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Optimization model of collective nutrition in the Serbian Armed Forces using linear programming and Python programming environment

Модел оптимизације колективне исхране Војске Србије заснован на линеарном програмирању и програмском окружењу Пајтон

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Summary
The aim of this paper is to develop an optimization model of collective military nutrition based on linear programming, to reduce the daily meal costs while meeting the energy, nutritional and logistical requirements of the Serbian Armed Forces. The research was conducted using linear programming, multi-criteria analysis and deterministic sensitivity analysis. The model was implemented in the Python programming environment, and the analysis covered 230 dishes from the Serbian Armed Forces Nutrition Plan, taking into account economic, nutritional, and organizational constraints, as well as price change scenarios. The research results show the optimization approach lowers daily meal costs compared to the existing normative model without compromising the defined nutritional standards. Furthermore, the model demonstrates satisfactory stability in different market conditions. The originality of this research lies in the development of an integrated model that unifies economic, nutritional, and logistical criteria into a single framework designed for the food system in the Serbian Armed Forces. The limitations of the research relate to the deterministic nature of the model, static nutritional parameters and the absence of full stochastic optimization.
Keywords: linear programming, nutrition in the Serbian Armed Forces, cost optimization, Python programming environment, Serbian Armed Forces.
JEL classification: C02, C60, M11, D12

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Сажетак
Циљ овог рада је да се развије оптимизациони модел колективне исхране војника заснован на линеарном програмирању, како би се смањили трошкови дневног оброка уз задовољавање енергетских, нутритивних и логистичких ограничења исхране у Војсци Србије. Истраживање је спроведено коришћењем линеарног програмирања, мулти-критеријумске анализе и детерминистичке анализе осетљивости. Модел је имплементиран у програмском окружењу Пајтон, а анализом је обухваћено 230 јела из Плана исхране у Војсци Србије, укључујући економска, нутритивна и организациона ограничења, као и сценарије промене цена. Резултати истраживања указују на то да оптимизациони приступ омогућава ниже трошкове дневног оброка у односу на постојећи нормативни модел, без кршења дефинисаних нутритивних стандарда, уз задовољавајућу стабилност модела у различитим тржишним условима. Оригиналност рада огледа се у развоју интегрисаног модела који комбинује економске, нутритивне и логистичке критеријуме у јединствени оквир прилагођен систему исхране у Војсци Србије. Ограничења истраживања односе се на детерминистички карактер модела, статичке нутритивне параметре и одсуство потпуне стохастичке оптимизације.
Кључне речи: линеарно програмирање, исхрана Војске Србије, оптимизација трошкова, програмско окружење Пајтон, Војска Србије.
JEL класификација: C02, C60, M11, D12

Introduction

Collective nutrition planning in the Serbian Armed Forces is a complex logistical and optimization problem that requires the harmonization of energy and nutritional needs of users with available financial resources, nutrition norms and organizational constraints of the food supply system (Jović, 2016). In addition to the economic aspects of food planning, food safety also plays an important role. Jović (2013) emphasizes its importance for preserving the health of the population, while Arsić (2014; 2025) points to the possibilities of improving the military food system in the Serbian Armed Forces by applying economic criteria. Martić et al. (1991) confirm that linear and integer programming models enable nutritionally and economically optimal menu planning. Doncore et al. (2023) state that modern nutrition optimization models integrate nutritional, economic, and organizational requirements into a single optimization framework. On the other hand, Rahbari et al. (2023) show that during the COVID-19 pandemic, robust optimization has played a significant role in the strategic management of canned food supply chains, enabling the selection of the most advantageous strategy and achieving significant savings with better capacity utilization.

The aim of this paper is to develop an optimization model of collective nutrition in the Serbian Armed Forces based on linear programming and implemented in the Python programming environment, which minimizes the cost of a daily meal while meeting the energy, nutritional and logistical constraints of the food system.

1. A brief overview of the relevant literature

Modern research in the field of collective nutrition indicates that menu planning is a multi-criteria problem that requires simultaneous satisfaction of nutritional, economic and organizational requirements. Traditional normative approaches are increasingly upgraded with methods of linear programming, robust optimization and sensitivity analysis for more rational use of resources and minimization of costs. In the domestic literature, special importance is given to nutritionally adequate nutrition as a factor in preserving the health ability and operational efficiency of members of the military (Jović, 2016; Božić, 2005; Jokić & Tešanović, 2017). Arsić & Pamučar (2025) propose a methodology that reduces subjectivism and improves nutrition planning in the Serbian Armed Forces. The theoretical foundations of food system optimization come from Stigler's cost minimization problem, which was one of the key incentives for the development of linear programming (Dantzig, 1963). Modern research confirms that linear programming is an effective approach to shaping nutritionally and economically optimal nutrition models (Donkor et al., 2023; Gerdessen & Borgonjen-van den Berg, 2023). Robust optimization approaches designed to make decisions in conditions of changing market parameters and expressed uncertainty are of particular importance (Sadana et al., 2023; Rahbari et al., 2023). Budowle et al. (2023) suggest that approaches based on the principles of fairness and equity can contribute to addressing food insecurity in a more sustainable way, thereby expanding the traditional optimization framework based solely on economic criteria.

Modern military nutrition research shows that the quality of nutrition directly affects the physical performance, resistance of the body, and the operational readiness of military systems (Karl et al., 2021; McClung & Gaffney-Stomberg, 2016; Bayes et al., 2025; Scott & Deuster, 2024; Fallowfield et al., 2025). Wincewicz-Bosy et al. (2022) highlight the importance of logistics planning and resilient food supply chain models in collective food systems. Darmon et al. (2002) have shown that minimizing costs without nutritional restrictions can negatively affect the quality of nutrition. The importance of AI DSS systems, sustainability and adaptive optimization approaches is confirmed by research by Bordbar et al. (2026), Pinel et al. (2024) and Grosul & Balatska (2021).

2. Diet plan proposal

The introduction of compulsory military service in Serbia from 2026 imposes the need to define an economically optimal model of soldiers' nutrition that simultaneously meets energy and nutritional limitations and enables rational management of available resources. A number of factors affect the solution of this problem, including the prices of food products, the structure of meals and the representation of certain food groups in the overall diet. Therefore, before implementing the food preparation process, it is necessary to look at all the relevant parameters and apply the methods of multi-criteria analysis and mathematical optimization in order to make optimal decisions.

The basis for the formulation of the model was the data from the Diet Plan in the Serbian Armed Forces, which includes 230 recipes of different categories of dishes: breakfast, snack, soups, main courses for lunch and dinner, salads, cakes, fruit and compotes. Based on the available data, a linear programming model was formulated in which the goal function and the set of constraints are defined by linear relationships while taking into account the energy and nutritional requirements of the food system (Martić et al., 1991).

Set of dishes:

$$J=\{1,2,...,230\}$$

Parameters:

c_i – the price of the dish,

Ei – energy value of the dish,

P_i, f_i, CH_i– protein, fat and carbohydrate content and

N = 353 – the number of days in a year, because a canned food meal is provided only once a month.

Variables:

The basic decision variable x_j is the annual frequency of food *j*.

Function of the target:

$$\text{Min } F = \sum_{j=1}^{n} c_i \cdot x_j$$

Limitations:

$$Nutritional\ restrictions$$

$$P_i^{\min} \leq \sum_{j=1}^{n} a_{ij} \cdot x_j \leq P_i^{\max}, \quad i = 1, \dots, m$$

$$Meal\ restrictions$$

$$\sum_{j=1}^{30} x_j = 353 \quad \text{(breakfast)}$$

$$\sum_{j=31}^{41} x_j = 245 \quad \text{(snack)}$$

$$\sum_{j=53}^{129} x_j = 353 \quad \text{(main dishes for lunch)}$$

$$\sum_{j=130}^{142} x_j = 353 \quad \text{(salads)}$$

$$\sum_{j=143}^{157} x_j = 131 \quad \text{(sweets)}$$

$$\sum_{j=158}^{166} x_j = 222 \quad \text{(fruits for lunch)}$$

$$Dinner$$

$$\sum_{j=167}^{182} x_j = 123 \quad \text{(cooked meals)}$$

$$\sum_{j=183}^{199} x_j = 122 \quad \text{(small dinners)}$$

$$\sum_{j=200}^{206} x_j = 108 \quad \text{(cold dinners)}$$

$$\sum_{j=220}^{227} x_j = 85 \quad \text{(fruit for dinner)}$$

$$x_{228} + x_{229} + x_{230} = 37 \quad \text{(compotes)}$$

$$Nutritional\ limits\ of\ the\ daily\ rations$$

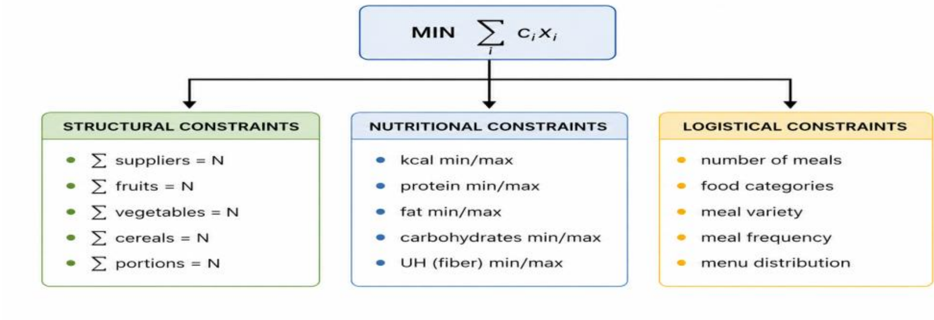
$$3300\ kcal \le \text{Energy value} \le 4200\,\text{kcal}$$

$$10\% \le \text{Proteins} \le 15\%$$

$$15\% \le \text{Fats} \le 30\%$$

$$55\% \le \text{Carbohydrates} \le 75\%$$

Figure1: Mathematical structure of the optimization model



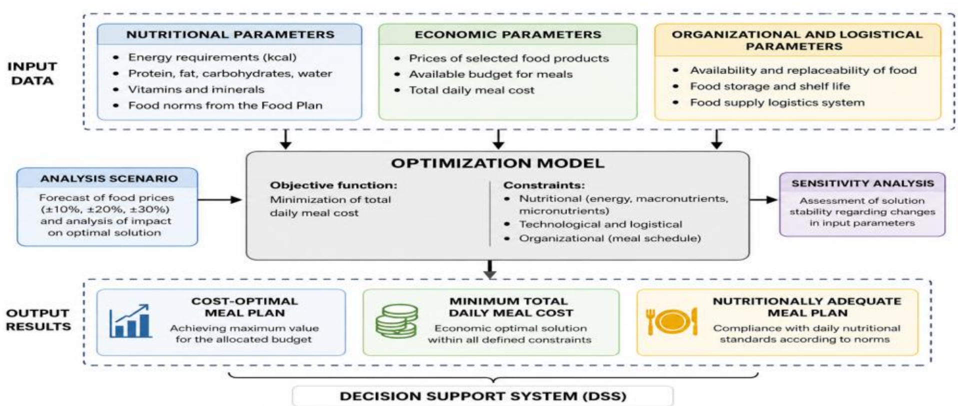
Source: Authors' processing

The presented mathematical scheme shows the relationship between the objective function and the structural, nutritional and logistical constraints of the model.

2.1. Programming the implementation of the optimization model in the Python programming environment

The optimization model was implemented in the Python programming environment using the pandas and NumPi libraries for processing the input data, while the linear programming problem was solved using the PuLP library and the built-in CBC (Coin-or Branch and Cut) solver. The optimization process of nutrition implemented in the Python programming environment consists of the phases shown in Figure 2.

Figure 2: Optimization process of soldier nutrition in the Python programming environment



Source: Authors' processing

2.1.1. Computational Complexity and Model Convergence

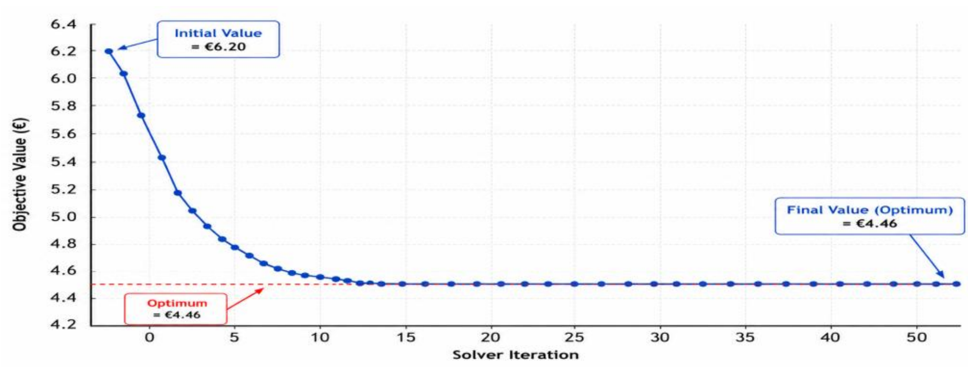
The formula includes 230 decision variables and a set of linear constraints. In the tested computer environment, the model execution time was less than one minute, with no identified numerical problems with instability or convergence.

Table 1: Basic characteristics of the optimization model and computer implementation

Characteristic	Value/Description
A type of optimization model	Integer Linear Programming (ILP)
Number of decision variables	230
Number of dishes analyzed	230
Objective function	Minimizing the cost of a daily meal
Type of restriction	Energy and nutritional restrictions
Number of major nutritional restrictions	4
Programming environment	Python
Used libraries	pandas, numpy, puLP
Optimization Solver	CBC (Coin-or Branch and Cut)
Type of variables	Integer variables
Output Result	The optimal frequency of application of dishes
Average Execution Time	< 1 minute
The Status of the Solution	Optimal solution found

Source: Authors' analysis

Chart 1: Convergence of the target function during the optimization process



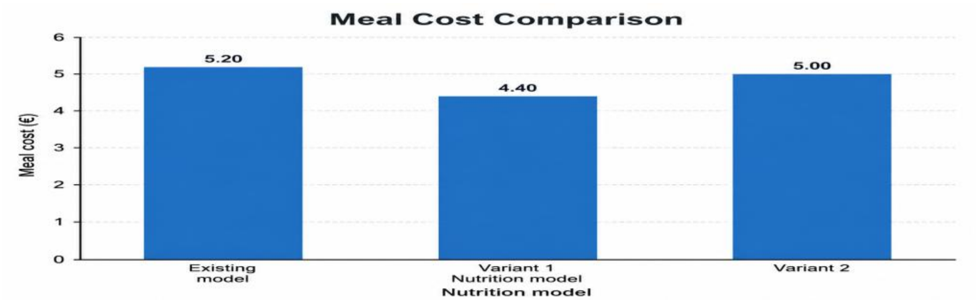
Source: Authors' processing

The presented results indicate the computational efficiency, numerical stability and practical applicability of the developed optimization model.

3. Results and discussion

Using the Python programming environment, multi-criteria analysis and linear programming, a mathematical model of nutrition in the Serbian Armed Forces was formulated with the aim of minimizing the cost of a daily meal while meeting the defined energy and biological limits. The model uses two optimization variants to determine the optimal annual frequency of serving specific dishes across breakfast, lunch, dinner, and snacks. In the first variant, the optimal price of a daily meal is €4.46, while the second variant, with a higher proportion of expensive meals, is €5.06.

Chart 2: Comparison of the cost of a daily meal by dietary models



Source: Authors' processing

Compared to the existing nutrition model in the Serbian Armed Forces, the optimization model allows for savings of 0.2 to 0.8 € per daily meal. Chart 2 shows a comparison of the cost of a daily meal between the existing nutrition model in the Serbian Armed Forces and the optimized models obtained by applying linear programming and multi-criteria analysis.

4. Verification and validation of the optimization model

4.1. Cost Sensitivity Analysis

The sensitivity analysis was carried out by simulating the change in food prices ranging from -20% to +20%. In this way, it was examined how changes in input prices affect the total cost of a daily meal, as well as the relative savings compared to the existing model.

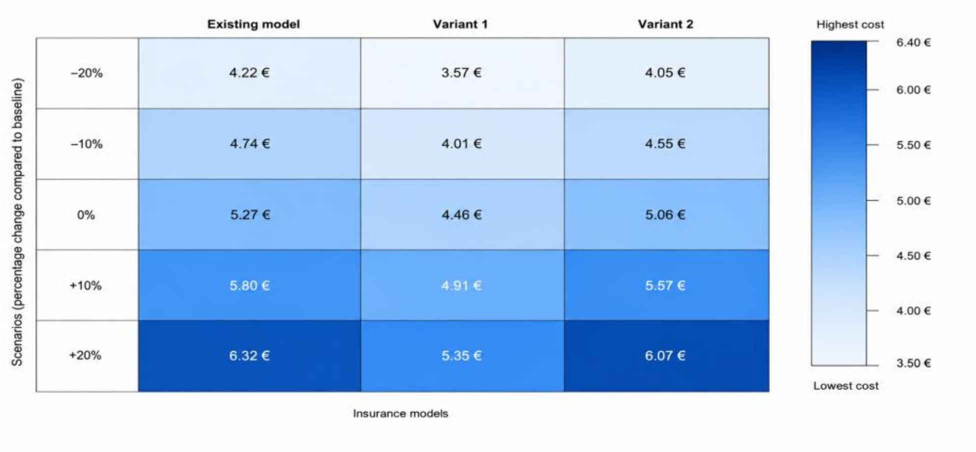
Table 2: Cost Sensitivity Analysis in the Context of Changes in Food Prices

Price change scenario	Existing model (€)	Option 1 (€)	Savings V1 (€)	Option 2 (€)	Savings V2 (€)
- 20%	4.22	3.57	0.65	4.05	0.17
- 10%	4.74	4.01	0.73	4.55	0.19
0%	5.27	4.46	0.81	5.06	0.21
+10%	5.80	4.91	0.89	5.57	0.23
+20%	6.32	5.35	0.97	6.07	0.25

Source: Authors' analysis

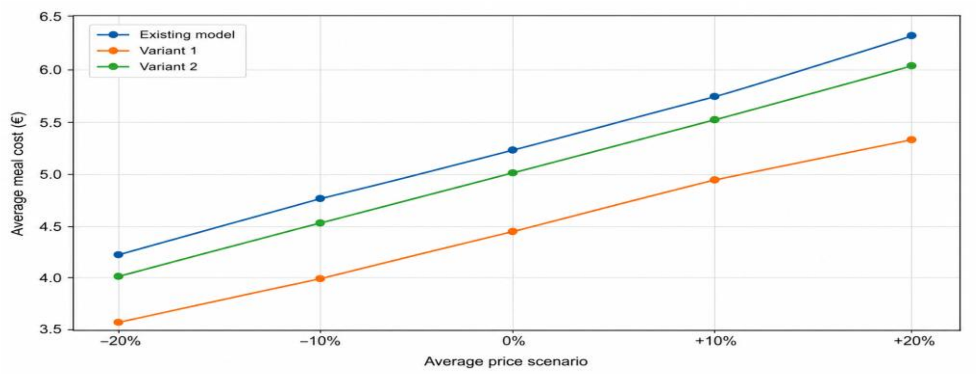
The results confirm that the optimized variants maintain lower cost levels compared to the existing normative model in all analyzed scenarios, with variant 1 achieving the lowest values of the target function. Chart 4 shows the change in the cost of a daily meal in different scenarios of food price changes.

Chart 3: Sensitivity Analysis of the Optimization Model Heat Map



Source: Authors' analysis based on the results of the optimization model simulation

Chart 4: Cost Sensitivity Analysis



Source: Authors' processing

4.2. Analysis of the stability scenario of the optimization model

In order to further verify the stability of the developed optimization model, deterministic sensitivity analysis was conducted through predefined scenarios of changes in food prices. Based on the scenario of change in prices of food products ranging from -20% to + 20%, the average cost values, standard deviation and sensitivity coefficient of the model were calculated. The obtained indicators enable a quantitative assessment of the model's behavior in response to fluctuating food prices.

Table 3: Descriptive stability indicators of the optimization model

Indicator	An existing model	Variant 1	Variant 2
Average price (€)	5.27	4.46	5.06
Average Savings (€)	—	0.81	0.21
Standard deviation	0.74	0.63	0.72
Sensitivity coefficient	1.00	0.85	0.93
Scope of deviation (€)	±0.18	±0.15	±0.17

Source: Authors' analysis

4.3. Analysis of deviations in nutritional parameters

Alongside the costs, the basic nutritional parameters were assessed for deviation from the set limits.

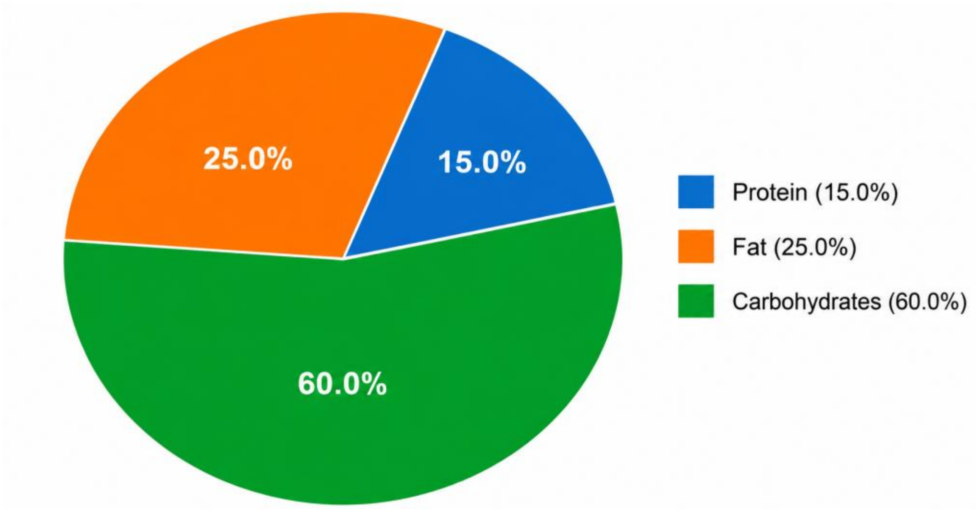
Table 4: Verification of compliance with the nutritional limits of the optimization model

Parameter	Lower limit	Upper limit	Variant 1	Variant 2	Rating
Energy	3300 kcal	4200 kcal	Within the limits	Within the limits	Acceptable
Proteins	10%	15%	Within the limits	Within the limits	Acceptable
Fats	15%	30%	Within the limits	Within the limits	Acceptable
Carbohydrates	55%	75%	Within the limits	Within the limits	Acceptable
Meal price	—	Minimum	€4.46	€5.06	V1 more economical, V2 more balanced

Source: Authors' analysis

The results indicate that cost reductions have not been achieved at the expense of compromising basic nutritional needs.

Chart 5: The Macronutrient Structure of an Optimized Daily Meal



Source: Authors' analysis

Chart 5 shows the optimal ratio of macronutrients in accordance with the nutritional standards of the Serbian Armed Forces.

4.4. Conceptual framework for robust optimization

In this paper, robust optimization is not performed as a separate stochastic model, but is presented as a conceptual extension of the basic linear optimization model. In real-world conditions, the prices of food products, the availability of groceries and logistics capacities may vary. The robust formulation of the model can be expressed as follows: minimize the total cost of a daily meal, provided that nutritional restrictions are met and in the event of adverse changes in prices and availability of products.

4.5. Formal formulation of robust optimization

To formalize a robust optimization approach, it is possible to define a robust target function based on minimizing the maximum expected costs under conditions of changes in input parameters. Unlike standard linear programming, where all parameters are assumed to be known and fixed, a robust optimization approach starts from the assumption that food prices can fluctuate within a defined set of uncertainties.

A robust formulation of the target function can be represented in the following form:

$$min_{x \in X}\, max_{c \in U} \sum_{i=1}^{n} c_i x_i$$

where:

x_i - frequency of application of *dish i*,

c_i - the price *i*–dish,

U - set of food products price uncertainties.

X – a set of permitted solutions defined by nutritional and logistical constraints.

A set of uncertainties can be defined in intervals, assuming that the price of each food product may deviate from the nominal value within a predefined interval:

$$c_i \in [\overline{c_i} - \Delta_i, \overline{c_i} + \Delta_i].$$

Where it is located:

$\overline{c_i}$ - the nominal price of the product,

Δ_i – the maximum permissible deviation from the price.

In this way, a robust optimization approach not only minimizes costs in nominal terms, but also minimizes the most unfavorable possible costs within a defined set of uncertainties. In this paper, the robust optimization formulation is not implemented as a full stochastic model, but represents a theoretical and methodological framework for the future extension of the developed linear optimization system.

4.5.1. Scenario analysis

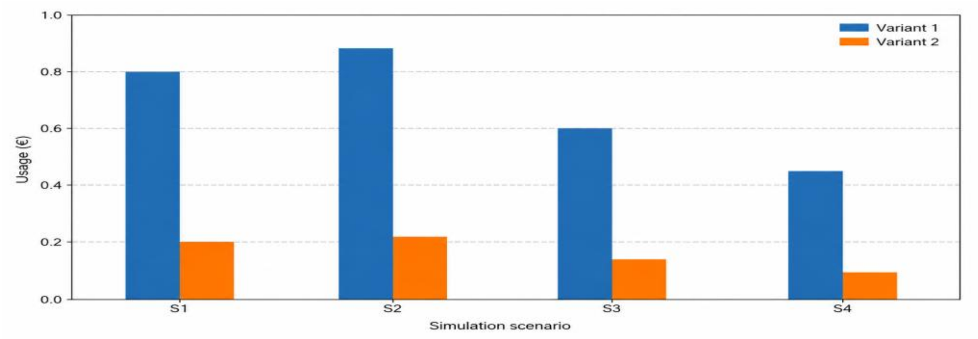
In order to further verify the behavior of the model under different conditions, four analytical scenarios were defined.

Table 5: Analysis of the behavior scenario of the optimization model in different market conditions

Scenario	Scenario description	The expected effect
S1 – Basic scenario	Prices and availability of products remain stable	The model achieves minimal costs
S2 – Inflation scenario	Increase in food product prices by 10-20%	Costs are increasing, but optimized variants remain more affordable
S3 – logistical disruption	Limited availability of certain foods	The model adjusts the structure of choice in favor of available dishes
S4 – quality scenario	The share of more expensive and varied dishes is increasing	The price is rising, but the acceptability of the menu is increasing

Source: Authors' analysis

Chart 6: Comparison of savings by simulation scenarios



Source: Authors' analysis

4.6. Comparison with actual historical cost data

In order to further verify the practical applicability of the developed optimization model, a conceptual comparison was made with historical data on food costs in the Serbian Armed Forces for a multi-year period. For each observed year, the input economic parameters were reconstructed on the basis of estimated market prices of food products, after which the optimization model was applied again to historical datasets.

Table 6: Comparative analysis of historical and optimized daily meal costs

Year	Existing model (€)	Optimized variant 1 (€)	Optimized variant 2 (€)	Estimated savings V1 (€)	Estimated Savings V2 (€)
2021	4.62	3.95	4.41	0.67	0.21
2022	4.88	4.13	4.63	0.75	0.25
2023	5.01	4.24	4.81	0.77	0.20
2024	5.18	4.39	4.96	0.79	0.22
2025	5.27	4.46	5.06	0.81	0.21

Source: Authors' analysis

The obtained results confirm that the optimized model in all analyzed years achieves lower projected costs of a daily meal compared to the existing normative approach, while maintaining the defined nutritional restrictions.

4.7. Comparison with alternative models

In order to further verify the feasibility of the proposed model, a conceptual comparison with alternative approaches to nutrition planning was performed.

Table 7: Comparison of the optimization model with alternative approaches to nutrition planning

Model	Basic characteristic	Advantages	Limitation
An existing normative model	Planning according to a valid diet plan	A well-established and operationally proven system	Does not reduce costs
Lowest price model	Selection of the cheapest dishes	Biggest savings	Risk of reduced diversity
Nutritionally balanced model	Priority nutritional structure	Good biological adequacy	Does not guarantee minimal costs
Proposed optimization model	price + nutritional restrictions + frequency of meals	Best Cost-Constraint Ratio	Requires up-to-date data and software support
Robust model	It involves the risk of changes in the price and availability of the product	Greater stability	More complex to apply

Source: Authors' analysis

4.8. Discussion of validation results

The obtained results confirm that optimization models improve the economic efficiency and nutritional adequacy of the food system (Karl et al., 2021; McClung & Gaffney-Stomberg, 2016; Wincewicz-Bosy et al., 2022; de Moor et al., 2024), while AI DSS systems support adaptive scheduling (Bordbar et al., 2026). Gerdessen & Borgonjen-van den Berg (2023) highlight the transparency and effectiveness of the MILP approach.

Conclusion

The results of the research indicate that the application of linear programming in collective nutrition planning in the Serbian Armed Forces enables the achievement of a more favorable relationship between costs and nutritional restrictions compared to the traditional normative approach. The scientific contribution of the paper is reflected in the formulation of an integrated MILP model that combines economic, nutritional and logistical criteria into a single optimization framework. The limitations of the research relate to the deterministic character of the model, the use of static nutritional parameters, and the absence of a full stochastic robust optimization formulation. Future research may be directed towards the development of stochastic and robust optimization models, the integration of simulation methods, and the application of adaptive algorithms for collective nutrition planning in complex logistics systems.

References

Arsić, S. (2014). Possibilities for improving the food system at the Military Academy: Economic aspects. *Military Technical Gazette, 62*(4), 168-186. Doi: https://doi.org/10.5937/vojtehg62-6219

Arsić, S. (2025). *Model of menu optimization of the Military Academy in the function of meeting the nutritional needs of users* (Doctoral dissertation). Military Academy, University of Defence, Belgrade. Retrieved from: https://nardus.mpn.gov.rs/handle/123456789/23645

Arsić, S., & Pamučar, D. (2025). Improving the implementation of the Nutrition Plan in the Serbian Armed Forces in the function of food user satisfaction. *War Work, 2*(2025), 67-88. Doi: https://doi.org/10.5937/vojdelo2502067A

Bayes, J., Burch, E., Lauche, R., & Wardle, J. (2025). What is the dietary intake and nutritional status of defence members: a systematic literature review. *Nutrition Research Reviews, 38*(1), 267-281. Doi: https://doi.org/10.1017/S0954422424000143

Bordbar, Y., Deng, J., King, B., Lee, H., & Zhang, W. (2026). Bridging technology and nutrition: A systematic review of AI and XR applications for nutritional insights in restaurants and foodservice operations. *Nutrients, 18*(9), 1364. Doi: https://doi.org/10.3390/nu18091364

Božić, D. (2005). *Quality of nutrition of the population of the European Union and Serbia*. Daesh, Belgrade.

Buildings, R., Porter, C. M., & McLennan, C. (2023). Justice and equity approaches to college and university student food (in)security: Introduction to the special section. *Journal of Agriculture, Food Systems, and Community Development, 12*(2). Doi: https://doi.org/10.5304/jafscd.2023.122.013

Dantzig, G. B. (1963). *Linear Programming and Extensions*. Princeton University Press. Retrieved from: https://www.rand.org/content/dam/rand/pubs/reports/2007/R366part1.pdf

Darmon, N., Ferguson, E., & Briend, A. (2002). A cost constraint alone has adverse effects on food selection and nutrient density: An analysis of human diets by linear programming. *The Journal of Nutrition, 132*(12), 3764-3771. Doi: https://doi.org/10.1093/jn/132.12.3764

de Moor, K., Janssen, L., & Peters, R. (2024). A robust approach to food aid supply chains. *European Journal of Operational Research, 318*(1), 269-285. Doi: https://doi.org/10.1016/j.ejor.2024.04.034

Donkor, L., Essien, E., & Affrifah, N. S. (2023). A systematic review of linear programming techniques as applied to diet optimisation and opportunities for improvement. *Journal of Optimization, 2023*(2), 1-17. Doi: https://doi.org/10.1155/2023/1271115

Fallowfield, J. L., McClung, J. P., Gaffney-Stomberg, E., Probert, B., Peterson, R., Charlebois, A., Boilard, H., Carins, J., & Kilding, H. (2025). Nutrition as a military capability to deliver human advantage: More people, more ready, more of the time. *BMJ Military Health, 171*(5), 402-407. Doi: https://doi.org/10.1136/military-2024-002738

Gerdessen, J. C., & Borgonjen-van den Berg, K. J. (2023). A linear programming based method for designing menus for controlled feeding trials. *The American Journal of Clinical Nutrition, 117*(2), 408-413. Doi: https://doi.org/10.1016/j.ajcnut.2022.11.006

Grosul, V., & Balatska, N. (2021). Development of a methodological basis for assessing the effectiveness of value-oriented management of development of a restaurant business enterprise. *Technology Audit and Production Reserves, 1*(4(57)), 66-76. Doi: https://doi.org/10.15587/2706-5448.2021.225084

Jokić, N., & Tešanović, B. (2017). Food safety and quality of life. *War Work, 6*(2017), 180-195. Retrieved from: https://www.vojnodelo.mod.gov.rs/pdf_clanci/vojnodelo394/vd-394-2017-69-6-11-Jokic.pdf

Jović, S. (2013). Food safety – a case study. *War Labor, 3*(2013), 154-169. Retrieved from: https://www.vojnodelo.mod.gov.rs/pdf_clanci/vojnodelo369/vd-369-2013-65-3-12-Jovic.pdf

Jović, S. (2016). *Economics of Food Development in the Serbian Armed Forces* (Doctoral dissertation). Military Academy, University of Defence, Belgrade.

Karl, J. P., Margolis, L. M., Fallowfield, J. L., Child, R. B., Martin, N. M., & McClung, J. P. (2021). Military nutrition research: Contemporary issues, state of the science and future directions. *European Journal of Sport Science, 22*(1), 87-98. Doi: https://doi.org/10.1080/17461391.2021.1930192

Martić, M., Petrić, J., Krčevinac, S. B., & Mladenović, N. M. (1991). Some experience in human nutrition and institutional menu planning and programming: Models, solution methods, applications. *Yugoslav Journal of Operations Research, 1*(2), 147-158.

McClung, J. P., & Gaffney-Stomberg, E. (2016). Optimizing performance, health, and Well-being: Nutritional factors. *Military Medicine, 181*(suppl_1), 86-91. Doi: https://doi.org/10.7205/MILMED-D-15-00202

Pinel, P., Drogue, S., Amiot-Carlin, M. J., Vannier, C., Bourlieu-Lacanal, C., & Micard, V. (2024). *Optimization of nutrition through linear programming of climate-smart and gluten-free pasta*. LWT, 197, 115899. Doi: https://doi.org/10.1016/j.lwt.2024.115899

Rahbari, M., Arshadi Khamseh, A., & Mohammadi, M. (2023). Robust optimization and strategic analysis for agri-food supply chain under pandemic crisis: Case study from an emerging economy. *Expert Systems with Applications, 225*, 120081. Doi: https://doi.org/10.1016/j.eswa.2023.120081

Sadana, U., Chenreddi, A., Delage, E., Forel, A., Frejinger, E., & Vidal, T. (2023). *An exploration of contextual optimization methods for decision-making under uncertainty*. Retrieved from: https://arxiv.org/abs/2306.10374

Scott, J. M., & Deuster, P. A. (2024). Role of nutrition in human performance in military populations. *BMJ Military Health, 170*(e1), 415-419. Doi: https://doi.org/10.1136/military-2022-002311

Wincewicz-Bosy, M., Sadowski, A., Wąsowska, K., Galar, Z., & Dymit, M. (2022). Military food supply chain during the COVID-19 pandemic. *Sustainability, 14*(14), 2464. Doi: https://doi.org/10.3390/su14042464