

Magdalena DĄBROWSKA • Anetta ZIELIŃSKA •
Grygorii MONASTYRSKYI • Mariola DROZDA

REDUCING FOOD WASTE AS A BASE OF INNOVATIVE LEAN SOCIETY PHILOSOPHY

Magdalena **Dąbrowska** (ORCID: 0000-0002-9305-7123) – *Witelon Collegium State University, Legnica, Poland*

Anetta **Zielińska** (ORCID: 0000-0001-8592-3530) – *Wroclaw University of Economics and Business, Poland*

Grygorii **Monastyrskyi** (ORCID: 0000-0001-6694-1960) – *West Ukrainian National University, Ukraine*

Mariola **Drozda** (ORCID: 0000-0002-8785-8397) – *Complex of Vocational and Comprehensive High Schools of 29th Infantry Regiment of 2nd Polish Army, Poland*

Correspondence address:

Komandorska Street 118/120, 53-345 Wroclaw, Poland

e-mail: anetta.zielinska@ue.wroc.pl

ABSTRACT: Due to the high level of losses and food waste nowadays, the problem become global. The main causes of food loss in households are: exceeding shelf life, excessive purchases, damage and low quality, additionally excessive portions of meals, wrong food storage, the bad taste of the product, lack of idea on how to use available ingredients, as well as reckless purchases, too large packaging. Negative effects of food loss can be grouped into three areas: environmental, economic and social, which are consistent with the basic goals of sustainable development. The aim of this article is to present an original proposal for an approach to Lean Society philosophy with respect to the problem of food loss. The authors reviewed conventional and unconventional methods of food preservation, identification of available and innovative solutions in terms of reducing food loss and indicated directions and opportunities for reducing food loss on the basis of Lean Society philosophy.

KEYWORDS: reducing food waste, Lean Society, conventional and unconventional methods of food preserving, rational food management, prevention

*The entire love of the world will not help
if there is not any food on the table.*

Diane Chamberlain

Introduction

Food is the foundation of human existence and survival. The need to eat always accompanies man at every stage of his/her life and development. Food issues are very important, as indicated by their position in Maslow's hierarchy of needs. Maslow (2004) prioritised the needs and placed the need of eating in the group of physiological needs, which, if not satisfied, will predominate over all other needs and they will determine not only human survival but also his/her behaviour. Apart from food, Maslow (2004) included the need for drinking, breathing, sleeping, avoiding cold and heat or sex to physiological needs. Giving the needs of eating first degree in his hierarchy, he attributed them very important status with regard to human functioning (Forsyth & Tatar, 2004; Maslow, 1990; Miler-Zawodniak, 2012; Stelmach, 2008).

Max-Neef et al. (1991) distinguished nine groups of needs, and they included food to needs of keeping alive, which are first-order needs (Table 1).

Due to high level of losses and food waste nowadays, the problem become global. This phenomenon occurs throughout the food chain, from the production process to the consumption (Marszałek, 2018). Unfortunately there is a lack of harmonised definition of food loss and with respect to this phenomenon the name food waste was applied (Sokołowski, 2020); hence, in 2012 European Parliament (EP) proposed that food loss is „food products discarded from the agri-food chain because of economic or esthetic reasons or close to expiry date, which can be still eaten and can be consumed by people and which because lack of an alternative way of use is intended for destruction and disposal, what causes negative spill-over effects taking into consideration their influence on the environment, economic costs and loss of revenue for businesses” (Resolution, 2012).

There are many sources of food loss. They vary and depend on many factors. The main factors which determine food loss are place in the agri-food chain, the type of industry or the economic situation of the country where the presented phenomenon occurs (Kwasek, 2016).

Table 1. Taxonomy of human needs

The need	Existence, being (qualities)	Possession (things)	Activities (actions)	Environment, system (interactions, communication, cooperation)
Keeping alive, existence	Physical and mental health	Food, shelter, work	Food, dressing, rest, work	Living environment, social, surrounding
Protection, safety	Care, adaptability – ability to adapt, autonomy	Social care, health care, work	Cooperation, planning, taking care over someone, something, help	Social environment, residential environment
Love, devotion	Respect, sense of humour, nobility, generosity, sensuality	Friendship, family, relations to nature	Sharing, caring, loving, expressing emotions	Personal space (intimate), privacy, sense of community
Comprehension, understanding	Ability to think critically, curiosity, intuition	Literature, teaching, politics, education	Analysis, studying, mediation, following	Schools, families, universities, communities
Involvement, participation	Openness, sensitivity, dedication, sense of humour	Responsibility, duties, work, rights	Cooperation, objection, expressing opinions	Associations, parties, churches, neighbourhood
Leisure time, relax	Imagination, calm, spontaneity	Entertainments, meetings, peace of mind	Day-dreaming, remembering, relax, having fun	Landscape, personal spaces (intimate), places of solitary stay
Creativity, creation	Imagination, clarity, invention, curiosity	Skills, abilities, work, techniques, methods of action	Searching, building, designing, work, composing, arrangement, interpreting	Space of the expression, workshops, public meetings
Identity, identification	Sense of belonging, self-esteem, stability	Language, religion, work, customs, values, standards	Self-awareness, development, engaging	Places of our commitment, daily environment, systems
Freedom	Autonomy, passions, self-esteem, lack of prejudices	Equal rights	Various views, risk-taking, development awareness	Everywhere, wherever

Source: authors' work based on Niezabitowska (2017).

It must be clearly stressed that in a globalising world, food adulteration and lack of food authenticity are very common phenomena. This has a direct influence on increasing the amount of food loss because not-authentic food (despite it being produced) is not accepted by consumers (Śmiechowska, 2013).

In the case of industrialised countries, most of the food is wasted at the stages of distribution and consumption, which means the final stages in the agri-food chain. An inverted trend is observed in developing countries where most losses appear at the initial stages of production. It is caused by a lack of advanced agricultural technologies, a lack of effective systems and transport

infrastructure, as well as a lack of solutions which ensure that products can last longer.

Table 2. Negative effects of food loss

The area of negative effects of food loss		
Environmental	Economic	Social
Vainuse of water	Increase in global costs	Objectives in achieving food security in starving world regions
Vainuse of soil	Cumulative costs on the entire length of food chain	Unethical practices
Vainuse of energy	Losses incurred by all supply chain operators	People's malnutrition
Vainuse of packages	Lack of possibility of introducing food marketing because of its low quality	Increased number of malnourished people
Vain use of other resources and materials used for food production and distribution and disposal of unsold products	Decrising economic value of the products	Lack of access to food for many people
Global warming	Financial losses	Increased consumption
Emission of methane	Additional costs in relations to treatment of wasted food	Lack of confidence in security of food supply
The need to manage greater mass of organic and inorganic waste	Increased investment connected with employment of people, purchase of raw materials, maintaining systems providing health security as well as maintenance of machinery equipment	
	Increasing food costs	
	Increase in the price of foodstuffs	
	Rise in the cost of production	

Source: authors' work based on Dąbrowska & Janoś-Kresło (2013); Marszałek (2018); Michalczyk & Michalczyk (2019); Sokołowski (2020); Zabłocka et al. (2016).

Taking into consideration the food industry, the causes of food loss are inadequate marketing strategy, inappropriate stock management, the inadequate target group of the product, and large-scale food disposal (Marszałek, 2018). The main causes of food loss in households are exceeding shelf life, excessive purchases, damage and low quality (Bilska et al., 2015), additionally excessive portions of meals, wrong food storage, the bad taste of the

product, lack of idea on how to use available ingredients (Mitka, 2020) as well as reckless purchases, too large packaging (Niedek & Krajewski, 2021).

Negative effects of food loss can be grouped into three areas: environmental, economic and social, which are consistent with the basic goals of sustainable development¹ (Table 2).

This article aims to present an original proposal for an approach to Lean Society philosophy with respect to the problem of food loss. The authors reviewed conventional and unconventional methods of food preservation, identification of available and innovative solutions in terms of reducing food loss and indicated directions and opportunities for reducing food loss on the basis of Lean Society philosophy.

Legislative aspects which protect food from wastage – Polish conditions

The problem of legal issues which protect food from wastage was undertaken in many publications (e.g. Leśkiewicz, 2015; Sokołowski, 2020).

Act of 19 July 2019 on preventing food waste is an important document in Polish legislation. It implemented principles concerning dealing with food and obligations for food traders and non-governmental organisations. The aim of the act was to support charitable activities by reducing the throwing of food away and its donation to people in need.

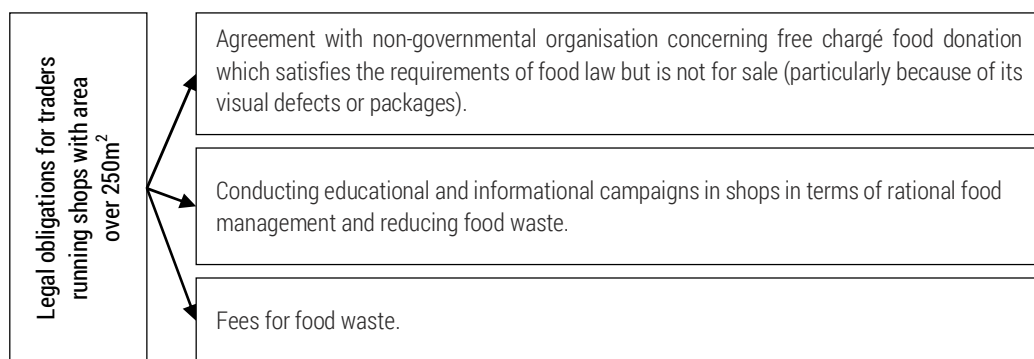


Figure 1. Legal obligations for traders running shops with area over 250 m²

Source: authors' work based on Act (2019).

¹ The areas of sustainable development were presented in: Borys (2005); Borys (2011); Burchard-Dziubińska et al. (2014); Ciarko & Paluch-Dybek (2014); Czaja & Fiedor (2010); Gupta & Vegelin (2016); Matuszczak (2009); Papuziński (2007); Rogall (2010); Skowroński (2006); Sztumski (2006).

In light of this act, obligations have been imposed on traders who run a shop with the area over 250 m² (earlier 400 m²) (Act, 2019) (Figure 1).

It must be stressed that the act imposes obligations only on distribution business operators and does not include all parts of the food chain. The act omits the issue of food donation for non-food purposes and food which is still safe for human consumption after the date of minimum durability. It must be marked that the food loss problem should be solved in a comprehensive way, and hence implemented legal instruments cannot be limited only to distribution (Sokołowski, 2020).

Conventional and unconventional methods of food preservation

Food preservation is an action whose aim is to stop the process of food spoilage (Baryłko-Pikielna, 1995). These are also activities aimed at protecting against spoilage and delay and stopping processes which reduce food quality (Wielgosik, 2020). Very important aspect of food preservation is to extend the shelf life of food by preserving certain quality characteristics (Harasym et al., 2016).

The development of methods of food preservation corresponds with civilisation and technological progress. The necessity of food preservation is also connected with an increasing number of people on Earth who have to satisfy their needs in terms of eating. There is a huge problem due to the delivery of fresh, healthy and proper amounts of food to societies. It results from different aerodynamic conditions in different parts of the world, mainly short-term harvesting and rapid population growth in cities far away from centres of agricultural production (Molenda, 2007).

The growth of human activity has forced a greater need for food which is safe and available, allowing prepare meals in an easy way at any time and in every situation. These contributed to searching such methods of processing and preserving food products which will result in easy, fast use and preparing products (Kowalczyk, 2004). Convenience food is widely defined, but the common element which connects all definitions presented in the literature on this subject is a minimal time of meal preparation² (Babicz-Zielińska et al., 2010). An approach to a matter of convenience of food is connected with methods of its preservation. Evolutionarily there are three generations which refer to methods of food preservation in terms of convenience food (Table 3).

² Examples of convenience food definitions were presented in: Gawęcki (2002); Gawęcki & Mossor-Pietraszewska (2008); Górską-Warsewicz (2007); Janicki (1993); Janicki (2006); Świdorski (2006).

Table 3. Food preservation and generations of convenience food

Generation	Methods of food preservation	Examples
I – first	Traditional methods: - drying, - freezing, - sterilisation, - pasteurisation.	- bread, - dried fruit, - dried vegetables, - dried meat, - dried fish, - traditional sterilised tinned meat, - traditional pasteurised tinned meat.
II – second	-microwave heating, -aseptic production, -vacuum packaging, - Modified Atmosphere Packaging.	- ready-to-eat dinners, -sterilised meals, - pasteurised meals, - frozen meals, - chilled meals, - meals intended to microwaving, - concentrates of soups, - concentrates of juice, - concentrates of desserts and cakes, - breakfast cereals.
III – third	Combined methods (use of few preserving agents at the same time): - sous-vide, - cook-chill, - non-thermal processing methods, - edible casings, - natural inhibitory substances or antimicrobial substances, -sustainable packaging, - natural and biological active substances.	

Source: authors' work based on Adamczyk (2010).

Table 4 presents conventional methods of food preservation, and Table 5 presents unconventional methods of food preservation.

Table 4. Conventional methods of food preservation

GROUP OF METHODS	METHOD	APPLICATION
PHYSICAL		
THERMAL METHODS	1. High temperatures	
	a) pasteurisation	destruction of pathogenic microorganisms and inactivation of vegetative forms of other microorganisms
	b) scalding	deactivation of tissue enzymes cleaning of raw material and reduction of microbiological contamination improvement of food structure especially further dehydrated
	c) sterilisation	removal or killing allmicrobes from the given environment, also spores,
	d) tyndallization (fractionated pasteurisation)	microbiological stability of fixed product in proces of production of tinned food, which extends food life for a year and milk for few weeks
	e) apertisation	for tinned food and „wek“ jar containers
	f) thermisation	extending food sustainability
	2. Low temperatures	
	g) cooling	reducing speed of chemical reactions extending shelf life for raw materials, by-products and food products for further processing or eating
	h) freezing	inhibiting the development of microorganisms and activity of tissue enzymes
PROTECTIVE GASES	1. Nitrogen	propellant, for example in containers with whipped cream
	2. Argon	protection against oxidation
	3. Carbon dioxide	fizzydrinks drinking water purification dryice – cooling agent coolant
REDUCTION OF WATER ACTIVITY	1. Water removal	
	a) densification (concentration)	concentration of components of dry matter in smaller mass of product
	• equilibrium methods	
	– evaporation	used in production of juice, puree, fruit and vegetable, pulp, jam, jelly, milk
	– cryoconcentration	
	• nonequilibrium methods (osmoactive)	inactivation of microorganisms by adding to food substances which increase osmotic pressure
	– osmosis	
	– dialysis	
– reverse osmosis		

GROUP OF METHODS	METHOD	APPLICATION
REDUCTION OF WATER ACTIVITY	b) drying	reduction of the water phase in raw material stopping of enzymatic and life processes of microorganisms
	• contact drying	
	• convection drying	
	• radiant drying	
	• fluidised drying	the method is used to dry for example pea, rape, bean, cereals or berries and this process is very fast
	• drying by the use of microwaves	
PRESERVATION BY THE USE OF CHEMICAL PRESERVATIVES	2. Osmotic substances	these include: sugar (sucrose), glucose, starch, corn syrup, glycerol, salt
	1. Marination	fixation in vinegar marinade with addition of aromatic spices, salt and sugar
PRESERVATION BY THE USE OF ORGANIC ACIDS	2. Preservation	inhibits the growth of bacteria, yeasts and mould inhibits development or destruction of microorganisms extending shelf life of food products preventing qualitative changes of products
	1. Acetic fermentation	inhibition of respiration in tissues, enzymatic, oxidative tissue processes which cause for example vitamin C oxidation or darkening of the surfaces reduction of softening and destruction of tissues and avoiding undesired changes in flavour and smell
	2. Lactic fermentation (lactate) – anaerobic glycolysis	inhibition of respiration in tissues, enzymatic, oxidative tissue processes which cause for example vitamin C oxidation or darkening of the surfaces reduction of softening and destruction of tissues and avoiding undesired changes in flavour and smell
PRESERVATION BY THE USE OF INORGANIC ACIDS	3. Marination	preservation in vinegar marinade with addition of aromatic spices, salt and sugar
	1. Acidification	preservation of different cool drinks, still and fizzy drinks
SMOKING, CURING	1. Smoking	
	a) cold smoking (temperature of the smoke approximately 22°C)	smoking of sausages, ham, preparing of cured cold smoked meat
	b) warm smoking (temperature of the smoke 25-45°C)	smoking sausages

GROUP OF METODS	METHOD	APPLICATION
SMOKING, CURING	c) hot smoking (temperature of the smoke 40-80 °C)	smoking of steamedham
	d) baking (temperature of the smoke 75-90 °C)	
	Curing	
	• drycuring	
	• wet curing (immersion curing)	
	• injected curing	
BIOLOGICAL		
LACTIC ACID FERMENTATION		<ul style="list-style-type: none"> - pickling cucumbers, cabbage, beetroots, olives, - in dairy industry for producing fermented and dietary dairy drinks (yoghurt, kefir, sour milk, buttermilk, cream) - producing curd, matured cheese, casein, lactose - in meat industry - in baking industry
ALCOHOLIC FERMENTATION		
ACIDIFICATION (AEROBIC)		<ul style="list-style-type: none"> - preservation of food product - enhancing organoleptic characteristics of food products - improving pro-health properties - receiving new chemical compounds and food products by the use of biological methods
PROPIONIC FERMENTATION	Maturing of renet cheese	<ul style="list-style-type: none"> - food additive in baking, confectionery - storage of cereals and forage
PICKLING		<ul style="list-style-type: none"> - pickling cucumbers, white and red cabbages, beetroots - silage for animals (forage)

Source: authors' work based on Krzysztofik et al. (2015).

Table 5. Unconventional methods of food preservation

METHOD	APPLICATION
IONIZING RADIATION	<ul style="list-style-type: none"> - sprouting inhibition in potatoes - preservation of onion - radiation disinfection of consumption grain and drying fodder - radiation preservation - destroying parasites in raw materials and food products - killing encysted larvae
NUCLEAR RADIATION	<ul style="list-style-type: none"> - reduction of microorganisms and their sporulated forms in food products - preventing of plant germination - extending of storage period - extending of period of fruit storage - extending of maturation period - preventing of development of fruit flies
ULTRAVIOLET RADIATION	<ul style="list-style-type: none"> - bactericidal activity - antiseptic effects - therapeutic effects - destruction of microflora on surfaces of meat and fish, spices, sugar used in preserved products, fruit - preventing cheese mould - sterilisation of water
SOUND AND ULTRASOUND VIBRATIONS	<ul style="list-style-type: none"> - destroying of microorganisms
PULSATING MAGNETIC FIELD	<ul style="list-style-type: none"> - preservation of food products
PULSATING ELECTRIC FIELD (PPE)	<ul style="list-style-type: none"> - processing of frozen products and food additives
PULSE LIGHT	<ul style="list-style-type: none"> - reduction of microorganisms on the Surface of meat, fish and bread - disinfection of packaging
HIGH PRESSURE	<ul style="list-style-type: none"> - keeping the level of vitamins and food colours - reduction of microorganisms or enzymes which reduce shelf life because of spoil
PULSE MICROWAVE FIELD	<ul style="list-style-type: none"> - fast heating of food without much water that limits loss of nutrients comparing to other cooking methods
USE OF ANTIBIOTICS	<ul style="list-style-type: none"> - prevention of development of pathogenic bacteria - reduction the amount of used chemical preservatives
ASEPTIC PACKAGING TECHNOLOGIES	
RESISTANCE WELDING	<ul style="list-style-type: none"> - minimising the risk of too long heat treating - minimising the risk of potential loss of nutritional characteristics
FILTRATION	
CENTRIFUGING (BACTOFUGATION)	<ul style="list-style-type: none"> - removing microorganisms - milk purification - separation and concentration of bacterial suspension of different origin
LESS AGGRESSIVE OR NEUTRAL PRESERVATIVES	<ul style="list-style-type: none"> - reduction of development of microorganisms and enhancing microbiological stability of the product - extending shelf life of the product

Source: authors' work based on Krzysztofik et al. (2015).

Identification of available and innovative solutions in terms of reduction of food loss

The phenomenon of food loss is an important problem and hence American Environmental Protection Agency has developed hierarchy of prevention of food loss. Reduction of losses and wasting at their roots are priorities. Next levels are: donating food to people in need, animal feed, industrial use, composting, and at the end storage and incineration (Kołożyn-Krajewska et al., 2016) (Figure 2).

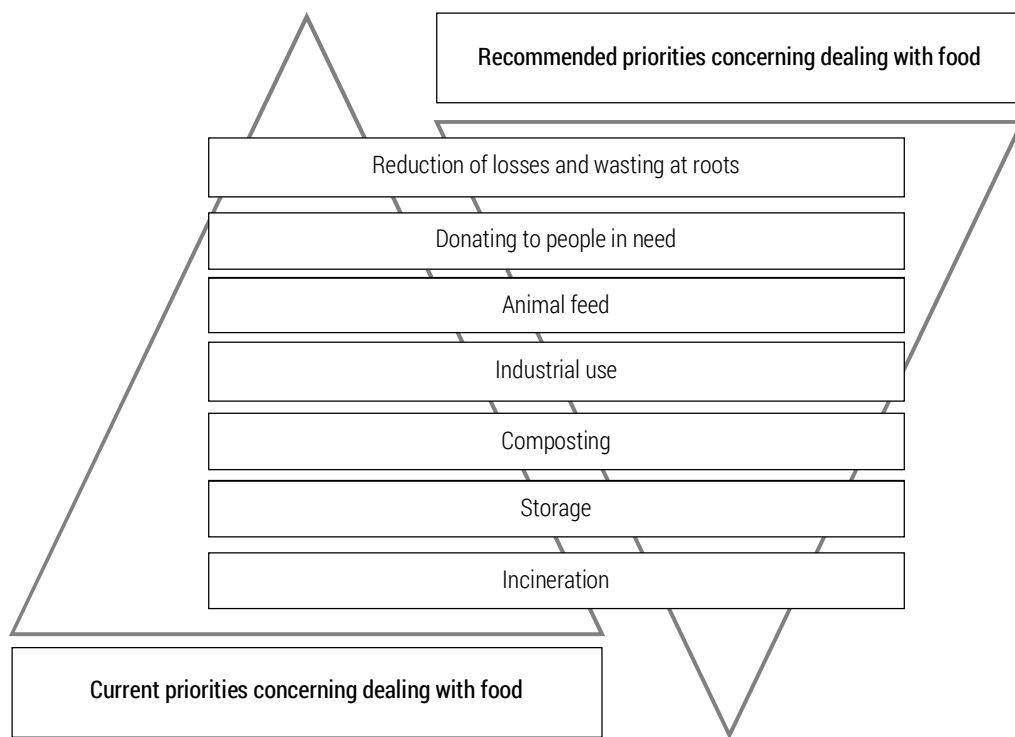


Figure 2. Current and recommended priorities concerning dealing with food

Source: authors' work based on Kołożyn-Krajewska et al. (2016).

Current solutions related to reduction of food loss can be placed in three groups of solutions: organisational, social and technical-technological (Table 6).

Table 6. Available solutions in terms of reduction of food loss

Group of solutions	Area of solutions	Examples of activities
Organisational	Legislative regulations	Regulation of the European Commission 1221/2008 – withdrawal of restrictive requirements concerning shape and size of vegetables and fruit
	Government policy	Legislation concerning necessity of segregation of wasted food (Ireland)
	Improvement of food logistics	Cooperative frames for improving supply chain (Netherlands) „Ale carte” menu (Denmark)
	Redistribution of food	Food banks Approved food (Great Britain) Buon Samaritano (Italy) Fare Share (Great Britain)
Social	Lifestyles	Foodsharing Freeganism Cocooning Smart shopping Anti-consumptionism Ecoconsumption
	Social campaigns	Love Food Hate Waste (Great Britain)
	Education, training	The art. Of not wasting (Lidl)
	Awareness	The awareness of food losses in Eurest (Sweden)
	Research projects	MOST (Poland)
Technical-technological	Mobile applications	Fooders Too Good To Go OLIO Food Rescue US Share Food43 Karma App

Source: authors' work based on Kołożyn-Krajewska et al. (2016); Kozłowski & Rutkowska (2018); Sieniecka & Kozłowska (2022).

According to the authors, the area of solutions, together with examples of actions, do not fully exhaust possibilities for the reduction of food loss. In the further part of the article, original proposals which enable a significant reduction of the amount of wasted food will be presented.

Food is an area of interest in the innovative Lean Society Philosophy

Presentation of the original definition of innovative philosophy, which is that Lean Society is: the philosophy of management of modern societies which steams from sustainable development principles and existing concepts of effective use of resources which was extended to the idea of lean thinking, eco-design, the real determination of actual needs by the support of government and society, as well as education of society, are starting point for deliberations (Dąbrowska et al., 2022).

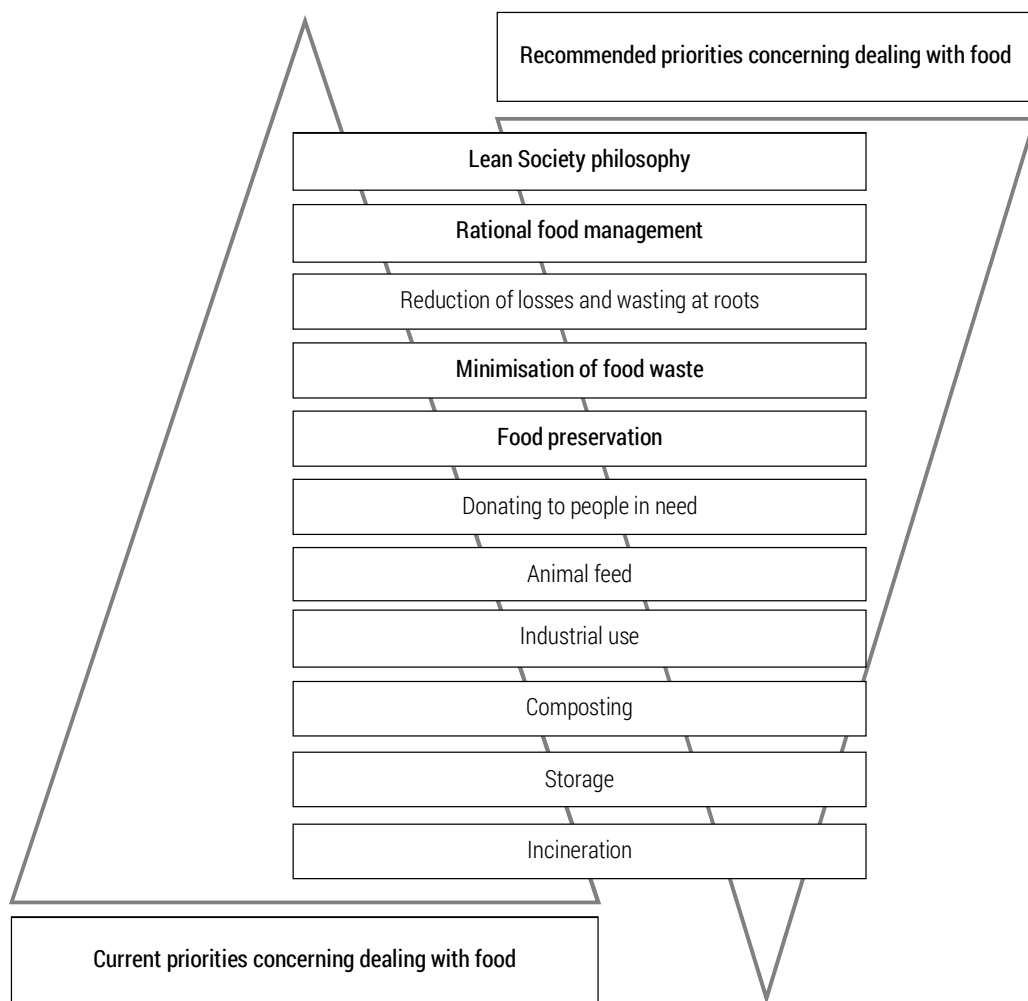


Figure 3. System actions aimed at dealing with food

With respect to Figure 2, recommended priorities concerning dealing with food should be extended to the following four activities (levels). These include food preservation, reduction of food loss, rational food management and Lean Society philosophy (Figure 3). Taking into consideration above mentioned conditions, there are postulated rules and example activities concerning rational food management, which in terms of the innovative concept of Lean Society, will reduce food loss (Figure 4, Table 7).

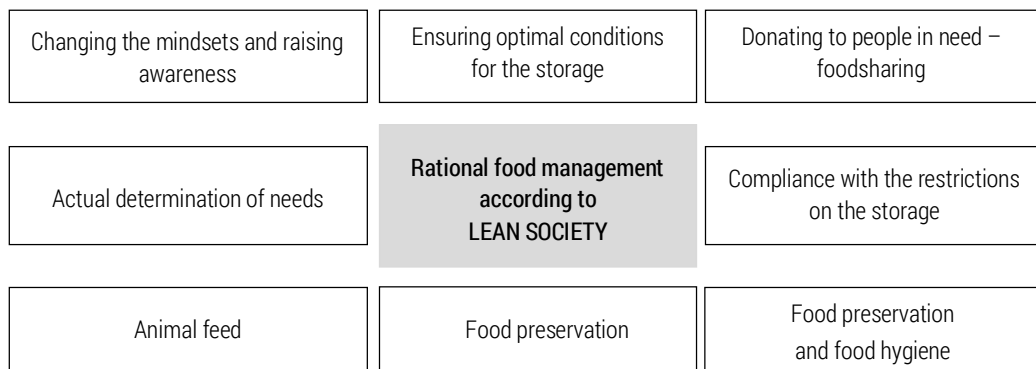


Figure 4. Rational food management according to the assumption of Lean Society Philosophy

Table 7. Supportive activities of rational food management

Principle	Activity
Changing the mindsets and rising awareness	-social campaigns, - education, - creative cooking.
Actual determination of needs	- creating shopping list, - using mobile applications, - checking of content of the fridge and pantry.
Animal feed	- feeding the birds, fish, - donating food to animal shelters.
Ensuring optimal conditions for the storage	-avoiding mistakes connected with food storage, e.g. storage of bananas next to apples, - delaying ripening, e.g. wrapping endings of bananas in cling film, - planning of arrangement of stored products, - ensuring proper storage temperature.
Food preservation	- use of conventional and unconventional methods of food preservation.
Donating to people in need – food sharing	-social fridges, - eating places.

Principle	Activity
Compliance with the restrictions of the storage	- 7P rule (store safe, go-over, put off, rethink, recycle, tidy up, pass down), -reading of labels.
Food preservation and food hygiene	- use of vacuum containers, - use of closed containers, - proper place for food storage, for example do not put raw meat on the top shelf of the fridge, - separation of raw food from cooked food, - dividing leftovers into smaller portion.

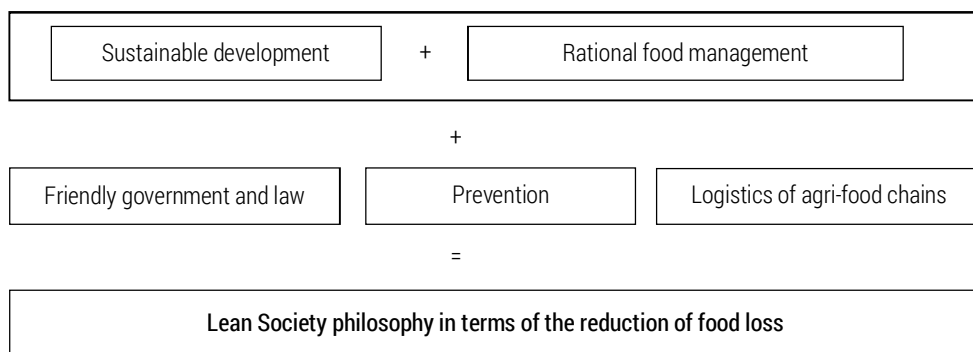


Figure 5. Pillars of Lean Society philosophy with regard to the reduction of food loss

Table 8. Proposals for actions reducing food loss with respect to pillars of Lean Society Philosophy

Pillars	Examples of activities
Sustainable development	- increase in use of biomass, - global assessment of the scale of the problem.
Rational food management	-avoiding excessive purchase and stockpiling, - reuse of safe food (freeganism), - recovery of food resources for production of animal feed.
Friendly government and law	- support in donation of unsold food as gifts to charitable bodies.
Prevention	- ongoing monitoring of situation and constant collection and analysis of data in order to better understanding of the causes of the problem and comprehensive solutions, - promoting education by e.g. social campaigns.
Logistics of agri-food chains	- promoting cross-sectoral cooperation, -commonality of agricultural policy, -strict rules for food segregation.

The objective of developing the assumption of the initial concept of Lean Society when it comes to the reduction of food loss was the concept of sustainable development and activity in terms of rational food management. However, it should be noted that the comprehensive approach of the Lean Society philosophy in terms of reduction of food loss requires additional support in three areas. There are friendly government and law, prevention and logistics of agri-food chains (Figure 5, Table 8).

Conclusions

The problem of food loss is global and should not be solved, taking into consideration only its country or origin scale. Struggle with food loss is one of the main challenges to the modern world economy. Current activities undertaken by global and European bodies are focused on the preparation of documentation and not on designing effective systematic solutions, which will unify activities aimed at implementing real practices. It must be noted that attempts to address the issue very often are initiated by individuals or social groups and sometimes are connected with a choice of particular lifestyle (freeganism, foodsharing, smart shopping).

The aim of this article was to present the original approach to Lean Society philosophy in relation to the problem of food waste. This objective was taken by:

- presentation of the original definition of Lean Society philosophy,
- innovative approach to systematic actions in dealing with food, taking into account systemic activities in the field of food preservation, minimising food waste, rational food management and the innovative lean society philosophy,
- indication of actions which support rational food management concerning organisational, social as well as technical and technological aspects,
- identification of pillars of Lean Society philosophy in terms of the reduction of food waste and,
- proposal of actions reducing food waste with regard to pillars of the innovative concept of lean society about sustainable development, rational food management, friendly state and law, preventive measures and logistics of agri-food chains.

The contribution of the authors

Magdalena Dąbrowska – 25%, Anetta Zielińska – 25%, Grygorii Monastyrskyi – 25%, Mariola Drozda – 25%.

References

- Act of 19 July 2019. On counteracting food waste. Journal of Laws, item 1680, as amended.
- Adamczyk, G. (2010). Popularność "żywności wygodnej". Journal of Agribusiness and Rural Development, 04(18), 5-13. (in Polish).
- Babiczk-Zielińska, E., Jeżewska-Zychowicz, M., & Laskowski, W. (2010). Postawy i zachowania konsumentów w stosunku do żywności wygodnej. *Żywność Nauka Technologia Jakość*, 17(4), 141-153. (in Polish).
- Baryłko-Pikielna, N. (1995). Konsument a jakość żywności. *Żywność. Technologia. Jakość*, 4(5), 3-10. (in Polish).
- Bilska, B., Grzesińska, W., Tomaszewska, M., & Rudziński, M. (2015). Marnotrawstwo żywności jako przykład nieefektywnego zarządzania w gospodarstwach domowych. *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, 17(4), 39-43. (in Polish).
- Borys, T. (2011). Zrównoważony rozwój – jak rozpoznać ład zintegrowany. *Problemy ekorozwoju*, 6(2), 75-81. (in Polish).
- Borys, T. (Ed.). (2005). *Wskaźniki zrównoważonego rozwoju*. Warszawa-Białystok: Wydawnictwo Ekonomia i Środowisko. (in Polish).
- Burchard-Dziubińska, M., Rzeńca, A., & Drzazga, D. (2014). *Zrównoważony rozwój – naturalny wybór*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego. (in Polish).
- BZSOS. (2016). *Marnowanie jedzenia to śmierdząca sprawa*. https://bzsos.pl/wp-content/uploads/2016/10/Raport-Nie-marnuj-jedzenia-2016_-cz%C4%99%C5%9B%C4%87-1-.pdf (in Polish).
- Ciarko, M., & Paluch-Dybek, A. (2014). Ład ekonomiczny, środowiskowy oraz społeczny triadą zrównoważonego rozwoju. *Współczesne Problemy Ekonomiczne*, 9, 16-27. (in Polish).
- Czaja, S., & Fiedor, B. (2010). Ekonomia środowiska i ekologiczna jako filary ekonomii zrównoważonego rozwoju. In B. Poskrobko (Ed.), *Ekonomia zrównoważonego rozwoju* (pp. 30-53). Białystok: Wyższa Szkoła Ekonomiczna. (in Polish).
- Dąbrowska, A., & Janoś-Kresto, M. (2013). Marnowanie żywności jako problem społeczny. *Handel wewnętrzny*, 4(345), 14-26. (in Polish).
- Dąbrowska, M., Drozda, M., Monastyrski, G., & Zielińska, A. (2022). Lean society jako innowacyjna filozofia zarządzania współczesnymi społecznościami. In J. Lewandowska-Bratek, R. Gnitecka & B. Wątopek (Eds.), *Smart Economy* (pp. 29-53). Poznań: Wydawnictwo PTE. (in Polish).
- European Parliament Resolution of 19 January 2012 on how to avoid food wastage: strategies for a more efficient food chain in the EU, Pub. L. No. 52012IP0014, 227E OJ C (2012). <https://eur-lex.europa.eu/legal-content/PL/ALL/?uri=CELEX%3A52012IP0014>
- FAO, IFAD, & WFP. (2013). *The State of Food Insecurity in the World 2013. The multiple dimensions of food security*. <http://www.fao.org/docrep/018/i3434e/i3434e.pdf>
- FAO. (2011). *Global food losses and food waste. Extent, causes and prevention*. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- Forsyth, P., & Tatar, K. (2004). *Jak motywować ludzi*. Gliwice: Wydawnictwo Helion. (in Polish).

- Fung, F., Wang, H. S., & Menon, S. (2018). Food safety in the 21st century. *Biomedical Journal*, 41(2), 88-95. <https://doi.org/10.1016/j.bj.2018.03.003>
- Gawęcki, J. (2002). Żywność nowej generacji a racjonalne żywienie. *Żywność Nauka Technologia Jakość*, 4(33), 5-15.
- Gawęcki, J., & Mossor-Pietraszewska, T. (Eds.). (2008). *Kompendium wiedzy o żywności, żywieniu i zdrowiu: praca zbiorowa*. Warszawa: Wydawnictwo Naukowe PWN. (in Polish).
- Górska-Warsewicz, H. (2007). Żywność wygodna w sektorze mięsnym. *Przemysł Spożywczy*, 7, 36-38. (in Polish).
- Gupta, J., & Vegelin, C. (2016). Sustainable development goals and inclusive development. *International Environmental Agreements: Politics, Law and Economics*, 16(3), 433-448. <https://doi.org/10.1007/s10784-016-9323-z>
- Harasym, J., Bogacz-Radomska, L., & Olędzki, R. (2016). Postęp cywilizacyjny w produkcji żywności – od żywności tradycyjnej do żywności funkcjonalnej. In M. Maciąg & F. Palakowski (Eds.), *Postęp cywilizacyjny – stan obecny i perspektywy* (pp. 106-129). Lublin: Wydawnictwo Naukowe TYGIEL. (in Polish).
- Janicki, A. (1993). Żywność wygodna; definicje i etapy rozwoju. *Przemysł Spożywczy*, 9, 227-230. (in Polish).
- Janicki, A. (2006). Żywność wygodna. In F. Świdorski (Ed.), *Żywność wygodna i żywność funkcjonalna: praca zbiorowa* (pp. 30-35). Warszawa: Wydawnictwa Naukowo-Techniczne. (in Polish).
- Kołożyn-Krajewska, D., Bilska, B., Krajewski, K., Wrzosek, M., & Trafiałek, J. (2016). Projekt MOST jako innowacyjne rozwiązanie dla zakładów produkcji i dystrybucji żywności. In T. Tarko, I. Drożdż, D. Najgebauer-Lejko & A. Duda-Chodak (Eds.), *Innowacyjne Rozwiązania w Technologii Żywności i Żywieniu Człowieka* (pp. 185-194). Kraków: Polskie Towarzystwo Technologów Żywności. (in Polish).
- Kowalczyk, I. (2004). Uwarunkowania konsumpcji koncentratów spożywczych. *Acta Scientiarum Polonorum Technologia Alimentaria*, 3(1), 187-198. (in Polish).
- Kozłowski, W., & Rutkowska, A. (2018). Megatrendy w konsumpcji żywności a marketing społecznie zaangażowany. *Handel Wewnętrzny*, 2(373), 261-269. (in Polish).
- Kraciuk, J. (2015). Bezpieczeństwo żywnościowe z perspektywy krajów słabo i wysoko rozwiniętych. *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, 17(3), 205-209. (in Polish).
- Kraciuk, J. (2016). Bezpieczeństwo żywnościowe w procesie globalizacji sektora rolnego. *Journal of Modern Science*, 1(28), 251-262. (in Polish).
- Kraciuk, J. (2017). Bezpieczeństwo żywnościowe krajów Unii Europejskiej. *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, 19(3), 150-155. (in Polish).
- Kraciuk, J. (2018). Bezpieczeństwo żywnościowe Polski na tle wybranych krajów Europy Wschodniej. *Zeszyty Naukowe SGGW: Ekonomika i Organizacja Gospodarki Żywnościowej*, (121), 41-53. (in Polish).
- Krzysztofik, B., Dróżdż, T., Sobol, Z., Nawara, P., & Wrona, P. (2015). *Metody zabezpieczenia i utrwalania surowców oraz produktów żywnościowych*. Kraków: Polskie Towarzystwo Inżynierii Rolniczej. (in Polish).
- Kwasek, M. (Ed.). (2016). *Z badań nad rolnictwem społecznie zrównoważonym. Analiza strat i marnotrawstwa żywności na świecie i w Polsce*. Warszawa: Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej-Państwowy Instytut Badawczy. (in Polish).

- Leśkiewicz, K. (2012). Bezpieczeństwo żywnościowe i bezpieczeństwo żywności- aspekty prawne. *Przegląd Prawa Rolnego*, 1(10), 179-198. (in Polish).
- Leśkiewicz, K. (2015). Prawne aspekty przeciwdziałania marnowaniu żywności. *Przegląd Prawa Rolnego*, 2(17), 119-133. (in Polish).
- Marszałek, A. (2018). Czy możliwe jest przezwyciężenie problemu marnotrawstwa żywności? *Nierówności Społeczne a Wzrost Gospodarczy*, 54(2), 474-485. (in Polish).
- Maslow, A. (1990). *Motywacja i osobowość*. Warszawa: PAX. (in Polish).
- Maslow, A. (2004). *W stronę psychologii istnienia*. Warszawa: Dom Wydawniczy Rebis. (in Polish).
- Matuszczak, A. (2009). Koncepcja zrównoważonego rozwoju w obszarze ekonomicznym, środowiskowym i społecznym. *Roczniki Ekonomiczne Kujawsko-Pomorskiej Szkoły Wyższej w Bydgoszczy*, 2, 125-141. (in Polish).
- Max-Neef, M., Elizalde, A., & Hopenhayn, M. (1991). *Human Scale Development. Conception, Application and Father Reflections*. London – New York: The Apex Press.
- Michalczyk, J. (2012). Bezpieczeństwo żywnościowe w obliczu globalizacji. *Ekonomia/Economics*, 18, 9-23. (in Polish).
- Michalczyk, J., & Michalczyk, W. (2019). Problem marnotrawstwa i strat wobec zachowania bezpieczeństwa żywnościowego w ujęciu międzynarodowym. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 63(3), 50-69. (in Polish).
- Miler-Zawodniak, A. (2012). Teorie potrzeb jako współczesne teorie motywacji. *Obronność. Zeszyty Naukowe Wydziału Zarządzania i Dowodzenia Akademii Obrony Narodowej*, 4, 101-116. (in Polish).
- Mitka, M. (2020). Marnowanie żywności w gospodarstwach domowych w Polsce. *Problems of Economics and Law*, 4(1), 1-14. (in Polish).
- Molenda, J. (2007). Wybrane niekonwencjonalne metody utrwalania żywności. *Medycyna Weterynaryjna*, 63(9), 1016-1020. (in Polish).
- Motarjemi, Y., Moy, G., & Todd, E. (Eds.). (2014). *Encyclopedia of food safety*. San Diego: Academic Press.
- Niedek, M., & Krajewski, K. (2021). Problematyka marnowania żywności w Polsce a kształtowanie wzorca zrównoważonej konsumpcji. *Studia Ecologiae et Bioethicae*, 19(2), 17-28. (in Polish).
- Niezabitowska, E. D. (2017). Architektura-podejście naukowe. *Builder*, 234(1), 30-31. (in Polish).
- Papuziński, A. (2007). Filozofia zrównoważonego rozwoju jako subdyscyplina badań filozoficznych. *Problemy ekorozwoju*, 2(2), 27-40. (in Polish).
- Rogall, H. (2010). *Ekonomia zrównoważonego rozwoju. Teoria i praktyka*. Poznań: Zysk i S-ka. (in Polish).
- Schmidt, R. H., & Rodrick, G. E. (2003). *Food safety handbook*. New Jersey: John Wiley & Sons.
- Sienicka, M., & Kozłowska, J. (2022). Sharing economy oraz foodsharing w nowoczesnych rozwiązaniach technologicznych. *Academy of Management – Akademia Zarządzania*, 6(1), 163-181. (in Polish).
- Sitarz, S., & Janczar-Smuga, M. (2012). Współczesne zagrożenia bezpieczeństwa żywności, możliwości ich kontroli oraz eliminacji. *Nauki Inżynierskie i Technologies/Engineering Sciences & Technologies*, 2(5), 68-93. (in Polish).
- Skowroński, A. (2006). Zrównoważony rozwój perspektywą dalszego postępu cywilizacyjnego. *Problemy ekorozwoju*, 1(2), 47-57. (in Polish).

- Sokołowski, Ł. M. (2020). O potrzebie całościowej regulacji prawnej przeciwdziałania marnowaniu żywności. *Przegląd Prawa Rolnego*, 1(24), 53-69. (in Polish).
- Stelmach, W. (2008). Jeszcze raz, ale inaczej, o teorii Masłowa. *Master of Business Administration*, 16(4), 3-6. (in Polish).
- Sztumski, W. (2006). Idea zrównoważonego rozwoju a możliwości jej urzeczywistnienia. *Problemy ekorozwoju*, 1(2), 73-76. (in Polish).
- Śmiechowska, M. (2013). Autentyczność jako kryterium zapewnienia jakości żywności. *Ann. Acad. Med. Gedan.*, 43, 175-181. (in Polish).
- Świdorski, F. (Ed.). (2006). *Żywność wygodna i żywność funkcjonalna: praca zbiorowa*. Warszawa: Wydawnictwa Naukowo-Techniczne. (in Polish).
- Wielgosik, I. (2020). *Towar jako przedmiot handlu. HAN.01. Prowadzenie sprzedaży*. Poznań: Wydawnictwo eMPI². (in Polish).
- Zabłocka, K., Rejman, K., & Prandota, A. (2016). Marnotrawstwo żywności w kontekście racjonalnego gospodarowania nią w gospodarstwach domowych polskich i szwedzkich studentów. *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego: Ekonomika i Organizacja Gospodarki Żywnościowej*, (114), 19-32. (in Polish).
- Zielińska, A. (2013). *Gospodarowanie na obszarach przyrodniczo cennych w Polsce w kontekście rozwoju zrównoważonego. Seria: Monografie i Opracowania nr 236*. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu. (in Polish).