns tend to involve higher downtime and costs. They can also disrupt the existing supply chain since they may repurpose buildings and personnel to handle a transaction they do not usually do.

In the food industry, it is very important to monitor the supply chain and disruptions due to food spoilage. Reverse logistics in the food industry demands carefully developed practices tailored to a reverse supply chain as well as transportation assets and facilities.

Some of the key factors in setting up the Reverse Logistics operations are:

- **Segregation and sorting:** this process needs to be optimized in order to avoid excessive spending on transportation. Also, large volume of similar type of products are likely to be handled more efficient than a group of products with divergent characteristics.
- **Transportation management:** reverse supply chain has its own practices and needs, hence using transportation and facilities that serve existing forward supply chain can cause disruptions and interfere in getting sellable

products to the market. However, this can be avoided by simplifying the operation i.e. by allowing each store to return material only when they are the last in the supply route since for retailers with multiple supply stores it is most efficient to collect the returned material to the Distribution Centres with the same truck that delivers the products.

- **Warehouse management:** warehouse design for placement and handling of returns, storage, waste management and integration of sale or reprocessing. All returned products that are nearing the end of their lifecycle may not always be sold at their original price, but can be put back in stock to be shipped to another market.
- **Information Management:** effective information systems are needed to individually track and track product returns. Uses barcodes, computerized return tracking, electronic document interchange to improve their reverse logistics operations and tracking. Complexity in the agricultural industry, producers must protect and control not only batches, but also the shelf life of products[6].

Ways to improve reverse logistics operations:

- **Automation:** automating return processing for similar items or items packed in the same container can simplify operations.
- **Efficient warehouse planning:** for efficient cargo handling, it is necessary to take into account return handling (destination and future storage locations) when designing a warehouse, and not just a direct flow.
- **Better In-house Operations:** food retailers and processors can speed up the process and reduce waste through better screening, segregation, centralized return.

## 4 Conclusion

Landfill disposal might be a simplest option, but it should be a last resort for both financial and environmental reasons. Ideally, recalled food product should be composted and any packaging recycled. Organic waste should be converted to renewable energy and polymeric materials should be recycled and reused. Reverse

logistics in the agriculture demands carefully developed practices tailored to a reverse supply chain as well as transportation assets and warehousing.

**References**

Budzik-Nowodzińska I., Logistyka zwrotna w gospodarce odpadami, „Logistyka" 2013, number 6, p. 553-555.

Fajczak-Kowalska A., Wybrane aspekty logistyki zwrotnej, „Logistyka" 2014, nr 6, p. 3498-3505.

Food and Agriculture Organization of the United Nations. (2011). "Global Food Losses and Food Waste". http://www.fao.org/save-food/resources/publications/en

New and Emerging Technologies for the Food Supply Chain <URL: https://sipmm.edu.sg/new-emerging-technologies-food-supply-chain/> [Accessed 9 November 2020].

Szołtysek J., Logistyka zwrotna, ILiM, Poznań 2009.

Sadowski A., Zarys rozwoju logistyki zwrotnej, „Logistyka" 2009, nr 5, s. 12-15

What is reverse logistics? <URL: https://www.c3controls.com/white-paper/what-is-reverse-logistics/> [Accessed 9 November 2020].

Proceedings in

# SLOVENE LANGUAGE

# KREPITEV LOKALNIH PREHRANSKIH VERIG - POTENCIALI ZAUPANJA, IZKUŠENJ IN DOŽIVETIJ

LEA-MARIJA COLARIČ JAKŠE, MANCA KAVŠČEK IN SAŠO OBOLNAR

Visoka šola za upravljanje podeželja GRM Novo mesto, Novo mesto, Slovenija.
E-pošta: lea.colaric-jakse@vsgrm.unm.si, manca.jst@gmail.com, manca.jst@gmail.com

**Povzetek** Slovenija se na agroživilskem področju sooča z izrazito negativno bilanco lastno pridelane hrane, povečuje se zunanje trgovinska izmenjava, lokalno proizvedenih živil na slovenskem trgu pa je še bistveno manj. Dodaten izziv predstavljajo podnebne in okoljske razmere na svetovni ravni, kako v najkrajšem času povečati lokalno pridelavo/uporabo hrane, zmanjšati zavržke in negativne vplive na okolje. Ob strukturnih spremembah, sektorskih vlaganjih, izboljšanju proizvodnih procesov, povezovanju in vzpostavljanju lokalnih prehranskih verig brez konkretnih naporov v smeri ozaveščanja domačih kupcev teh ciljev ne bo mogoče doseči. Zagotavljanje kakovosti lokalnih pridelkov, večje vključevanje lokalnih živil v gostinstvo, ponudba tradicionalnih jedi in osebna izkušnja pridelave hrane lahko dodatno vzpodbudijo povečanje pridelave in povpraševanje ter prispevajo k zmanjševanju zavržkov hrane v prehrambni verigi. Kupci v okviru raziskave izkazujejo interes po kakovostnih živilih s slovenskim poreklom, žal pa lahko obstoječe stanje prinaša tveganje za upad zaupanja, kar se odraža v razkoraku med pričakovanim in dejanskim stanjem. Okrepitev gostinske ponudbe s tradicionalnimi jedmi lahko pripomore k povečanemu povpraševanju lokalno pridelane hrane s potrebo po večji izbiri raznolikih in ustrezno prezentiranih sezonskih tradicionalnih jedi. Osebna izkušnja lastne pridelave prispeva k boljši ozaveščenosti. Izboljšanje ukrepov na teh področjih pozitivno vpliva tudi na odnos do lokalne hrane oziroma na zmanjšanje njenih zavržkov.

**Ključne besede:** lokalno pridelana hrana, sheme kakovosti hrane, gostinska ponudba, lastna pridelava, zavržki hrane.

Univerzitetna založba Univerze v Mariboru

DOI https://doi.org/10.18690/978-961-286-406-4.6
ISBN 978-961-286-406-4

# STRENGTHENING LOCAL FOOD CHAINS - POTENTIALS OF TRUST, EXPERIENCE AND ADVENTURES

LEA-MARIJA COLARIČ JAKŠE, MANCA KAVŠČEK & SAŠO OBOLNAR

GRM Rural Management College Novo mesto, Novo mesto, Slovenia.
E-mail: jakse@vsgrm.unm.si, manca.jst@gmail.com, manca.jst@gmail.com

**Abstract** In the agriculture sector, Slovenia is facing a distinctly negative balance of its own food, foreign trade is increasing, and there are significantly fewer locally produced foods on the Slovenian market. An additional challenge is the global climate and environmental conditions, how to increase local food production/use, reduce discards and negative environmental impacts in the shortest possible time. With structural changes, sectoral investments, improvement of production processes, integration and establishment of local food chains, these goals will not be achieved without concrete efforts to raise awareness among domestic customers. Ensuring the quality of local produce, greater involvement of local foods in restaurants, the supply of traditional dishes and personal food production experience can further stimulate increased production and demand, and contribute to reducing food waste in the food chain. As part of the survey, people are showing interest in quality foods of Slovenian origin, but unfortunately the current situation may carry the risk of a decline in trust, which is reflected in the gap between the expected and actual situation. Strengthening the catering, with traditional dishes can contribute to the increased demand for locally grown food with the need for a greater choice of varied and properly presented seasonal traditional dishes. Personal experience of food production contributes to better awareness. Improving measures in these areas also has a positive effecton attitude towards local food or on reducing its discards.

**Keywords:** locally grown food, food quality schemes, catering, own production, food discards.

https://doi.org/10.18690/978-961-286-406-4.6 DOI
978-961-286-406-4 ISBN

University of Maribor Press

## 1 Uvod

Slovenija je na prehranskem področju pred največjim izzivom doslej. Mednarodne zahteve, tudi skupna kmetijska politika, podrejena evropskemu zelenemu dogovoru, zahtevajo od kmetijskega sektorja nujne ukrepe k prilagajanju na podnebne spremembe in zmanjšanju negativnih okoljskih vplivov. Ob tem bo zaradi prehranske varnosti, kot enega od temeljev suverenosti, prav tako potrebno v razmeroma kratkem obdobju, predvsem v sektorju rastlinske pridelave, občutno povečati lastno proizvodnjo in vzpostaviti lokalne prehranske verige. Pred nami je izziv, kako se v okviru mednarodne vpetosti, prostega pretoka blaga in visoko konkurenčnega okolja spoprijeti z zgoraj navedenimi problemi. Za dvig lokalne proizvodnje živil so potrebne strukturne reforme, optimizacije in inovacije v proizvodnih procesih ter finančne spodbude za področja in sektorje, ki izkazujejo potencial. Pri krepitvi lokalnih prehranskih verig igra eno ključnih vlog stopnja ozaveščenosti ponudnikov in porabnikov prehranskih izdelkov. Trend krepitve mednarodne blagovne menjave na področju živil navkljub izrazito negativni bilanci lastne pridelane hrane kaže, da Slovenija veliko kakovostno proizvedenih živil izvozi, s tem pa je dostopnost lokalno proizvedene hrane domačemu kupcu še manjša. Ob obisku prodajalen je opaziti, da je na policah veliko oglaševanih izdelkov, ki nagovarjajo na slovensko poreklo. Ali je pri tem zlorabljeno zaupanje domačega kupca ali množica tovrstnih komercialnih oznak in živil povečuje ozaveščenost kupcev ter vpliva na krepitev lokalnih prehranskih verig?

Eden od stranskih učinkov trenutne prehranske verige v Sloveniji, ki je močno odvisna od globalnih trgov in razmer, so tudi relativno veliki zavržki hrane. Ti nastajajo vzdolž celotne prehranske verige, kar ne predstavlja zgolj finančnih izgub pri deležnikih v verigi, ampak tudi okoljski in družbeni problem. Na eni strani je zaznati veliko nepotrebnih odpadkov, na drugi strani pa je ob viških hrane vedno več ljudi lačnih. Vzpostavljanje lokalnih prehranskih verig ni pomembno zgolj zaradi dviga proizvodnje in zaupanja med deležniki, temveč pomembno vpliva na odnos do hrane. Rezultat vzpostavitve lokalnih prehranskih verig se odraža v dvigu kakovosti proizvedenih živil, boljšem prerazporejanju mankov in viškov, kar lahko rezultira tudi v zmanjšanje zavržkov hrane, krajšanje transportnih poti pa izboljšuje okoljski odtis. Sheme kakovosti z oznakami, ki nakazujejo na lokalno poreklo, so lahko ustrezno komunikacijsko orodje za krepitev zaupanja v lokalno pridelano

hrano. Pri uradnih in komercialnih shemah in oznakah živil se poraja vprašanje ali vlivajo dovolj zaupanja in obstaja razlika med pričakovanim in dejanskim stanjem.

Gostinska ponudba jedi iz lokalnih sestavin predstavlja učinkovito komunikacijsko orodje pri krepitvi lokalnih prehranskih verig, ki pa je premalo izkoriščena. Neposredna izkušnja lokalne hrane, ki je pripravljena na tradicionalen način, lahko prispeva k povečani porabi lokalnih živil tudi znotraj gospodinjstev, visoka pričakovanja pa bi pripomogla k dvigu kakovosti pridelave živil. Nenazadnje bi bilo lahko povečanje lastne izkušnje pridelave, tako neposredno kot tudi posredno, vodilo do krepitve lokalne prehranske verige. Slovenci smo načeloma znani kot narod vrtičkarjev, vendar v zadnjih desetletjih vrtove zamenjujejo zelene puščave, majhne kmetije pa vse bolj izginjajo.

Ključno vprašanje je torej ali lahko dosledno označevanje, sledljivost in zagotavljanje kakovosti lokalnih pridelkov, gostinstvo z večjim vključevanjem lokalnih živil in ponudbo tradicionalnih jedi ter osebna izkušnja pridelave hrane prispevajo k ozaveščenosti ljudi in dodatno vzpodbudijo povečanje pridelave, povpraševanje po lokalno pridelani hrani ter zmanjševanju zavržkov v prehranski verigi?

### 1.1. Namen prispevka z opredelitvijo hipotez

V okviru raziskave smo želeli od prebivalcev Republike Slovenije pridobiti mnenja, ki bi lahko odgovorila na raziskovalna vprašanja: ali bi lahko sheme kakovosti živil, tradicionalno gostinstvo in izkušnja lastne pridelave hrane prispevale k povečanju in porabi lokalno pridelane hrane in hitrejši vzpostavitvi lokalnih prehranskih verig.

V prvem sklopu se raziskava nanaša na področje zagotavljanja kakovosti in sledljivosti izdelkov. Poznamo uradne in komercialne sheme in oznake živil, ki so temelj zaupanja med ponudnikom in kupcem. Pri tem nas zanima, kakšna so dejanska pričakovanja kupcev do shem in oznak, oziroma ali jih sploh poznajo. Naša hipoteza je, da domači kupci v večji meri želijo nakupovati kakovostne izdelke slovenskega porekla ter pričakujejo pristnost izdelka z deklariranim opisom, ki se navezuje na lokalno okolje. Rezultati bi lahko prispevali k izboljšanju nadzora, regulaciji, informiranju in promociji uradnih shem kakovosti, kot tudi izdelkov iz teh shem.

V drugem sklopu smo od vprašanih želeli izvedeti, ali bi lahko gostinski sektor z večjo integracijo lokalnih izdelkov in okrepitvijo ponudbe s tradicionalnimi jedmi prispeval k okrepitvi splošne ponudbe in povpraševanja lokalno proizvedene hrane oziroma k okrepitvi lokalne prehranske verige. Ob tem smo želeli izvedeti, kje so pri tovrstni obstoječi ponudbi ključni problemi. Naša hipoteza je, da je tradicionalno gostinstvo ustrezno komunikacijsko orodje, ki bi lahko prispevalo k okrepitvi lokalne prehranske verige. Podani rezultati lahko prispevajo k nadaljnjemu razvoju v gostinskemu sektorju.

V tretjem sklopu smo želeli raziskati, kakšna je dosedanja izkušnja lastne pridelave hrane med prebivalci Republike Slovenije in ali lahko tovrstna izkušnja prispeva k večji ozaveščenosti in okrepitvi lokalne prehranske verige. Naša hipoteza je, da tovrstna izkušnja, ne glede na obseg, lahko prispeva k zgoraj navedenima ciljema. Rezultati lahko prispevajo k usmeritvam kmetijskih ukrepov.

V četrtem sklopu smo zastavili vprašanje ali lahko okrepitev lokalne prehranske verige z zgoraj navedenimi pristopi prispeva k zmanjšanju zavržene hrane. Naša hipoteza je, da lahko, od vprašanih pa smo želeli izvedeti tudi, kakšni so po njihovem mnenju razlogi in kako rokujejo z zavržki hrane, kar je lahko v pomoč pri oblikovanju nadaljnjih strategij na agroživilskem področju.

## 2 Teoretične Osnove

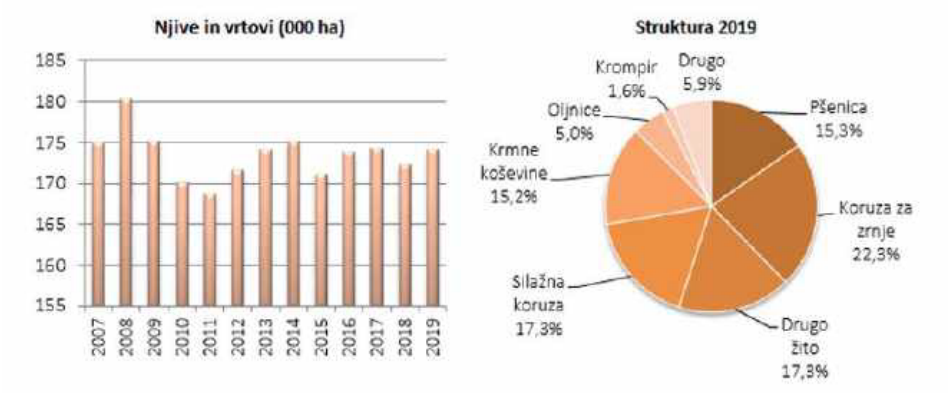
### 2.1 Stopnja prehranske samopreskrbe in delež blagovne menjave agroživilskih proizvodov

Eden ključnih izzivov za Slovenijo v spopadanju in prilagajanju na podnebne spremembe, kot tudi pri okoljskem vprašanju je, kako zmanjšati negativne vplive kmetijstva, ob tem pa celo povečati proizvodnjo z namenom doseganja čim večje stopnje samooskrbe. Slovenija ima glede na naravne danosti večino kmetijskih zemljišč z omejenimi dejavniki, kar v praksi omogoča predvsem živinorejo in z njo povezane dejavnosti.

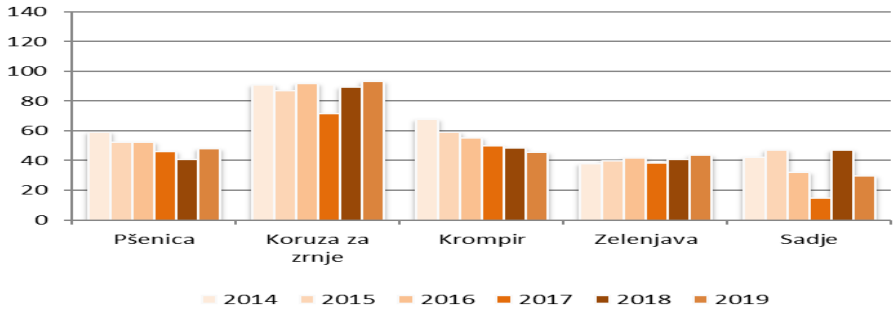
Tako je ob posledični podpori slovenske kmetijske politike v ta sektor stopnja samopreskrbe z mesom na ravni petletnega povprečja znašala 79 %. Stopnje samooskrbe se pri posameznih vrstah mesa precej razlikujejo in na ravni petletnega povprečja pri govejem mesu znaša 106 %, pri prašičjem mesu 40 %, pri perutninskem mesu 108 %, pri mesu drobnice pa 87 %. Stopnja samopreskrbe mleka na ravni petletnega povprečja znaša 127 %, jajc 93 % in medu 55 % (Poročilo o stanju kmetijstva 2019).

Pri rastlinski pridelavi so razmere nekoliko drugačne. Potrebno je poudariti, da se je pri strukturi kmetijskih zemljišč v letu 2019 v primerjavi z letom 2018 rahlo povečal obseg njiv in vrtov, ki v skupni strukturi obsegajo 36,3 % kmetijskih zemljišč v uporabi. Največ njivskih površin je namenjenih rastlinski pridelavi za potrebe živinoreje. Na 55 % njivskih površin prevladuje koruza, pšenica in ječmen, na 33 % pa pridelava zelene krme, silažna koruza in krmne koševine (Poročilo o stanju kmetijstva 2019).

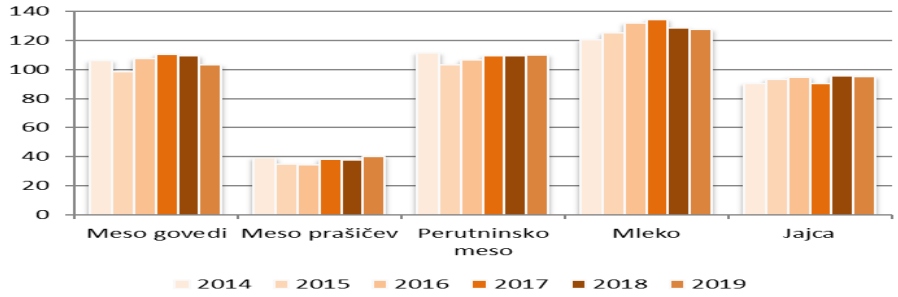
Stopnja samooskrbe rastlin namenjene neposredno za prehrano ljudi v pet-letnem povprečju znaša pri pšenici 50 %, pri krompirju 56 %, zelenjavi 40 % in pri sadju 37 % (Poročilo o stanju kmetijstva 2019).




**Slika 1: Skupna površina in setvena struktura njiv**
(Vir: KIS)




**Slika 2: Samooskrba z rastlinskimi pridelki (%); 2014–2019**
(Vir: KIS)




**Slika 3: Samooskrba z osnovnimi živalskimi proizvodi (%); 2014-2019**
(Vir: KIS)

Eden od bistvenih podatkov, koliko lokalno proizvedene hrane se v lokalnem okolju tudi porabi, je ob stopnji samooskrbe tudi delež zunanje trgovinske blagovne menjave z agroživilskimi proizvodi. Zunanje trgovinska izmenjava na tem področju se konstantno povečuje in je že presegla 4 milijarde EUR. Ob izrazitem prehranskem primanjkljaju, ki se povečuje in presega 1 milijardo EUR, smo v letu 2019 v primerjavi z letom 2018 izvoz lokalnih agroživilskih proizvodov še povečali za 7 % (Poročilo o stanju kmetijstva 2019). V praksi to pomeni, da je na domačem trgu vedno manj lokalno in kakovostno proizvedenih živil, s povečanim transportom pa se povečuje ogljični odtis.


**Slika 4: Izvoz in uvoz ter zunanje trgovinska bilanca agroživilskih proizvodov (v mio EUR); 2007–2019**
(Vir: KIS)

## 2.2 Sheme kakovosti hrane in označbe porekla

Pri spodbujanju pridelave in prodaji lokalno proizvedenih živil igra ključno vlogo ozaveščanje kupcev o pomenu in prednostih teh živil. V luči vplivov globalnega trga in visoke konkurence je pri ozaveščanju kupcev pomembna pridobitev zaupanja, da je določeno živilo dejansko proizvedeno v lokalnem okolju z bistveno višjo kakovostjo. Ob množici izdelkov na trgovinskih policah, kjer je poudarjeno lokalno poreklo, se postavlja vprašanje ali je ob zgoraj navedenih dejstvih to možno. Kupci poreklo določenega živila močno povezujejo s poreklom osnovnih sestavin, vprašanje pa je, če je temu res tako. V Evropski uniji, kot tudi v Sloveniji, je bila na tem področju do leta 2018 država porekla opredeljena v carinski uredbi (Uredba št. 952/2013), ki v 2. odstavku 60. člena določa, da ima izdelek poreklo države ali ozemlja, kjer je bila opravljena njegova zadnja bistvena, gospodarsko upravičena predelava ali obdelava, ki rezultira v novem proizvodu ali ki predstavlja pomembno stopnjo proizvodnje.

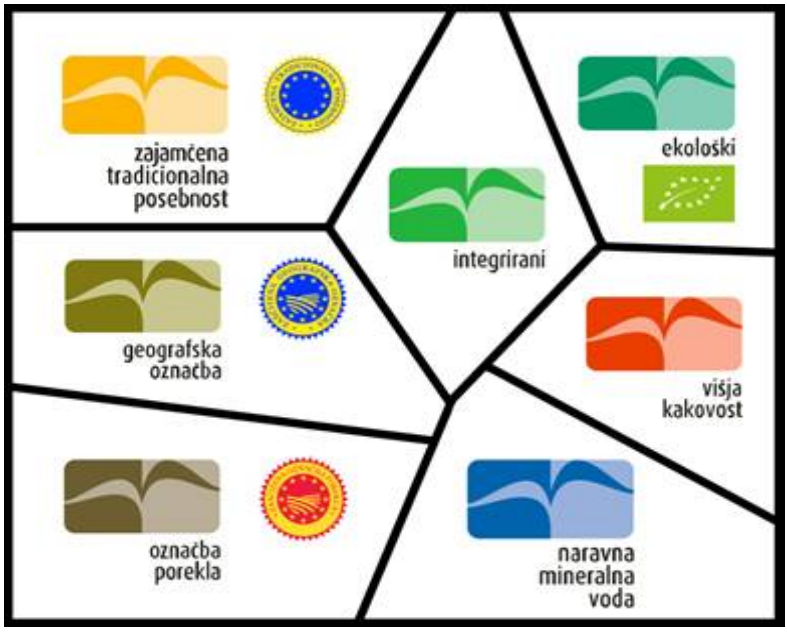
Iz tega je jasno razvidno, da je lahko prihajalo do razhajanj, kjer se je v deklariranem lokalnem proizvodu dejansko nahajalo uvoženo primarno živilo. Tu je bilo lahko zlorabljeno zaupanje kupcev, pri tem pa je bila lahko prizadeta tudi lokalna pridelava živil. Tako se je glede na pomanjkljivosti pri zagotavljanju informacij o živilih to področje poskušalo urediti. V letu 2018 je Evropska komisija sprejela Izvedbeno uredbo (EU) št. 2018/775 o pravilih za uporabo člena 26(3) Uredbe (EU) št. 1169/2011.

Pravila glede navajanja države porekla ali kraja izvora osnovne sestavine živila v primerih, ko je na živilu prisotna informacija o poreklu živila ali se le-ta lahko sklepa iz predstavitve živila, so se začela uporabljati 1. 4. 2020. Izvedbena uredba po novem določa načine označevanja, kadar se država porekla ali kraj izvora živila nanašata na kraje ali geografska območja. Tako je potrebno živilo in njegovo osnovno sestavino, ki nimajo istega porekla, ustrezno označiti. Zaradi zaščite proizvodnje, pridelave in predelave živil s posebnimi lastnostmi, tradicionalne sestave ali vpliva geografskega območja je Republika Slovenija v skladu s predpisi Evropske unije z namenom zaščite lokalnih živil določila uradne sheme kakovosti živil predpisala njihovo označevanje.

Po podatkih iz uradne spletne strani Naša super hrana (https://www.nasasuperhrana.si) v Sloveniji uporabljamo sledeče označbe kakovosti:

- Zaščitena geografska označba (ZGO) – Vsaj ena od proizvodnih faz kmetijskega pridelka ali živila mora potekati na določenem geografskem območju. Kakovost, sloves ali druge značilnosti proizvoda je mogoče pripisati temu geografskemu okolju.
- Zaščitena označba porekla (ZOP) - Vse faze pridelave in predelave kmetijskega pridelka ali živila morajo potekati na določenem geografskem območju. Kakovost in značilnost proizvoda je izključno ali bistveno posledica vpliva geografskega okolja.
- Zajamčena tradicionalna posebnost (ZTP) – ti proizvodi se proizvajajo ali na tradicionalen način ali iz tradicionalnih surovin ali po tradicionalnem receptu. Proizvodnja ni omejena na določeno geografsko območje, kar pomeni, da se lahko proizvajajo na celotnem ozemlju RS in EU (v kolikor je pridobljena evropska zaščita).
- Višja kakovost (VK) – kmetijski pridelek ali živilo po svojih značilnih lastnostih pozitivno odstopa od drugih podobnih kmetijskih pridelkov in živil.
- Ekološka pridelava (EKO) – kmetijski pridelek ali živilo je pridelano in predelano po naravnih metodah in postopkih.
- Integrirana pridelava (IP) – kmetijski pridelek je pridelan po metodah, kjer se nadzorovano izvajajo dovoljeni agrotehnični ukrepi.

– Izbrana kakovost – kmetijski pridelek ali živilo ima posebne lastnosti, ki se lahko nanašajo na sestavo kmetijskega pridelka ali živila, okolju prijazno pridelavo, kakovost surovin, dobrobit živali, posebno zdravstveno varstvo živali, način krmljenja, dolžino transportnih poti, predelavo, hitrost predelave surovin oziroma čim manjšo kasnejšo obdelavo pri skladiščenju in transportu.




**Slika 5: Označbe živil**

(Vir: https://www.nasasuperhrana.si/clanek/oznacbe-zivil/)

## 2.3 Vloga tradicionalnega gostinstva pri krepitvi lokalne prehranske verige

Tradicionalno gostinstvo obravnava gostinske obrate, ki so po svoji vsebini, izgledu in načinu delovanja usmerjeni k tradiciji, ponudba jedi je sestavljena iz tradicionalnih receptur, ki vsebujejo živila iz lokalnega okolja. Ti so v veliki meri povezani z višjo kakovostjo in veljajo za bolj sveže, hranljive in okusnejše. Uporaba lokalno pridelane hrane v tradicionalnem gostinstvu ugodno vpliva na zmanjšanje negativnih vplivov

na okolje in podnebne spremembe, kot tudi na krepitev lokalne prehranske verige in njenih deležnikov (Colarič, Križmančič, 2020).

V dokumentu Strategija razvoja gastronomije Slovenije (Bogataj in sod, 2006) so med prednosti, ki se nanašajo na 'tradicionalno gostinstvo' avtorji prepoznali:

- bogato in raznovrstno slovensko kulinariko,
- različne vrste obratov, tako po kakovostnih in cenovnih razredih,
- da je slovenska kulinarika za gosta varna (ni nalezljivih bolezni, ki bi jih prenašali s hrano).

Poglavitne slabosti pri razvoju tradicionalnega gostinstva so v Strategiji razvoja gastronomije Slovenije (Bogataj in sod, 2006) opredeljene kot:

- pomanjkljiva strokovnost ponudnikov in šibko poznavanje kulinarične dediščine,
- nizka pripravljenost za inoviranje, tveganje in vzgajanje potrošnikov,
- spreminjanje starih receptur jedi na napačen način,
- razdrobljena in manjšinska ponudba v primerjavi z ostalimi jedmi,
- slaba promocija.

Med poglavitne priložnosti, ki bi jih razvoj tradicionalnega gostinstva imel v krepitvi lokalne prehranske verige dokument navaja:

- s povečano ponudbo za družine povečati obisk domačih gostov,
- inovativnost na področju hitrih prigrizkov,
- horizontalno povezovanje gostincev v okviru gastronomskih regij,
- povezava gostincev z lokalnimi pridelovalci, specializiranimi na gojenje tradicionalne kulture regije,

Med poglavitne nevarnosti, za stagnacijo tradicionalnega gostinstva, pa je v dokumentu opredeljeno:

- nekritično prenašanje tujih in modnih receptur v slovenski prostor in s tem tudi potrebo po tujih surovinah,

- cenovna dostopnost,
- nizka informiranost in ozaveščenost lokalnega prebivalstva o pomenu avtohtonih lokalnih jedi (Strategija razvoja gastronomije Slovenije, 2006).

## 2.4 Zavržena hrana v Sloveniji

V Sloveniji se je delež zavržene hrane v letu 2018 v primerjavi s preteklim letom povečal za 4 kg. V povprečju prebivalec Slovenije zavrže kar 68 kg hrane v enem letu. Po podatkih SURS-a (2020) se določeni količini zavržene hrane ne moremo izogniti, saj 62 % hrane predstavljajo neužitni deli, lahko pa s spremembo svojih ravnanj bistveno prispevamo k zmanjšanju užitnih delov hrane med zavržki. Užitni del zavržene hrane predstavlja 38 % vse zavržene hrane, oziroma okoli 53,162 ton na letni ravni v Republiki Sloveniji. Največ zavržkov hrane proizvedejo gospodinjstva, teh je 52 % ter gostinstvo s 30 %, sledijo trgovine in distribucija z 10 % in proizvodnja hrane z 8 % (SURS, 2020).

Največ hrane, še posebej v gospodinjstvih, je zavržene zaradi preobsežnega nakupa živil, posledičnega preteka roka uporabe, nepravilnega shranjevanja in predimenzioniranih obrokov (Zveza potrošnikov Slovenije, 2020).


**Slika 6: Odpadna hrana glede na izvor, 2018**
(Vir: SURS)

Odpadna hrana predstavlja 11 % v celotni strukturi nastalih komunalnih odpadkov v gospodinjstvih. V ta podatek ni zajet delež odpadkov, ki jih gospodinjstva kompostirajo ali zavržejo drugače, kot v okviru javnih zbirnih sistemov. Bolj načrtovana (u)poraba hrane z večjim deležem lastnega kompostiranja (podeželje) bi lahko ob zmanjšanju odpadne hrane razbremenil tudi sistem zbiranja odpadkov. Po podatkih SURS-a (2020) v sistemu zbiranja odpadne hrane, tovrstni odpadki v 48 % končajo v bioplinarnah, 29 % v kompostarnah, hrana med komunalnimi odpadki

konča z ostalimi mešanimi odpadki na biološki stabilizaciji. Delež te odpadne hrane znaša kar 21 %. V 2 % deležu pa odpadna hrana konča v drugih načinih obdelave (npr. sosežig in sežig, ponovno rafiniranje olja ter drugi postopki biološke predelave).


**Slika 7: Ravnanje z odpadno hrano, 2018**
(Vir: SURS)

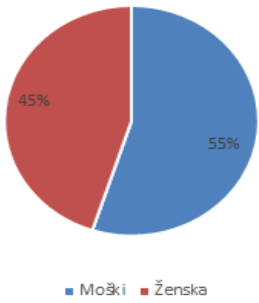
## 3 Raziskava in rezultati z razpravo

Med prebivalci Slovenije smo izvedli raziskavo, s katero smo želeli ugotoviti, kakšen je njihov odnos do lokalno pridelane hrane in kako si razlagajo določene pojme/označbe, ki se navezujejo na lokalno pridelano hrano. Raziskava je potekala v mesecu avgustu 2020 preko spletnega portala 1ka, sodelovalo je 200 anketirancev, rezultate predstavljamo v obliki grafov (lastni viri). Prvi sklop vprašanj se nanaša na izkušnje posameznika z lastno pridelavo hrano. V drugem sklopu vprašanj smo želeli preveriti anketirančeve predstave/razlage pojmov shem kakovosti, ki so največkrat kot komunikacijsko orodje uporabljene za pridobitev zaupanja posameznika, da se odloči za nakup lokalnega izdelka. V tretjem sklopu vprašanj smo želeli ugotoviti, v kakšni meri lahko gostinstvo v smislu komunikacijskega orodja prispeva k povečanju povpraševanja po lokalnih živilih. Z anketo smo želeli ugotoviti ali anketiranci smatrajo, da se s povečanjem pridelave in uživanjem kakovostne in lokalno pridelane hrane lahko privede do zmanjšanja zavržkov hrane.

V začetku nas je zanimala spolna struktura anketirancev, kot tudi njihova izobrazba.

### 3.1 Struktura po spolu in izobrazbi

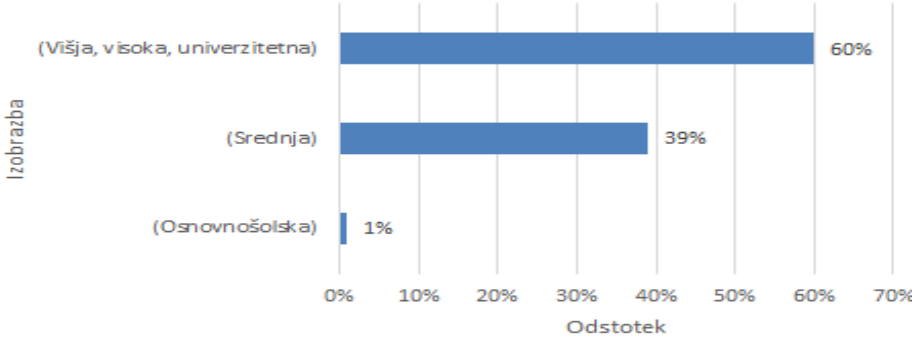
Vprašanje 1: Spol?




**Graf 1: Spol**

V anketi je z vidika zastopanosti spola sodelovalo 45 % žensk in 55 % moških, kar bi lahko opredelili kot uravnoteženo zastopanost.

Vprašanje 2: Izobrazba?




**Graf 2: Izobrazba**

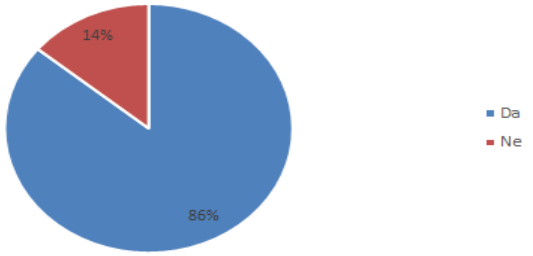
Na izpolnjevanje ankete, ki se nanaša na vsebino in odnos do lokalno pridelane hrane, so se v 60 % odzvali ljudje z višjo, visoko ali univerzitetno izobrazbo, z 39 % so se na anketo odzvali ljudje, ki imajo srednješolsko izobrazbo, z minimalno zastopanostjo 1 % pa so se na anketo odzvali ljudje, ki imajo zgolj osnovnošolsko izobrazbo. Če rezultate analiziramo s primerjavo podatkov glede izobrazbene

strukture prebivalstva iz Statističnega urada RS za leto 2019, ki ocenjuje, da je v tem letu v Republiki Sloveniji 23 % prebivalstva z osnovnošolsko izobrazbo ali manj, 52,8 % s srednješolsko izobrazbo in 24 % z višjo ali visokošolsko izobrazbo, lahko zaključimo, da je zanimanje do vprašanj, povezanih z lokalno in kakovostno pridelano hrano, obratno sorazmerno in narašča z večjo izobraženostjo prebivalstva. Pri tem je potrebno upoštevati tudi dejstvo, da v enakem sorazmerju narašča kupna moč, pri kateri je kakovostna hrana z višjo dodano vrednostjo bolj dostopna izobraženi strukturi prebivalstva oziroma je posledično pri tej skupini obratno sorazmerno povečano zanimanje za vsebine, povezane z lokalno pridelano hrano.

## 3.2 Lastna pridelava hrane

V tem sklopu vprašanj nas je zanimalo, kakšne so izkušnje anketirancev z lastno pridelavo hrane in v kakšnem obsegu samooskrbe jo pridelujejo. Izkušnja lastne pridelave lahko pomembno vpliva na pogled in pomen rabe lokalnih in kakovostnih proizvodov, kjer pri nakupu ne igra odločilno vlogo cena. Zanimalo nas je tudi ali lastna izkušnja pridelave hrane vpliva na odnos njene smotrne uporabe.

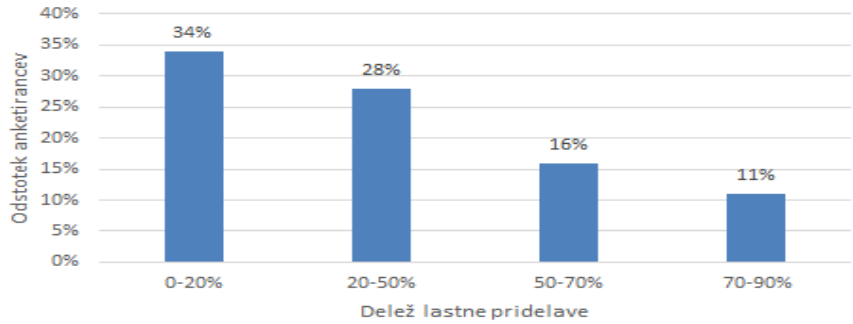
Vprašanje 3: Ali pridelujete svojo hrano?




**Graf 3: Lastna pridelava hrane**

Na vprašanje ali pridelujejo lastno hrano, je 86 % vprašanih potrdilo, da pridelujejo lastno hrano, zgolj 14 % vprašanih pa je odgovorilo, da se z lastno pridelavo ne ukvarjajo. Ne glede na vzgib iz ekonomskih, socialnih, zdravstvenih ali drugih razlogov je iz rezultata razvidno, da ima precejšen delež Slovencev izkušnjo s pridelavo hrane. Ta izkušnja lahko krepi zavedanje in pomen o lokalni pridelavi hrane ter o samem ravnanju s hrano.

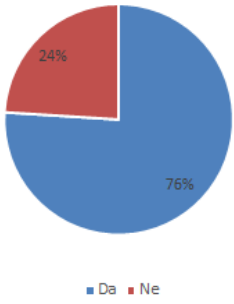
Vprašanje 4: Koliko hrane pridelate (v %) ?




**Graf 4: Delež lastne pridelave hrane**

Iz grafa je razvidno, da 36 % vprašanih prideluje lastno hrano v obsegu od 0 do 20 % lastne samooskrbe. 32 % vprašanih za lastno uporabo pridela od 20 do 50 % hrane, opazno manjši je z 18 % deležem tistih, ki pridelajo hrano za lastne potrebe med 50 in 70 % deležem. Z najmanjšim, 13 % deležem pa sledijo tisti, kjer je delež samooskrbe s hrano med 70 in 90 %. Zaključimo lahko, da je kar 68 % vprašanih odvisnih od dokupa hrane med 50 in 100 %. Stopnja izkušnje lastne pridelave se z nižanjem deleža sorazmerno manjša, kar lahko pomeni, da se z zmanjševanjem izkušnje manjša tudi zavedanje o pomenu lokalno pridelane hrane. Sklepamo lahko, da bi s spodbujanjem lastne pridelave in povečevanjem deleža samopreskrbe, povečali zavedanje in pomen o lokalni pridelavi hrane.

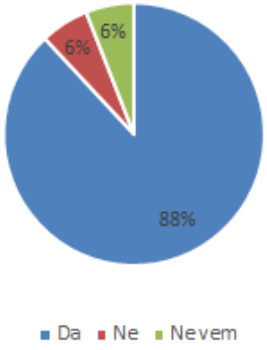
Vprašanje 5: Če bi imeli možnost, bi hrano pridelovali sami?




**Graf 5: Možnost lastne pridelave**

Čeprav je bil delež tistih, ki do sedaj še niso imeli izkušenj s pridelavo hrane zgolj 15 %, je v okviru vprašanja, ali bi pridelovali hrano, če bi imeli to možnost, kar 76 % vprašanih odgovorilo pritrdilno. Zagotovo je med omejitvami časovna komponenta, ki ljudem, navkljub materialnim pogojem omejuje izkušnjo lastne pridelave. Med pomembnejše omejitvene dejavnike sodijo lahko tudi materialni pogoji (obdelovalna površina, orodja …) in pomanjkanje znanja. Z omogočanjem, zlasti slednjih dveh dejavnikov, bi lahko še povečali izkušnjo lastne pridelave, zavedanje o pomenu lokalno pridelane hrane ter odgovornem ravnanju s hrano.

Vprašanje 6: Ali bi spodbujanje lastne pridelave hrane okrepilo zavedanje o pomenu lokalno pridelane hrane in odgovornem ravnanju s hrano?

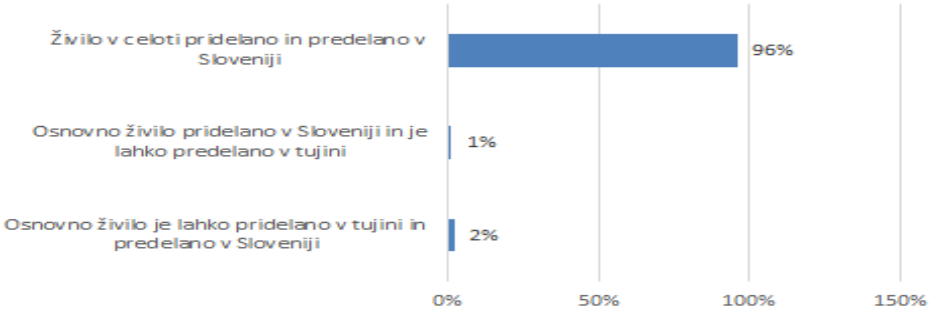



**Graf 6: Dvig zavedanja pomembnosti lokalnega z lastno pridelavo**

88 % vprašanih je odgovorilo pozitivno na vprašanje, ali bi spodbujanje lastne pridelave okrepila zavedanje o pomenu lokalno pridelane hrane in odgovornem ravnanju s hrano. Le 6 % vprašanih ni prepoznalo te korelacije kot bistvene za dvig zavedanja, 6 % pa jih na to vprašanje ni znalo odgovoriti. Rezultat tako potrjuje dejstvo, da izkušnje z lastno pridelavo hrane krepijo zavedanje o pomenu lokalno pridelane hrane in povečujejo odgovorno ravnanje s hrano, k temu dejstvu pa bi lahko bistveno prispevale materialne ali finančne spodbude s strani lokalne skupnosti ali države.

### 3.3 Razumevanje shem označevanja živil

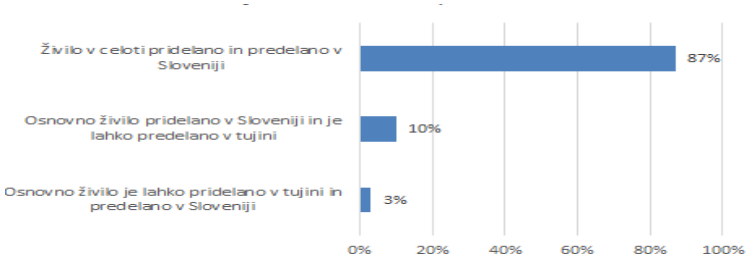
Vprašanje 7: Kaj smatrate pod pojmom ˝lokalno pridelana hrana˝?




**Graf 7: Pojem ˝lokalno pridelana hrana˝**

Uvodoma smo glede osnovnega razumevanja zastavili vprašanje, kaj si anketiranci predstavljajo pod pojmom "lokalno pridelana hrana". Gre za vse bolj pogosto besedno skovanko, ki se v okviru komunikacijskih orodij uporablja za trženje lokalno proizvedene in kakovostne hrane. Rezultati ankete kažejo, da kar 96 % vprašanih pod uporabo te besedne skovanke razume oziroma pričakuje, da je živilo v celoti proizvedeno v Sloveniji. Zgolj 1 % vprašanih pod tem pojmom razume pridelavo kot primarno produkcijo živila in dopušča možnost nadaljnje predelave v tujini. 2 % vprašanih pa dopušča, da je takšno živilo zgolj predelano v Sloveniji, ne glede na izvor primarne surovine. Iz odgovorov je razvidno, da vprašani v veliki večini pod besedo pridelava pojmujejo celotno proizvodnjo, kar je v osnovi napačno, vendar se pojavlja kot pridevnik hrani, ki pa je razumljeno kot končno živilo za namen konzumiranja, ne glede na stopnjo obdelave. Iz tega je pričakovanje večine vprašanih, da je lokalno pridelana hrana tista, ki je v celoti proizvedena v Sloveniji, upravičeno.

Vprašanje 8: Kaj za vas pomeni pojem ˝slovensko poreklo˝?




**Graf 8: Pojem ˝slovensko poreklo˝**

Označba "slovensko poreklo" je med najbolj uporabljenimi besednimi zvezami za označevanje živil, ki naj bi izhajala iz Slovenije. Trgovske verige uporabljajo vrsto besednih zvez za živila, s katerimi nakazujejo na slovensko poreklo. Ne glede na komercialne oznake, ki promovirajo slovensko poreklo živila, poznamo tudi uradne oznake, ki natančneje definirajo slovensko poreklo. Iz odgovorov je razvidno, da kar 87 % vprašanih pod to oznako pričakuje, da je živilo v celoti proizvedeno v Sloveniji. 10 % vprašanih meni, da je tovrstna označba smiselna le za osnovne surovine, pridelane v Sloveniji, ne glede na lokacijo njene nadaljnje predelave. Le 3 % vprašanih pa pod to označbo dopušča, da je osnovno živilo lahko pridelano v tujini ter nato dodatno obdelano v Sloveniji. Glede na visoko stopnjo pričakovanja, da je živilo z označbo, ki nakazuje na slovensko poreklo v celoti proizvedeno v Sloveniji, bi bilo v prid večjega zaupanja smiselno uvesti strožja določila in nadzor.

Vprašanje 9: Kaj razumete pod pojmom ˝domače˝?


**Graf 9: Pojem ˝domače˝**

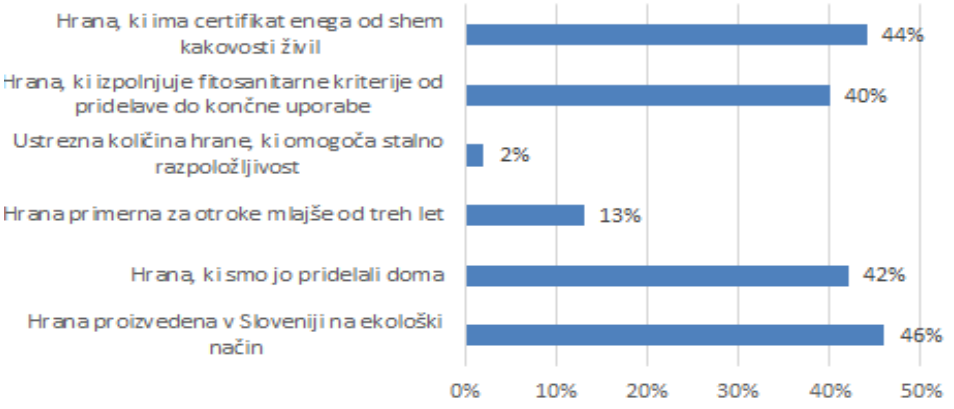
"Domače" je ena najbolj uporabljenih besed, s katerimi proizvajalci in trgovci označujejo živila. Dopušča mnogo razlag, kar je razvidno iz rezultatov ankete, ki ponazarjajo, da zgolj 3 % vprašanih meni, da je živilo, deklarirano kot domače, lahko v celoti proizvedeno v tujini, vendar po tradicionalni recepturi iz lokalnega okolja. Pri teh je lokalna tradicionalna receptura poglavitna, da si živilo zasluži oznako "domače". Kar 41 % vprašanih meni, da je lahko živilo deklarirano, kot "domače" zgolj iz lastne pridelave. Ti torej menijo, da je tako poimenovano živilo v celoti proizvedeno in kupljeno neposredno na kraju samem. 46 % vprašanih pod to oznako prednostno pričakuje ekološko in lokalno poreklo živila, ni pa jim bistvena tradicionalna receptura. Zgolj 4 % vprašanih prednostno postavlja tradicionalno recepturo kot tisto, ki opravičuje živilo kot domače, ne glede na to, da je proizvedeno na industrijski način z neznanim poreklom surovin. Nasprotno pa kar 74 % vprašanih meni, da mora biti tako deklarirano živilo v celoti proizvedeno le v okviru družinskih kmetiji in po tradicionalni recepturi. 45 % vprašanih pričakuje, da je ne glede na recepturo in način proizvodnje živilo, deklarirano kot domače, v celoti proizvedeno v lokalnem okolju, v katerem živijo. Iz rezultatov je razvidno, da v večini pod označbo živil "domače" vprašani pri živilih pričakujejo tradicionalno posebnost in izvor iz lokalnega okolja. Vprašani pričakujejo, da je živilo v celoti proizvedeno v sklopu družinskih kmetij in ne v industrijskih obratih.

Vprašanje 10: Kako razumete pojem ˝naša super hrana˝ ?


**Graf 10: Pojem ˝naša super hrana˝**

"Naša super hrana" je projekt in besedna skovanka, ki se uporablja v uradni promociji Republike Slovenije za hrano, pridelano in predelano v Sloveniji. Cilj projekta je prepričati slovenske kupce, da je slovenska hrana kakovostna in varna ter preko povečanega zaupanja doseči večjo odzivnost za nakup lokalno proizvedene hrane. 37 % vprašanih meni, da je pod to besedno zvezo promovirana hrana z zaščitenim geografskim in tradicionalnim poreklom. Lokalni in tradicionalni izdelki jim predstavljajo sinonim za kakovost in varnost živila, ne glede na način proizvodnje (ekološki, integrirani, konvencionalni). 40 % vprašanih meni, da pod to besedno zvezo pričakujejo lokalno in na ekološki način proizvedene izdelke. Kakovost in varnost povezujejo z načinom proizvodnje, ki ne uporablja potencialno škodljivih kemičnih substanc. 35 % vprašanih meni, da bi se lahko pod to besedno zvezo promovirala vsa hrana, ki je proizvedena v Sloveniji, ne glede na način proizvodnje, kakovost in varnost. Pri 35 % vprašanih besedna skovanka vzbuja pričakovanja v promocijo vitaminsko in z minerali bogate hrane. 65 % vprašanih ne povezuje besedne skovanke s promocijo zgolj enega segmenta živil, ki je sicer za zdravje med pomembnejšimi. 40 % vprašanih si predstavlja, da je "naša super hrana" tista, ki je v glavnem proizvedena na družinskih kmetijah ali v lastni režiji na način, ki ohranja polnovrednost živil. Iz rezultatov je razvidno, da besedna skovanka "naša super hrana" pri vprašanih v večini predstavlja lokalno hrano z družinskih kmetij, ki je pridelana na ekstenziven način z željenimi geografskimi ali tradicionalnimi posebnostmi.

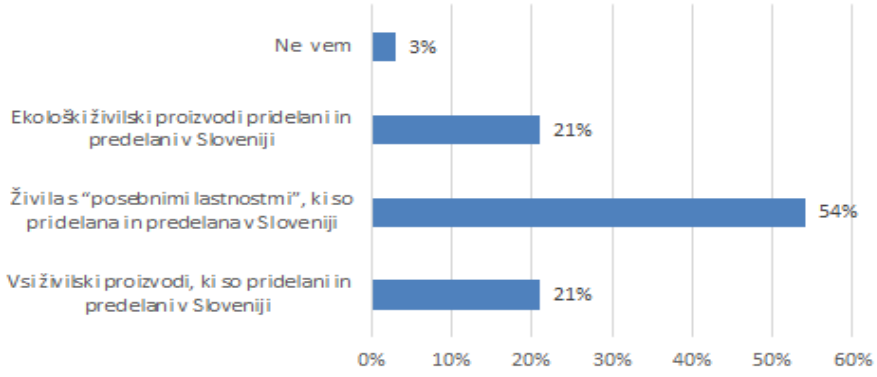
Vprašanje 11: Kako razumete pojem ˝varna hrana˝ ?




**Graf 11: Pojem ˝varna hrana˝**

V okviru tega pojma se lahko v javnosti vzbujajo različna, pogosto tudi napačna pričakovanja. Pogosto se pojem enači z načinom pridelave in kakovostjo izdelkov, vendar kakovost določenega živila glede na njegovo polnovrednost ali morebitno tradicionalno pridelavo in poreklo še ne pomeni, da je hrana varna za zaužitje. Kontaminacije živil v procesu proizvodnje z biološkimi, kemičnimi, fizičnim in fizikalnih dejavniki lahko prispevajo k zmanjšanju kakovosti živil in imajo lahko takojšen vpliv na poslabšanje zdravstvenega stanja. Zato so v procesih proizvodnje vzpostavljeni fitosanitarni kriteriji, ki zmanjšujejo kontaminacijo in posledično tveganje. Iz rezultatov je razvidno, da 44 % vprašanih povezuje pojem varne hrane z načinom proizvodnje, ki jih opredeljujejo sheme kakovosti živil. Zanimiv je rezultat, pri katerem zgolj 40 % vprašanih varnost hrane povezuje z izpolnjevanjem fitosanitarnih kriterijev v procesu proizvodnje. Vprašani tega pojma v veliki večini, kar 98 %, ne povezujejo z zadovoljivimi in dostopnimi količinami zalog hrane. 78 % vprašanih ne povezujejo tega pojma z opredelitvijo primerne hrane za otroke, mlajše od treh let. Kar 42 % vprašanih goji prepričanje, da je doma proizvedena hrana tudi varna, ne glede na način proizvodnje. 46 % vprašanih pa meni, da je ekološki način proizvodnje sinonim za varno hrano. Rezultati nakazujejo, da vprašani pojem varne hrane v veliki meri enačijo z načinom proizvodnje, ki definira kakovost živila. Pri tem je to enačenje povečano pri ekološkem načinu pridelave, kjer je manj možnosti kemične kontaminacije, preseneča pa podatek, da tega pojma vprašani v večini ne povezujejo z vzporednimi fitosanitarnimi ukrepi v procesu proizvodnje, ki so ključni za končno varnost izdelka.

Vprašanje 12: Kako razumete pojem ˝izbrana kakovost Slovenije˝ ?



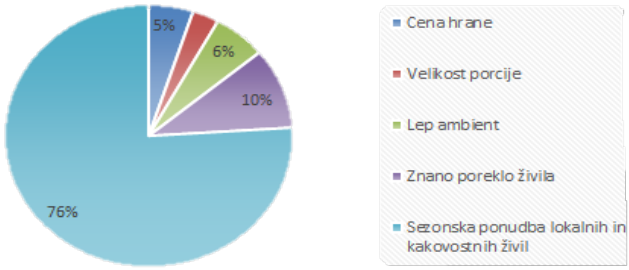

**Graf 12: Pojem ˝izbrana kakovost Slovenije˝**

V okviru projekta Naša super hrana, ki ga vodi Ministrstvo za kmetijstvo, gozdarstvo in prehrano, je nastala nova shema kakovosti, s katero bi se še bolj izpostavila živila iz lokalnega okolja (https://www.nasasuperhrana.si/o-projektu/). Pri vprašanju nas je zanimalo, kakšne izdelke lokalnega izvora anketiranci pričakujejo pod to oznako. Rezultati so pokazali, da v zelo majhnem deležu vprašani te oznake ne poznajo. 21 % vprašanih v okviru tovrstne sheme pričakuje lokalno in ekološko proizvedena živila, enak odstotek vprašanih meni, da pod to oznako tržijo vsa živila, proizvedena v Sloveniji, ne glede na način proizvodnje oziroma kakovost. 54 % vprašanih pa ocenjuje, da gre pri tovrstni označbi za živila z izraženimi posebnimi lastnosti, ki so v celoti proizvedena v Sloveniji. Glede na rezultate lahko sklepamo, da je promocija in razumevanje tovrstne sheme v precejšnji meri uspešna.

## 3.4 Gostinstvo kot potencial pri povečanju rabe lokalne hrane

Pri tem sklopu vprašanj smo želeli ugotoviti ali gostinstvo lahko predstavlja pomemben komunikacijski potencial pri povečanju rabe lokalno in kakovostne pridelane hrane.

Vprašanje 13: Kaj je vaše poglavitno vodilo pri izbiri gostinskega obrata?

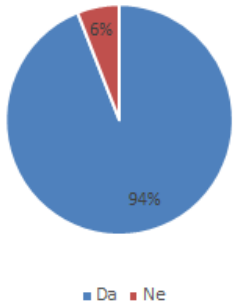



**Graf 13: Obisk gostinskega obrata**

Pri tem vprašanju smo želeli izvedeti, v kakšni meri ponudba lokalne hrane iz kakovostnih živil vpliva na obisk gostinskega obrata. Rezultati so pokazali, da pri izbiri gostinskega obrata na kar 76 % vprašanih vpliva ravno ponudba sezonske lokalno pridelane hrane. Zgolj pri 5 % na izbiro gostinskega obrata vpliva cena hrane, kar predstavlja spodbudo za povečanje ponudbe tovrstne hrane. Tudi velikost

obroka ni med glavnimi vodili za obisk gostinskega obrata, saj je temu pritrdilo zgolj 3 % vprašanih. Nikogar od vprašanih pa ne pritegne le ambient gostinskega lokala. Iz rezultatov je razvidno, da povečanje lokalne, sezonske in kakovostne hrane predstavlja najbolj pomembno vodilo za izbiro gostinskega obrata.

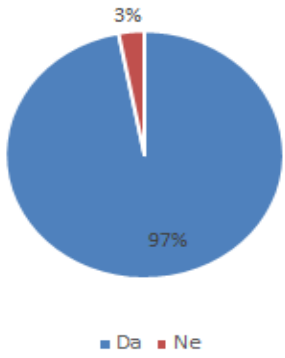
Vprašanje 14: Bi gostinski obrat obiskali pogosteje, če bi v njem nudili hrano iz lokalnih in kakovostnih živil?




**Graf 14: Obisk gostinskega obrata z lokalno hrano**

Iz vprašanja smo želeli izvedeti, kako ponudba lokalno pridelane in kakovostne hrane vpliva na priljubljenost in ponovni obisk gostinskega obrata. Rezultati so pokazali, da kar 94 % vprašanih ponovno obišče gostinski obrat, kjer je ponudba lokalne in kakovostne hrane. Sklepamo, da lahko povečana ponudba lokalne in kakovostne hrane v gostinskih obratih predstavlja pomemben ekonomski potencial za celotno lokalno živilsko predelovalno verigo.

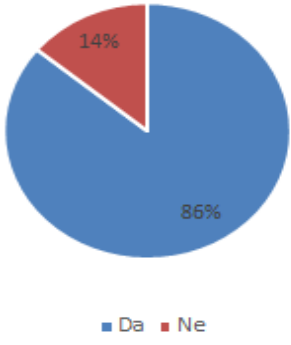
Vprašanje 15: Bi gostinski obrat obiskali pogosteje, če bi le-ta temeljil na ponudbi tradicionalnih jedi?




**Graf 15: Obisk gostinskega obrata s tradicionalnimi jedmi**

Zanimalo nas je tudi ali bi anketiranci pogosteje obiskali gostinski obrat, če bi lokalna in kakovostna živila postregli v okviru tradicionalnih jedi oziroma receptur. Na to vprašanje je kar 97 % vprašanih odgovorili pritrdilno. Iz rezultata lahko sklepamo, da povečanje ponudbe tradicionalnih jedi ne bi prispevalo samo k večjemu obisku prehranskih obratov, temveč bi lahko tovrstno povečanje ponudbe prispevalo tudi k povečanemu povpraševanju in proizvodnji lokalnih in kakovostnih živil.

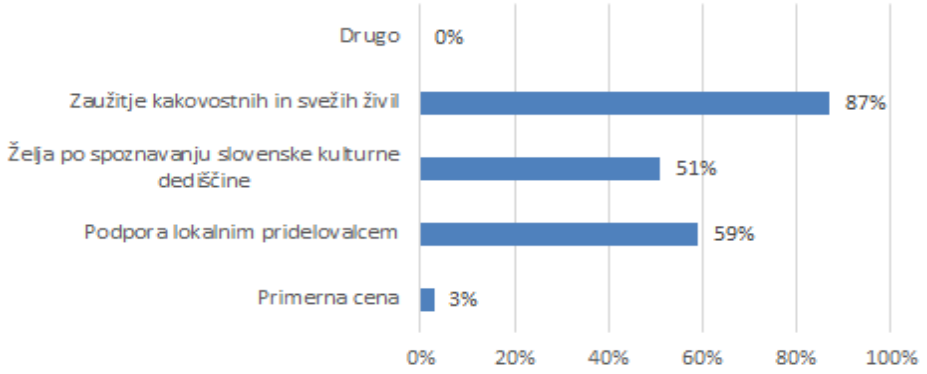
Vprašanje 16: Ali v gostinskih obratih pogosto posegate po sezonskih in tradicionalnih jedeh?




**Graf 16: Poseganje po sezonskih in tradicionalnih jedeh**

V okviru vprašanja smo želeli izvedeti ali vprašani pogosto posegajo oziroma uživajo tradicionalne jedi. Rezultat kaže, da kar 86 % vprašanih pogosto uživa tradicionalne jedi, iz česar lahko sklepamo, da je priljubljenost uživanja tradicionalnih jedi velika, kar predstavlja potencial pri razvoju in ponudbi teh jedi s strani gostinskih obratov.

Vprašanje 17: Razvrstite razloge za uživanje sezonskih in tradicionalnih jedi?

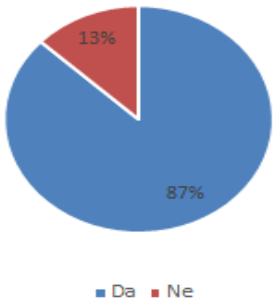



**Graf 17: Razlogi za uživanje sezonskih in tradicionalnih jedi**

Zanimalo nas je, kateri so poglavitni razlogi za pogostost uživanja tradicionalnih jedi. 87 % vprašanih kot razlog podaja zaužitje kakovostnih in svežih živil, 59 % vprašanih kot razlog uvrščajo podporo lokalnim pridelovalcem, 51 % pa želja po spoznavanju slovenske kulturne dediščine. Zgolj pri 3 % vprašanih je primerna cena glavni razlog za pogostost uživanja teh jedi. Zaužitje kakovostnih in svežih živil, kot glavni razlog za uživanje tradicionalnih jedi, nakazuje na njihovo medsebojno odvisnost. Krepitev tradicionalnega gostinstva bi lahko tako vplivala na povečano proizvodnjo lokalno pridelane hrane.

## 3.5 Lokalno pridelana hrana in zavržki hrane

Vprašanje 18: Ali po vašem mnenju sezonsko uživanje kakovostne hrane prispeva k zmanjšanju zavržene hrane?




**Graf 18: Zmanjševanje zavržene hrane**

Od vprašanih smo želeli pridobiti mnenje o tezi, da lahko uživanje kakovostne hrane zmanjša količine zavržene hrane. Kar 87 % vprašanih se je strinjalo, da povezava obstaja. Iz tega lahko sklepamo, da lahko prednostno uživanje kakovostno proizvedene hrane zmanjšuje potrebo po zaužitju, nakupu in pripravi večje količine hrane, kar posledično vodi v zmanjševanje zavržene hrane.

Vprašanje 19: Zakaj po vašem mnenju prihaja do zavržkov hrane?


**Graf 19: Zakaj prihaja do zavržkov hrane**

Zanimalo nas je, katere razloge za zavržke hrane vprašani ocenjujejo kot najpomembnejše. Iz odgovorov je razvidno, da 72 % vprašanih med poglavitne razloge uvršča dostopnost nekakovostne in poceni hrane v trgovinah. 71 % jih med poglavitne razloge uvršča neustrezno načrtovanje nakupov in obrokov, 37 % vprašanih za razlog ocenjuje pomanjkanje recikliranja, 17 % pa jih meni, da je razlog v krajši obstojnosti, sicer kakovostnih in svežih živil. Na vprašanje, zakaj prihaja do zavržkov hrane, večina navaja ravno nakopičenost poceni in nekakovostnih izdelkov, kot tudi neustrezno načrtovanje nakupov in obrokov.

Vprašanje 20: Kaj naredite z vašimi zavržki hrane?


**Graf 20: Zavržki hrane**

Zavržki hrane predstavljajo etični in okoljski problem, zato nas je zanimalo, kakšen je odnos vprašanih do zavržkov hrane oziroma kam jih zavrže. Raziskava kaže, da kar 76 % vprašanih zavržke hrane reciklira oziroma kompostira, 20 % jih odda v predvidene zabojnike javne službe, 4 % pa odvečno hrano zavrže v naravo. Rezultati kažejo na razmeroma dobro prakso kompostiranja večine vprašanih.

## 4 Zaključek

Rezultati raziskave so dali pomemben vpogled na stanje ozaveščenosti prebivalstva v zastavljenih segmentih in lahko prispevajo k izboljšanju na področju prizadevanj krepitve lokalne prehranske verige. V sklopu lastne pridelave hrane smo v okviru raziskave ugotovili, da ima precejšen delež anketiranih izkušnje z lastno pridelavo,

kar rezultira ne samo k večji lastni prehranski varnosti, ampak k doseganju večje ozaveščenosti in povečanju tako proizvodnje, kot tudi prodaje/nakupa lokalno proizvedenih živilskih produktov. Visoka lastna izkušnja pridelave hrane posledično pozitivno rezultira tudi pričakovanju visokih kakovostnih standardov znotraj različnih shem, ki so namenjene za promocijo lokalno pridelane hrane, kot tudi pričakovanju povečane gostinske ponudbe tradicionalnih jedi z lokalnimi in sezonskimi surovinami. Opozoriti je potrebno tudi na tiste, ki nimajo lastne izkušnje, bi si jo pa ob zagotovitvi določenih pogojev želeli. Ustvarjanje materialnih pogojev in dostopnosti do znanja, ne glede na obseg, bi morale biti prihodnje usmeritve kmetijske politike, da bi povečali samopreskrbo s hrano in ozaveščenost prebivalstva o pomenu nakupa lokalno proizvedenih živil.

Sheme kakovosti in različne oznake, ki opredeljujejo lokalno pridelano hrano so zagotovo nujna orodja, s katerimi kontroliramo proizvodnjo, obenem pa lahko učinkovito nagovarjajo k nakupu lokalno pridelane hrane. Ugotovili smo, da so pričakovanja anketirancev do označb lokalno pridelane hrane jasna, v nekaterih primerih pa prihaja do razlikovanj pojmovanj, kar je posledica količine označb in morebitnih zavajanj s strani označevalcev oziroma opredeljevalcev shem kakovosti. Gostinstvo ni zgolj del samostojne gospodarske panoge, ampak skozi ponudbo jedi predstavlja pomembno podporo pri spodbujanju rabe lokalnih živilskih proizvodov. Ljudje imamo velik interes po kakovostnih lokalnih živilskih proizvodih, pri čemer med poglavitne razloge prištevamo kakovost in svežino živil ter podporo lokalnim pridelovalcem. V tradicionalnih jedeh je veliko možnosti za plasiranje lokalno pridelane hrane, vendar bi bilo za množičnejšo rabo potrebno zagotoviti širšo ponudbo tovrstnih jedi ter izboljšati kakovost prezentacije hrane. Iz ankete je razvidno, da vprašani jasno vidijo korelacijo med povečanjem rabe lokalno pridelane hrane z zmanjševanjem zavržene hrane, ki je posledica prevelike in neenakomerne koncentracije poceni in nekakovostne hrane, kot tudi nesmotrnega načrtovanja porabe živil.

**Literaura**

Blatnik, M., Jagodič S., Strmšnik, K. (2013). Bomo v prihodnje kupovali še tuje?. Celje: Ekonomska šola Celje.

Lončar S., Korže Vovk A., Reš M., Perdih F., Rotar I. (2020). Samooskrba v praksi, Ljubljana.

Colarič-Jakše, L.-M., Križmančič, M. (2020). Pasti in prednosti tradicionalnega gostinstva, objavljeno v Raspor, P. (ur). Hrana, Prehrana, Zdravje. Ljubljana, 2020.

Ogrinc, N. (2013). Lokalna trajnostna prehranska samooskrba, Celje.
Bavec, M. (2003). Tehnike pridelovanja zelenjadnic, Ljubljana, MKGP.
Laketič, D. (2015). Promocija oskrbe s kakovostno lokalno hrano v Sloveniji, diplomsko delo, Ljubljana.
Stritih, J. (2018). Okoljski odtis Slovenije – Izračun projekcij in scenarijev zmanjšanja okoljskega odtisa za izbrane ukrepe, Končno poročilo, Bovec.
Statistični urad (2018). *Bilance proizvodnje in potrošnje kmetijskih proizvodov*. WWW <URL: https://www.stat.si/StatWeb/News/Index/8111> Obiskano: 28.10.2020
Larisa, D. (2020). *Vrtičkanje v času krize ali kje smo pri samooskrbi s hrano*?. WWW <URL https://www.rtvslo.si/okolje/novice/vrtickanje-v-casu-krize-ali-kje-smo-pri-samooskrbi-s-hrano/520419>, Obiskano: 28.10.2020
Naša super hrana (2016). *Lokalna hrana ima največ hranil*. WWW <URL https://www.nasasuperhrana.si/clanek/lokalna-hrana-ima-najvec-hranil/> Obiskano: 28.10.2020
Naša super hrana (2020). *Označbe shem kakovosti*. WWW <URL: https://www.nasasuperhrana.si/za-potrosnike/sheme-kakovosti/oznacbe-shem-kakovosti/> Obiskano: 28.10.2020
Naša super hrana (2017). Nacionalni projekt naša super hrana. WWW <URL: https://www.nasasuperhrana.si/o-projektu/> Obiskano: 28.10.2020
Poročilo o stanju kmetijstva (2019). Poročilo o stanju kmetijstva, živilstva, gozdarstva in ribištva. WWW <URL: https://www.kis.si/f/docs/Porocila_o_stanju_v_kmetijstvu_OEK/ZP_2019_splosno__priloge_net.pdf > Obiskano: 17.10.2020
Uredba št. 952/2013 o carinskem zakoniku unije (2013). WWW <URL: https://eur-lex.europa.eu/legal-content/sl/TXT/?uri=CELEX%3A32013R0952> Obiskano: 17.10.2020
Izvedbena uredba (EU) št. 2018/775 (2018). WWW <URL: https://eur-lex.europa.eu/legal-content/SL/TXT/PDF/?uri=CELEX:32018R0775&from=LV> Obiskano: 27.10.2020
Sibila Lebe S. (2006). Strategija razvoja gastronomije Slovenije. WWW <URL: https://www.slovenia.info/uploads/dokumenti/turisticni-produkti/Strategija_gastronomije-31.8.2006_4277_11649.pdf≥ Obiskano: 12.10.2020
SURS (2019). Prebivalec Slovenije je v 2018 zavrgel povprečno 68 kg hrane. WWW <URL: https://www.stat.si/StatWeb/news/Index/8433> Obiskano: 13.10.2020
Zveza potrošnikov Slovenije (2020). Vsakodnevni nasveti za manj zavržene hrane. WWW <URL: https://www.zps.si/index.php/hrana-in-pijaa-topmenu-327/nasveti-za-zdravo-prehranjevanje/9953-vsakodnevni-nasveti-za-manj-zavrzene-hrane> Obiskano: 22.10.2020

# TEHNIČNI PREGLEDI NAPRAV ZA NANOS FITOFARMACEVTSKIH SREDSTEV

PETER KUHAR

GRM Novo mesto – Center biotehnike in turizma, Novo mesto, Slovenija.
E-pošta: peter.kuhar@grm-nm.si

**Povzetek** Tehnični pregledi naprav za nanos fitofarmacevtskih sredstev so se v Sloveniji začeli že v osemdesetih letih prejšnjega stoletja. Na začetku so bili prostovoljni, obvezni pa so postali leta 1995. Podobno je bilo tudi v nekaterih drugih evropskih državah, kot so na primer Nemčija, Poljska, Belgija in Španija. Tehnični pregledi naprav za nanos fitofarmacevtskih sredstev so zelo pomembni v luči zagotavljanja varne pridelave hrane. Škropilnice in pršilniki so najbolj pogosto uporabljene naprave, ki so lahko traktorsko nošene, vlečene ali samohodne. V letu 2012 je bila evropska direktiva 2009/128/CE vključena v našo zakonodajo. Leta 2019 je bil sprejet nov pravilnik, ki ureja omenjene preglede. Tehnični preglede na območju jugovzhodne Slovenije opravlja Grm Novo mesto – Center biotehnike in turizma. Kvaliteta pregledanih naprav v tej regiji se je skozi leta izboljšala, kot je vidno v raziskavi med leti 2004 in 2013. V osrednji Sloveniji je bila v letu 2019 opravljena raziskava, ki prikazuje kateri deli naprav za nanos FFS so bili najbolj okvarjeni pri njih. Tehnični pregledi so organizirani kmetom prijazno, kar pomeni, da se izvajajo v bližini njihovih gospodarstev in tako ne potrebujejo premagovati velikih razdalj s traktorji.

**Ključne besede:**
tehnični pregledi,
FFS,
škropilnica,
pršilnik,
Slovenija,
GRM
Novo mesto.

Univerzitetna založba Univerze v Mariboru

DOI https://doi.org/10.18690/978-961-286-406-4.7
ISBN 978-961-286-406-4

# TECHNICAL INSPECTIONS OF DEVICES FOR THE APPLICATION OF PLANT PROTECTION PRODUCTS

PETER KUHAR

GRM Novo mesto – Center for Biotechnology and Tourism, Novo mesto, Slovenia.
E-mail: peter.kuhar@grm-nm.si

**Abstract** The inspection of plant protection equipment in Slovenia was introduced in the eighties. It used to be on volunatry level and became mandatory in 1995. It was nearly the same as in some other European countries like Germany, Poland, Belgium and Spain. The inspection of plant protection equipment is very important in order to ensure the quality of pesticide application in aspect of safe food production. Boom sprayers and orchard sprayers are most frequently used types of machines and can be tractor mounted, trailed or selfpropelled. In 2012 the 2009/128/CE directive was adopted in the Slovenian legislation. In 2019 the new policy was introduced and the inspections must now be done under its directive. The inspection in southeast Slovenia is done by Grm Novo mesto – Center of Biotechnics and Tourism. The quality of inspected sprayers in this region has increased over the years, as seen in the research from 2004 to 2013. Research in 2019 in central Slovenija shows, which parts of sprayers were most defetctive in that region. The inspections are organised farmer friendly, which means that the inspectors com close to the farmers' neighbourhood, so the farmers do not need to drive their tractors long distances.

**Keywords:** sprayer inspection, boom sprayer, orchard sprayer, Slovenia, GRM Novo mesto.

https://doi.org/10.18690/978-961-286-406-4.7 DOI
978-961-286-406-4 ISBN

University of Maribor Press

## 1 Uvod

Čemu sploh so potrebni tehnični pregledi naprav za nanos FFS? Ker so priključeni na traktor, so torej traktorski priključek. Zavedati se moramo, da s temi stroji, za razliko od vseh ostalih, kot so na primer plugi, brane, prikolice itd., na ciljne površine nanašamo fitofarmacevtska sredstva, ki so večinoma razne kemikalije in kot take potencialno nevarne za okolje in ljudi. Gre torej za to, da se v največji možni meri prepreči zanos FFS na ne-ciljne površine. Brezhibno delovanje naprav za nanos je torej ključnega pomena za doseganje teh in tudi okoljevarstvenih ciljev. Poleg brezhibnega delovanja naprav pa je zelo pomembna tudi pravilna uporaba oziroma nastavitev naprav.

Tehnični pregledi naprav za nanos FFS so se na področju današnje Slovenije opravljali že v bivši državi, vendar zgolj na prostovoljni ravni. Na preglede so naprave pripeljali kmetje, ki so se že takrat zavedali pomena brezhibnega delovanja strojev za nanos FFS. Kočiš (2020) navaja, da je Biotehniška šola Rakičan take preglede opravljala že leta 1984.

Na tehničnih pregledih se opravi pregled naprav, hkrati pa se po potrebi opravi katero od manjših nastavitev (npr. tlak v veterniku) in pomaga uporabniku z manjšimi nasveti.

Uporabnik, ki je večinoma tudi lastnik naprave, po opravljenem pregledu prejme potrdilo o delovanju naprave, ki izkazuje brezhibno delovanje naprave in znak o pregledu, ki se namesti na vidno mesto na napravi.

Mesto pregleda mora ustrezati določenim zahtevam, ki jih predpisuje zakonodaja. Biti mora dovolj veliko, kar se da vodoravno ter čim manj prometno. Zaradi zagotavljanja delovanja opreme mora biti tudi možnost priklopa na električno omrežje. Pregledna mesta kot tudi vabljenje strank za Grm Novo mesto organizira Kmetijsko gozdarski zavod Novo mesto.

Pregledi se opravljajo v spomladanskem obdobju s pričetkom v sredini meseca marca, ko so zunanje temperature tolikšne, da ni več nevarnosti zmrzovanja naprav ter trajajo najdlje do prvih dni julija.

# 2 Teoretične osnove

## 2.1 Naprave za nanos FFS

To so vse naprave, ki na kakršen koli način nanašajo pesticide (posplošeno jih imenujemo FFS – fitofarmacevtska sredstva). Sem lahko načeloma uvrščamo vse od najmanjših ročnih naprav do velikih s prostornino nekaj tisoč litrov. Poznamo različne načine nanosa FFS: megljenje, zaplinjevanje itd., najbolj poznan in najpogosteje uporabljen pa je nanašanje s pomočjo vode. Površine, kamor se nanaša FFS, so lahko različne. To so lahko razna skladišča, semena, gomolji, tla, največkrat pa so to rastline same oziroma njihovi listi. V slovenskem prostoru so najpogosteje uporabljene naprave škropilnice ter pršilniki. Večina teh naprav je nošenih, kar pomeni, da so vpeti na tritočkovni sistem traktorja, nekaj, predvsem na velikih gospodarstvih, pa je tudi vlečenih.

## 2.2 Zgradba naprav

Da lahko bolje razumemo pojem tehnični pregled naprav za nanos FFS, je dobro poznati vsaj osnovno zgradbo naprav. Oba tipa naprav, tako škropilnice kot pršilniki, imata nekaj skupnih sestavnih delov. To so osnovno ogrodje, rezervoarji, črpalka, cevi, manometer, ventili ter regulator tlaka.

### 2.2.1 Škropilnice

Najbolj značilna lastnost vsake škropilnice so njene škropilne letve, ki se praviloma raztezajo levo in desno od središča naprave. Po letvah so napeljane cevi, po katerih teče pripravljena brozga, ter šobe, ki so zelo pomembne pri pretoku ter oblikovanju curka. S tem želimo doseči ustrezno širino delovanja. Druga pomembna lastnost pa je, kar že v imenu povemo, da z njo škropimo, se pravi, da je velikost kapljic, ki jih ustvarjajo šobe, večja in gre tako za škropljenje. Tretja pomembna lastnost pa je ta, da delujejo na bistveno nižjem tlaku, to je 0–12 barov (Nošene …, 2013).

### 2.2.2 Pršilniki

Pršilniki so prepoznanih po njihovih puhalih. Na bolj preprostih izvedbah so videti kot nekakšni ventilatorji na zadnjem delu naprave. Namen teh puhal je, da s pomočjo zračnega toka FFS zanesejo v krošnje rastlin. Pri vseh pršilnikih je znano to, da so šobe nameščene po obodu oziroma robu teh puhal. Delovni tlak pri teh napravah je višji, to je od 5 pa vse do 30 ali celo 40 barov (Nošene …, 2013). Zaradi tako visokega tlaka in posebnosti šob je posledično velikost kapljic manjša in zato govorimo o pršenju.

## 2.3 Pregledi naprav v tujini

Preglede naprav so že v preteklosti izvajali tudi v nekaterih evropskih državah. Okolje je skupen prostor, hrana se uvaža in izvaža med državami, zato so se tudi drugod zavedali pomena kvalitetnega nanosa fitofarmacevtskih sredstev in s tem pridelave varne hrane.

### 2.3.1 Nemčija

V Nemčiji so preglede škropilnic začeli uvajati konec šestdesetih let prejšnjega stoletja, za pršilnike, ki so namenjeni oskrbi sadovnjakov, vinogradov in hmeljišč, pa sredi osemdesetih let prejšnjega stoletja. S tem si je Nemčija pridobila veliko izkušenj na področju tehničnih pregledov naprav za nanos FFS. Preglede so imeli zasnovane na poenotenih zahtevah, ki jih izvaja okoli 1000 priznanih organizacij na približno 2000 mestih. Tako kot pri nas, morajo biti tudi v Nemčiji pregledne skupine uradno potrjene in v večini primerov uporabljajo opremo, ki mora biti tudi redno pregledana in potrjena s strani njihovih inštitutov. Do leta 1993 so vsako leto pregledali približno 30.000 naprav. Ko so z letom 1993 pregledi postali obvezni, je število naprav naraslo na 63.000 na leto (Osteroth, 2004).

### 2.3.2 Poljska

Na Poljskem so obvezne preglede za vse naprave, tako traktorsko nošene, vlečene kot tudi samohodne in za oba tipa, tako škropilnice kot tudi pršilnike, uvedli leta 1999 (Holownicki in sod., 2004). Pregledi so bili vpeljani leta 1995 z zakonom o varstvu rastlin, katerega podlaga je bila direktiva njihovega ministrstva za kmetijstvo.

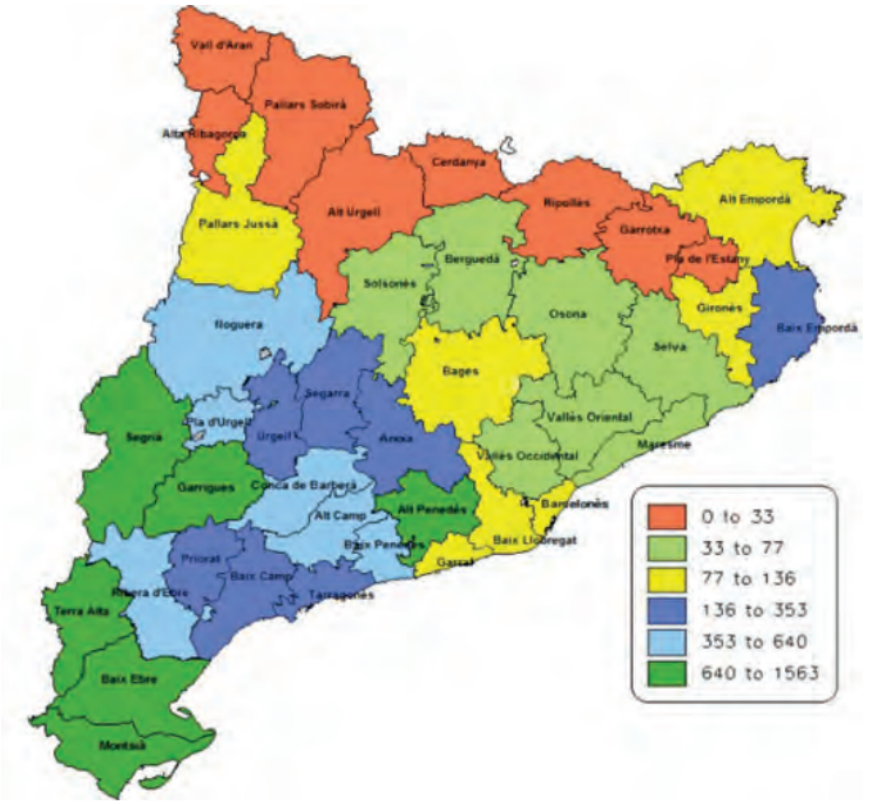
V njej so bila navedena pravila, organizacija in postopek pregleda. Osnovni prijemi pri pregledu so bili zelo podobni tistim iz EN 13790 standarda. Zahteve so bile manj stroge in nekateri parametri so bili podvrženi očesni oceni namesto opravljanju meritev. Poljski sistem za pregled naprav za nanos FSS temelji na njihovi organizaciji za varstvo rastlin in semenarstva, ki vse skupaj tudi nadzoruje. Sistem vključuje 321 uradno potrjenih preglednih enot. Te preglede v veliki meri izvajajo trgovci s kmetijsko mehanizacijo, fitofarmacevtskimi sredstvi pa tudi srednje šole in nekatere ostale podporne službe, povezane s kmetijstvom. Osebje, ki izvaja preglede, mora opraviti 5-dnevni tečaj na enem od šestih izobraževalnih centrov ter opraviti izpit (Holownicki in sod., 2004).

### 2.3.3 Belgija

V Belgiji so z obveznimi pregledi začeli leta 1996 (Declercq in sod., 2012). Pregled naprav za nanos FFS je izveden tako na stacionarnih enotah kot tudi po terenu, kjer sodelujeta po dva člana. Organizacija in vodenje pregledov izvaja zvezno ministrstvo za varstvo potrošnikov, javno zdravje in okolje (Belgijski FAVV). V Flamski regiji pa so tehnični pregledi izvedeni pod okriljem raziskovalnega inštituta za kmetijstvo in ribištvo (ILVO).

### 2.3.4 Španija

V Španiji so s prvimi prostovoljnimi pregledi naprav za nanos FFS začeli v osemdesetih letih prejšnjega stoletja za naprave, ki so se uporabljale v integrirani pridelavi in kasnejših certificiranih programih. Preglede so izvajale oziroma jih vsaj organizirale javne ustanove. V letu 2014 še ni znano, koliko naprav bi moralo biti pregledanih. Od leta 2009 dalje je obvezna uradna registracija vseh naprav, tako novih kot tistih v uporabi. Za naprave, ki so že v uporabi, so metode registracije poenostavljene, saj tehnična dokumentacija večinoma ni na voljo. Za seznam naprav je odgovorno ministrstvo za kmetijstvo, s katerim sicer razpolaga lokalna administracija. Do sedaj je na seznamu 170000 naprav, vendar je dejanska številka verjetno veliko večja. Iz seznama naprav lahko poleg števila vidimo tudi geografsko razporeditev naprav, kar nam omogoča organizacijo pregledov. Kot primer lahko na Sliki 1 vidimo razporeditev naprav v Kataloniji na severovzhodu Španije. Pri vzpostavljanju pregledov mora namreč biti zagotovljeno, da so lahko vse naprave pregledane blizu njihovega nahajanja (Solanelles in sod., 2014).




**Slika 1: Razporeditev naprav v Kataloniji**
(Vir: Solanelles in sod., 2014)

## 2.4 Zakonodajna podlaga

Sam postopek pregleda naprav ureja zakon o fitofarmacevtskih sredstvih v skladu z Direktivo 2009/128/ES. Ta ureja promet in uporabo fitofarmacevtskih sredstev, določa nacionalni akcijski program za doseganje trajnostne rabe FFS, usposabljanje o FFS, preglede za naprave za nanašanje FFS, posebne ukrepe v zvezi z uporabo FFS, obveščanje javnosti o FFS, strokovne naloge in raziskovalno delo v zvezi s FFS, zbirke podatkov in pridobivanje ter uporabo podatkov, laboratorije, kazenske določbe ter pooblastila organov, ki so odgovorni za izvrševanje tega zakona in

nadzor nad njegovim izvajanjem ter predpisi, izdanimi na podlagi tega zakona (Zakon …, 2012).

Za opravljanje te dejavnosti Uprava za dobo petih let dodeli za izvedbo pregledov in izdajo potrdil o pravilnem delovanju naprav ter znakov o rednem pregledu naprav javno pooblastilo fizični ali pravni osebi, ki izpolnjuje pogoje glede prostorov in tehnične opreme. Preglednik naprav mora imeti sam ali oseba, s katero ima sklenjeno pogodbo o zaposlitvi za nedoločen čas, univerzitetno izobrazbo ustrezne smeri in pet let delovne dobe (Zakon …, 2012).

Omenjeni zakon je podlaga za pravilnik o zahtevah glede pravilnega delovanja naprav za nanašanje fitofarmacevtskih sredstev in o pogojih ter načinu izvajanja njihovih pregledov (Pravilnik …, 2019). Pravilnik navaja, da morajo biti pregledane vse naprave, izvzete so ročne ali nahrbtno nošene škropilnice in pršilniki ter naprave, ki so namenjene kontaktnemu uničevanju plevela in se ne uporabljajo kot traktorski priključek (npr. mazala). Večino pregledov se opravi terensko, za kar morajo biti izpolnjeni določeni pogoji. Ti so na primer ustrezen prostor za opravljanje administrativno tehničnih opravil, ki je v našem primeru prirejen kombi. Poleg tega mora biti zagotovljena ustrezna površina, ki mora biti ravna ter prosta, zagotovljeno pa mora biti tudi zbiranje in vračanje tekočine v rezervoar. To je na terenu rešeno s posebnim lovilnim bazenom. Ker se delo izvaja na prostem, morajo biti ustrezne tudi vremenske razmere, kar pomeni, da ne sme biti padavin, hitrost vetra pa ne večja od 5m/s, razen če je možno urediti ustrezno mehansko zaščito. Poleg vsega naštetega pravilnik (Pravilnik …, 2019) navaja še, da mora bit mesto takšno, da ni nevarnosti onesnaževanja vodnih virov.

Kadar pa se pregledi izvajajo v posebnem prostoru, pravilnik ureja, da morajo biti ti prostori ločeni od drugih prostorov, da se preprečijo vplivi emisij hrupa, plinov in drugih nevarnih snovi ter vlage. Poleg tega mora omogočati namestitev naprave na preizkusno mesto, neovirano gibanje izvajalcev pregleda naprav in nameščanje preizkuševalne opreme. Predvsem zaradi izpušnih plinov mora biti urejeno tudi bodisi naravno bodisi umetno prezračevanje. Zagotovljeno mora biti tudi zbiranje tekočine, ki izteka med pregledom, v skupno lovilno posodo ali v zaprt zbiralni sistem za razlitje. Nikakor se tekočina ne sme prosto razlivati ali biti speljana v zunanjo kanalizacijo (Pravilnik …, 2019).

Po opravljenem pregledu naprave z meritvami preglednik naprave izda potrdilo o pravilnem delovanju naprave, ki vsebuje najmanj naslednje podatke (Pravilnik …, 2019):

- lokacijo pregleda (kraj pregleda),
- podatek o pregledniku naprave (osebno ime in naslov ali podjetje in sedež preglednika),
- datum pregleda in izdaje potrdila,
- podatek o lastniku naprave,
- ime proizvajalca naprave,
- vrsta naprave,
- podatek o napravi (izdelovalec, tip, leto izdelave, serijska številka),
- način priklopa (nošena/vlečena/samohodna),
- rezultate meritev,
- opombe.

Pravilnik navaja tudi veljavnost pregledov, ki so z letom 2020 nekoliko spremenjeni, in sicer: za naprave, pregledane od 1. januarja do 30. junija, velja potrdilo o pravilnem delovanju naprave do 30. junija tretjega leta od pregleda naprave. Za naprave, pregledane od 1. julija do 31. decembra, velja potrdilo o pravilnem delovanju naprave do 31. decembra tretjega leta od pregleda naprave. Za nove naprave, kupljene od 1. januarja do 30. junija, velja potrdilo o pravilnem delovanju naprave do 30. junija petega leta od nakupa nove naprave. Za nove naprave, kupljene od 1. julija do 31. decembra, velja potrdilo o pravilnem delovanju naprave do 31. decembra petega leta od nakupa nove naprave (Pravilnik…, 2019).

Novo napravo je potrebno vpisati v register v roku šestih mesecev od dneva nakupa in tehnični pregled ni potreben. Lastnik mora predložiti izvirni račun in vse tehnične listine o napravi, iz katerih je razvidno, da je izdelovalec naprave zagotovil tehnično ustreznost naprave v skladu s predpisi, ki urejajo tehnične zahteve za proizvode in postopke ugotavljanja skladnosti (Pravilnik …, 2019).

## 2.5 Organizacija pregledov

Pregledi se opravljajo terensko, kar pomeni, da pregledniki s svojo opremo za pregled pridejo v bližnjo okolico lastnikov, da imajo le-ti čim krajšo pot do mesta pregleda, saj naprave večinoma pripeljejo s traktorji, ki niso namenjeni premagovanju daljših razdalj. S tem se tudi vsaj deloma izognemo dodatnemu obremenjevanju okolja z izpušnimi plini. Pregledi so strokovno organizirani, kar pomeni, da je poskrbljeno za samo mesto pregleda, kot tudi obveščanje oziroma vabljenje strank.

Pri izvedbi pregledov Grm Novo mesto - center biotehnike in turizma sodeluje skupaj s Kmetijsko gozdarskim zavodom Novo mesto, pri čemer slednji skrbi za organizacijo prostorov ter vabljenje strank. Za mesta pregledov, ki so praviloma večje asfaltirane in vodoravne površine, je potrebno pridobiti soglasja lastnikov oziroma upravnikov.
Na preglede se vabi uporabnike, ki jim v danem letu poteče veljavnost pregleda ter uporabnike, ki jim je veljavnost potekla v predhodnem letu. Starejši zamudniki morajo sami poskrbeti za pregled, če to seveda potrebujejo.

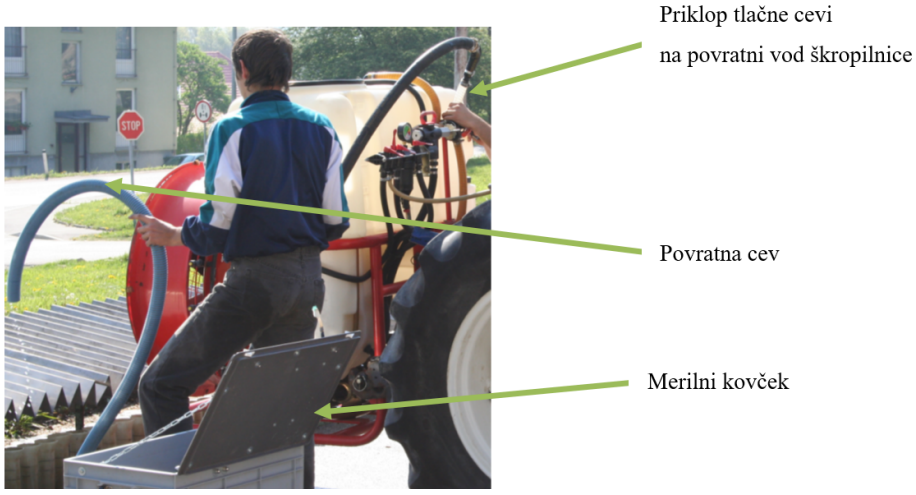
## 2.6 Izvedba pregleda naprav na mestu samem

Stranka ob vnaprej določeni uri pripelje svojo napravo na dogovorjeno mesto. Pregledniki napravo najprej predhodno pregledajo brez meritev, kar zajema:

- ocena rezervoarja, kjer se preveri tesnjenje, vidnost merilne skale, nalivno odprtino in morebitne druge poškodbe,
- delovanje ventilov praznjenja in njihovo tesnjenje ter stanje filtra,
- pregled tesnjenja cevi, njihova pregibnost in morebitna stisnjenost ter razpokanost,
- ogled čistosti in poškodovanosti filtrov,
- poškodovanost (zvitost) in zložljivost letev pri škropilnici,
- zaščita kardanske gredi in
- stanje puhala pri pršilnikih.

V kolikor naprava ne izpolnjuje kateregakoli kriterija, se jo zavrne že pri predhodnem pregledu. V kolikor uvodnih pomanjkljivosti ni, se nadaljuje s pregledom, kjer se opravlja meritve s posebno opremo.

Najprej sledijo meritve črpalke (Slika 2). Način merjenja pri škropilnici je enak kot pri pršilniku, le da je pri slednjem tlak merjenja višji, to je 15 barov, medtem ko se pretok črpalke pri škropilnici meri pri 3 barih. Pretok črpalk se meri pri 540 o/min. Vedno se najprej meri pretok pri 0 barih, nato pa se z merilnim kovčkom tlak postopoma zvišuje do 3 oziroma 15 barov.



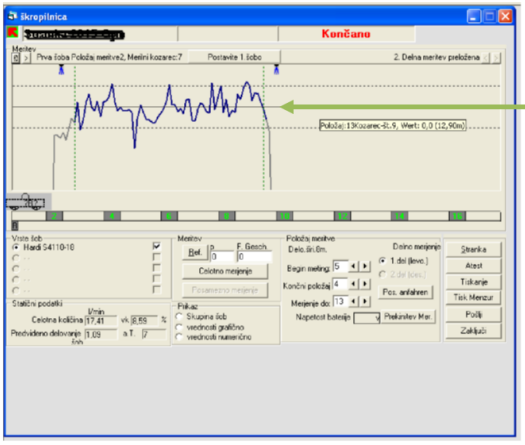

**Slika 2: Priklop merilnega kovčka na škropilnico**
(Vir: lastni)

Če se ugotovi, da črpalka ne deluje v redu, se pregled zaključi z negativnim izidom. V kolikor je delovanje črpalke ustrezno, se nadaljuje s pregledom delovanja šob oziroma prečnega nanosa pri škropilnicah, ki se meri s posebnim računalniško brezžično vodenim vozičkom (Slika 3) proizvajalca Herbst - SprayerTest 1000. Ta izmerjene podatke sproti pošilja v računalnik, kjer se le-ti izpišejo numerično ali v obliki grafa (slika 4). Program izračuna tudi koeficient variacije, ki ne sme biti večji od 15 %.

Oprema za pregled:

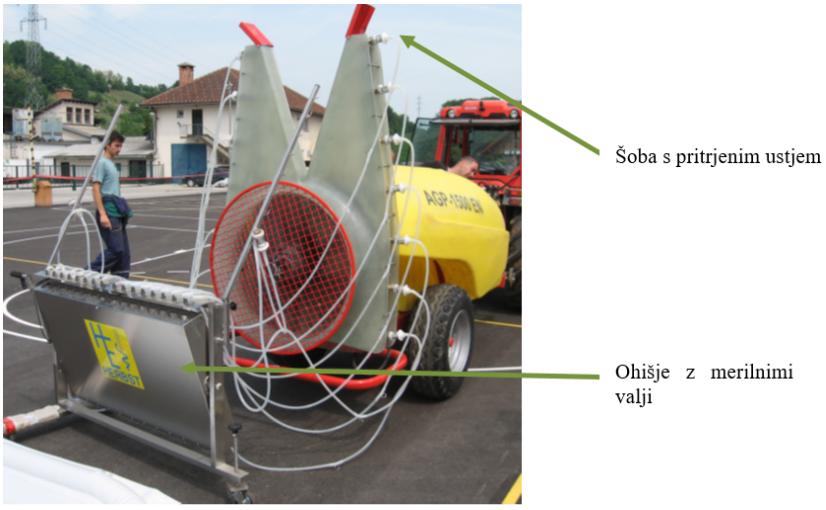
- merilni kovček Herbst ROT-650/60/40/10 (merjenje pretoka črpalke in preverjanje manometra),
- merilne menzure Herbst ED 16 ECO,
- merilni elektronski voziček SprayerTest 1000,
- brezžični usmernik Linksys,
- računalnik IBM Lenovo R60,
- lovilni bazen in
- aluminijaste tračnice za voziček.


**Slika 3: Postavitev traktorja s škropilnico na klančino za merjenje prečnega nanosa (voziček na končni točki)**
(Vir: lastni)




**Slika 4: Primer prikaza meritev prečnega nanosa**
(Vir: Lastni)

Pri pršilnikih se prečnega nanosa ne meri, saj je način delovanja naprave drugačen. Ta ima šobe običajno nameščene na vencu okoli puhala. Delovanje pretoka šob se preveri tako, da se na vsako šobo posebej namesti ustnike (Slika 5), od katerih so speljane cevi, in sicer vsaka v svoj merilni valj. Rezultate se odčita na merilni skali valja.




**Slika 5: Naprava za meritev pretoka šob na pršilnikih**
(Vir: Lastni)

Vse podatke o pregledu se vnaša v spletno aplikacijo, ki jo vodi Uprava Republike Slovenije za varno hrano, veterinarstvo in varstvo rastlin. Na koncu pregleda se lastniku izda potrdilo o pravilnem delovanju (slika 7) ter znak o pregledu, ki se ga namesti na vidno mesto naprave (slika 6).


**Slika 6: Vzorec znaka o pregledu**
(Vir: Pravilnik…, 2019)

| Pregledniк naprav: *(Test station)* | Številka znaka: **20000041** *(Label No.)* |
|---|---|
| **GRM NOVO MESTO - center biotehnike in turizma**<br>Sevno 13,<br>8000 Novo mesto | Prostor za nalepko z zaporedno št. znaka: *(Place for label)* |

**POTRDILO O PRAVILNEM DELOVANJU NAPRAVE ZA NANAŠANJE FFS**
**Certificate for the inspection of pesticide application equipment**

## Podatki o lastniku:
*(Owner`s identity)*

Ime in priimek: [redacted]
*(Name and Surname)*

Naslov, kraj, poštna številka: [redacted]
*(Owner`address)*

## Vrsta naprave:
*(Type of application equipment)*

- ☐ škropilnica *(boom sprayer)*
- ☑ pršilnik *(sprayer)*
- ☐ naprava za zamegljevanje *(logging equipment)*
- ☐ vlagalec granulat *(granular applicator)*
- ☐ naprave za kemično obdelavo semenskega materiala *(seed treatment equipment)*
- ☐ kombinirani vlagalec granulat *(combined granular applicator*
- ☐ naprava za zatiranje rastja na železniških progah *(train-mounted sprayer)*
- ☐ nepremična / polpremična naprav *(fixed and semi-mobile sprayer)*

## Podatki o napravi:
*(Identification of the equipment)*

Izdelovalec: [redacted] D.D. Leto izdelave: **1998**
*(Manufacturer)* *(Year of manufacture)*

Tip: **AGP 400 ENU** Serijska številka: **004521**
*(Type)* *(Serial No.)*

Pogon: **traktorska nošena (tractor-mounted)**
*(Power)*

Datum nakupa – samo za nove naprave: **28.2.2016**
*(Date of purchase–only for new equipment)*

Opomba: **Nova naprava račun št. 444444**
*(Notes)*

## Rezultat pregleda:
*(Conclusions of the inspection)*

Naprava ustrezna: Da ☒ Ne ☐
*(Equipment approved)* *(Yes)* *(No)*

Kraj in datum: **Sevno, 4.3.2016**
*(Place and date)*

Veljavnost znaka: **28.2.2021** Podpis preglednika:
*(Validation of Label)* *(Signature)*

ID zapisa: 100702529 48540C5735C40B4ABA864121BF8B9BD6 Datum izpisa: 28.10.2020 19:32:34

**Slika 7: Vzorec potrdila o pravilnem delovanju naprave**
(Vir: lastni)

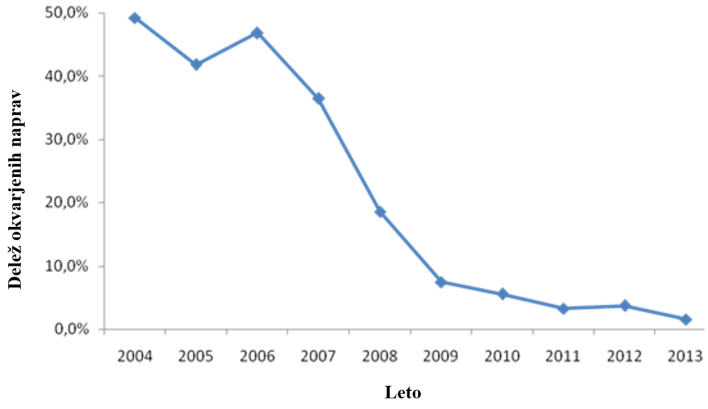
## 3 Raziskava z razpravo

### 3.1 Tehnično stanje naprav v jugovzhodni Sloveniji

Na območju jugovzhodne Slovenije je bila opravljena raziskava o tehničnem stanju naprav za nanos FFS za obdobje od leta 2004 do 2013, kjer so ugotavljali tehnično brezhibnost naprav. Število pregledanih naprav je odvisno od leta pregleda in je prikazano v preglednici (Preglednica 1). Na vsaki napravi so bili pregledani sklopi, kot so pogon, proti kapni ventili, šobe, filtri, cevi, manometri, pipe in zasuni, regulatorji tlaka, mešalo, črpalka, praznjenje, rezervoar ter škropilne letve oziroma puhala pri pršilnikih. Po analizah podatkov je bilo ugotovljeno, da je bilo tehnično stanje naprav v začetnem obdobju zelo slabo (Slika 8), vendar se je do leta 2013 zelo izboljšalo (Bernik in sod., 2017).

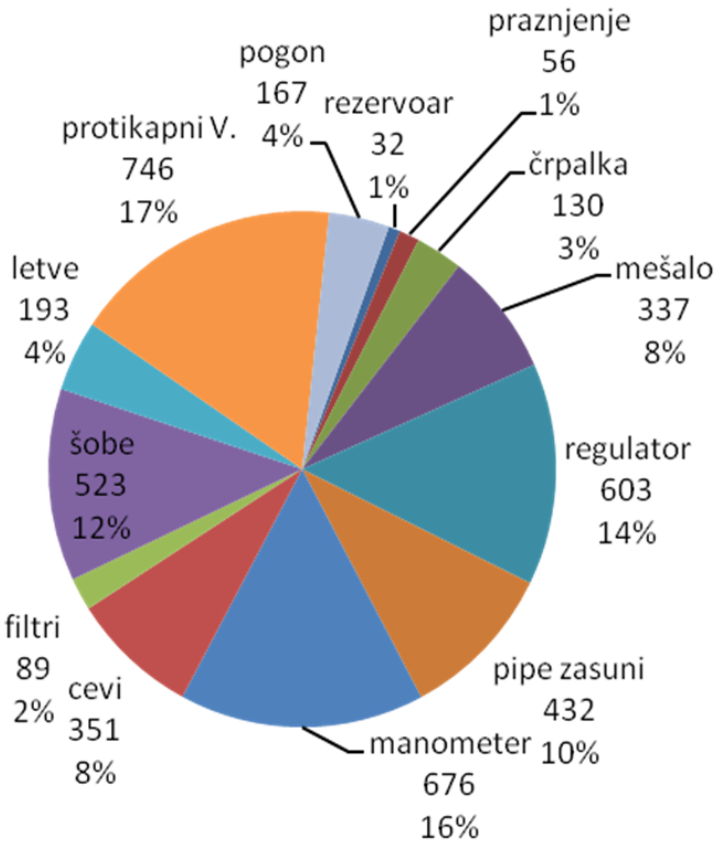
**Preglednica 1: Podatki o pregledanih napravah (škropilnice in pršilniki skupaj) v posameznem letu**
(Bernik in sod., 2017)

| Leto | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|
| Število pregledanih | 1440 | 2037 | 799 | 1419 | 1012 | 2006 | 1013 | 1939 | 1056 | 1823 |
| Št. okvarjenih | 708 | 851 | 374 | 517 | 188 | 150 | 56 | 63 | 39 | 29 |
| Delež okvarjeih | 49.2 % | 41.8 % | 46.8 % | 36.4 % | 18.6 % | 7.5 % | 5.5 % | 3.2 % | 3.7 % | 1.6 % |



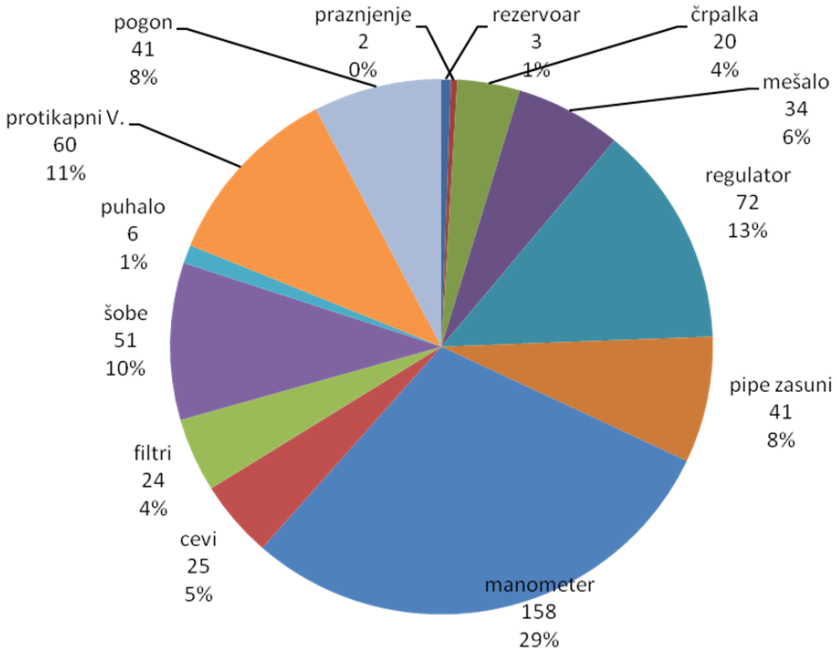

**Slika 8: Delež okvarjenih naprav za obe vrsti naprav v posameznem letu**
(Vir: Bernik in sod., 2017)

Za jugovzhodno Slovenijo je bila narejena tudi raziskava, glede okvarjenosti posameznih sklopov na škropilnicah (slika 9) in pršilnikih (slika 10). Iz grafikonov lahko razberemo, da so pri škropilnicah najpogosteje okvarjeni protikapni ventili, regulatorji tlaka, manometri ter šobe..




**Slika 9: Delež okvar za posamezen sklop škropilnice**
(Vir: Kuhar, 2016)

Podobne napake se pojavljajo pri pršilnikih. Tako lahko iz slike 10 razberemo, da so bili daleč najbolj okvarjeni manometri, regulatorji tlaka, protikapni ventili ter šobe.



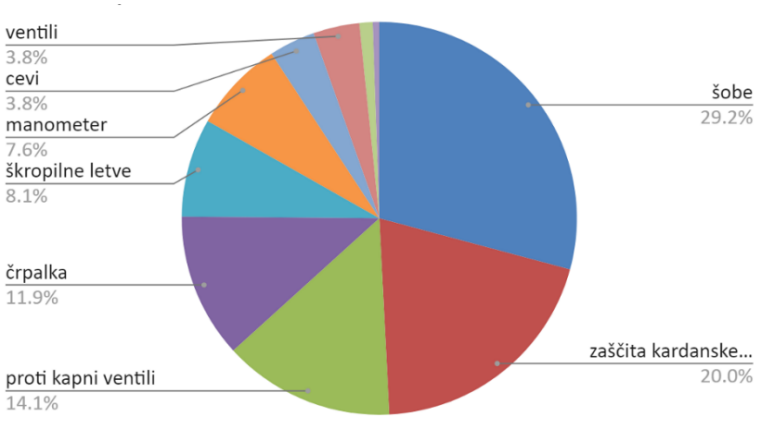

**Slika 10: Delež okvar za posamezen sklop pršilnika**
(Vir: Kuhar, 2016)

## 3.2 Analiza naprav v osrednji Sloveniji

V letu 2019 je pregeldna skupina iz Biotehniške fakultete v Ljubljani opravljala tehnične preglede na območju osrednje Slovenije. V preglednici 2 lahko natančneje vidimo lokacije pregledov ter število in delež okvarjenih naprav za posamezno območje (Novak, 2019). Poleg splošnega stanja so med drugim so opravili analizo okvarjenih sklopov. Na gafikonu (slika 11) lahko vidimo, da so bili najpogosteje okvarjeni sklopi šobe, zaščita kardanske gredi, protikapni ventili ter črpalke.

**Preglednica 2: Podatki o pregledanih napravah v letu 2019**
(Novak, 2019)

| Kraj testiranja | | Brezje | Bled | Kranj | Čadovlje | Lj - Šentvid | Dobrova | Vrhnika | Brezovica pri Borovnici | Logatec | Cerknica |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Brezhibne | Število | 3 | 10 | 5 | 6 | 4 | 7 | 12 | 2 | 3 | 1 |
| | Delež [%] | 37,5 | 71,4 | 45,5 | 54,5 | 36,4 | 63,6 | 52,2 | 25,0 | 42,9 | 25,0 |
| Okvarjene | Število | 5 | 4 | 6 | 5 | 7 | 4 | 11 | 6 | 4 | 3 |
| | Delež [%] | 62,5 | 28,6 | 54,5 | 45,5 | 63,6 | 36,4 | 47,8 | 75,0 | 57,1 | 75,0 |
| Skupaj | Število | 8 | 14 | 11 | 11 | 11 | 11 | 23 | 8 | 7 | 4 |
| | Delež [%] | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |




**Slika 11: Delež okvar po sklopih**
(Vir: Novak, 2019)

## 3.3 Razprava

Analize tehničnega stanja so bile opravljene vsaka v svojem obdobju ter drugem delu Slovenije. Iz vsake raziskave so bili povzeti ključni rezultati, ki nakazujejo, da se okvare na napravah za nanos fitofarmacevtskih sredstev pojavljajo tudi po tem, ko so pregledi že več kot dve desetletji obvezni. Podrobna analiza okvarjenih sklopov (slika 9, 10 in 11) kaže, da so nekateri sklopi bolj podvrženi okvaram. Omenjenim

sklopom je skupno to, da so potrošne narave, kar pomeni, da jih je potrebno menjati ko se obrabijo oziroma kot priporoča proizvajalec.

## 4 Zaključek

Tehnični pregledi naprav za nanos FFS, ki jih pogosto imenujemo kar »testiranje škropilnic«, so velik dejavnik pri zagotavljanju varne oziroma zdrave hrane. Pesticidi so nujno zlo, ki nam olajšajo, velikokrat pa celo omogočajo pridelavo zadostne količine hrane. Ker trenutno še nimamo ustrezne zamenjave za ta način proizvodnje, pa lahko vsaj poskrbimo, da je uporaba pesticidov kvalitetna in kar se da varna. Pesticidi morajo sicer biti pravilno izbrani, uporabljeni ob pravem času in v pravih količinah. Preveč porabljenega pesticida dodatno škodi okolju, s premalo pesticida pa ne dosežemo željenih rezultatov.

Pri vsem tem pomembo vlogo igrajo prav naprave za nanos FFS, zato je prav, da so tehnično brezhibne. Pregledi se izvajajo terensko, kar nam omogoča neposreden stik z uporabniki in tako lahko veliko naredimo na osveščanju. Ugotavljamo lahko, da je Slovenija kar se tiče pregledov v samem evropskem vrhu, saj preglede opravljamo že desetletja, čeprav so bili na začetku neobvezni.

Iz raziskave lahko tudi vidimo doprinos pregledov k mnogo boljšemu stanju naprav.

Kljub vsem tem pregledom, pa se okvare niso odpravile enkrat za vselej, ampak se ponavljajo. Ker so mnogokrat najbolj okvarjeni sklopi, ki so potrošni material, lahko sklepamo, da gre velikokrat za človeški faktor. Določenim okvaram bi se namreč lahko izognili že z rednim vzdrževanjem naprav, vendar se nekateri uporabniki tega ne zavedajo dovolj. V prihodnosti bi morda veljalo delovati tudi na ozaveščanju. Okvare se namreč dogajajo med delom in če niso odpravljene takoj, se lahko naredi veliko škode, predno naprava spet pride na pregled. Za načrtovanje aktivnosti v prihodnje, bi morda veljalo opraviti analizo stanja naprav za celoten slovenski prostor.

**Literatura**

Bernik, R. and Kuhar, P. ( 2017) The analysis of technical suitability of the equipment for application of plant protection products in Southeastern Slovenia, Journal of , Acta agriculturae Slovenica, pp. 337-347

Declercq J.; Nuyttens D. (2012). Inspection method for spray rate controllers in Flanders (Belgium). V: Fourth European workhop on standardised procedure for the inspection of sprayers. Lana (South Tyrol), March 27-29, pp. 117-121

Holownicki R., Doruchowski G., Godyn A., Swiwchowski W. 2004. Obligatory inspection of sprayers in Poland – organisation and first experiences. V: First European workhop on standardised procedure for the inspection of sprayer in europe. Mitteilungen aus der Biologischen Bundesanstalt. Braunschweig, Germany, 27. – 29. apr. 2004. Ganzelmeier H., Wehmann H. J. (ed.). Berlin, Biologischen Bundesanstalt für Land- und Forstwirtschaft Berlin und Braunschweig: 51-56

Kočiš, D (2020) Pregledovanje naprav za nanos fitofarmacevtskih sredstev. [WWW] <URL: http://solarakican.si/index.php/sl/izobrazevanje-odraslih-2 [Accessed 20 October 2020.]

Kuhar, P. (2016). Analiza tehničnega stanja naprav za nanos fitofarmacevtskih sredstev na območju jugovzhodne Slovenije. Magistrska naloga. Biotehniška fakulteta, Univerza v Ljubljani

Nošene traktorske škropilnice. Navodilo za uporabo. Kranj, Agromehanika: 52 str.

Novak, E. (2019). Analiza tehničnega stanja naprav za nanos fitofarmacevtskih sredstev v Sloveniji. Diplomsko delo. Biotehniška fakulteta, Univerza v Ljubljani

Osteroth H. J. 2004. Inspection of sprayers in Germany – results and experience over past decades. V: First European workhop on standardised procedure for the inspection of sprayer in europe. Mitteilungen aus der Biologischen Bundesanstalt. Braunschweig, Germany, 27.–29. apr. 2004. Ganzelmeier H., Wehmann H. J. (ed.). Berlin, Biologischen Bundesanstalt für Land- und Forstwirtschaft Berlin und Braunschweig: 68 -73

Pravilnik o zahtevah glede pravilnega delovanja naprav za nanašanje fitofarmacevtskih sredstev in o pogojih ter načinu izvajanja njihovih pregledov. 2019. Ur. l. RS št. 36/2019

Solanelles, F., Gracia, F., Fillat, A., Camp, F. (2014) Present situation of the inspection of sprayers in use in Spain. Fifth European Workshop on Standardised Procedure for the Inspection of Sprayers in Europe - SPISE 5 - Montpellier, France, October 15-17, pp. 186-190

Zakon o fitofarmacevtskih sredstvih. 2012. Ur. l. RS št. 83/12

Zakon o zdravstvenem varstvu rastlin Ur. L. RS, št. 511- 01/94

# XIV. INTERNATIONAL CONFERENCE ON LOGISTICS IN AGRICULTURE 2020

ANDREJ LISEC (ED.)
University of Maribor, Faculty of Logistics, Celje, Slovenia.
E-mail: andrej.lisec@um.si

**Abstract** The 14th International Conference on Logistics in Agriculture, which has been organized by the Municipality of Sevnica, Grm Novo mesto - Biotechnology and Tourism Center, Faculty of Logistics, University of Maribor, Landscape Governance College GRM and Cooperative Union of Slovenia has this year's central theme the Climate Change in Logistics in Agriculture. The conference has become traditional and pays attention to the ways for different views of logistics in connection with agriculture. That is why we/the organizers have invited lecturers on the topic Impact of climate change in agriculture. This year we will have on line conference due to coronavirus.

**Keywords:** logistics, agriculture, local food, packaging, climate change.

University of Maribor Press

DOI https://doi.org/10.18690/978-961-286-406-4
ISBN 978-961-286-406-4

University of Maribor

Faculty of Logistics

**12th November 2020**
**on-line**
**Slovenia**