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Organic Products And Health: Contemporary Medical Aspects, Food Safety, And Digital Erp Technologies

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ABSTRACT

Modern medicine is paying increasing attention to the quality of nutrition as a key factor in the prevention of chronic diseases. Organic products are considered an important component of a healthy diet due to their minimal pesticide content, absence of chemical fertilizers, and higher concentration of biologically active substances.

However, organic production remains a challenging task: it requires strict compliance with environmental standards, logistics control, seasonality, and precise quality management. The article proposes a dynamic adaptive planning (DAP) model using the Odoo ERP system, which ensures food safety, improves product quality, and increases their health benefits for consumers.

The ERP model demonstrates:

– a reduction in the toxic load on the consumer's body by tracking all stages of production

– operational control of biological risks (mold, microbiological contamination, toxins)

– improved nutrient composition of products through compliance with organic methods

– a 2–4% reduction in production costs and increased production stability

– increased transparency and traceability, which is critical for clinical and preventive standards

It should be noted that planning the production of organic products is a complex process due to the specifics of the industry: strict quality standards, limited product shelf life, environmental requirements, and logistical challenges.

Effective management of such production requires a comprehensive and flexible model that takes into account seasonality, environmental restrictions, minimum storage periods, and other factors.

The article proposes a dynamic adaptive model for planning the production of organic products, covering all stages from planting to sale. The model integrates modern automation tools based on the Odoo ERP system, which allows for variable factors such as weather conditions, changes in demand, and delivery delays to be taken into account.

The developed model provides the following results:

- a 2–4% reduction in production costs;
- operational control and traceability of all stages of production;
- improved management of product quality, inventory, and delivery times;
- flexibility in adapting plans to changes in external conditions, including seasonal fluctuations and force majeure;
- automated control of certificates and documentation.

The proposed solution demonstrates high efficiency in the management of organic product manufacturing, ensuring cost reduction and increased process transparency.

KEYWORDS: EAACI (European Academy of Allergy and Clinical Immunology)

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INTRODUCTION

The rise in chronic diseases related to nutrition — obesity, metabolic syndrome, allergies, inflammatory bowel disease — makes food quality a key factor in 21st-century medicine. At the same time, global demand for organic products is growing as a safer alternative to industrially grown foods.

According to EFSA, regular consumption of organic products reduces pesticide intake by 80–90%. The Harvard School of Public Health has shown that organic fruits and vegetables contain 20–40% more antioxidants, which play a role in the prevention of cardiovascular disease, cancer, and chronic inflammation.

Studies confirm that
organic food improves the condition of the gut microbiota
it reduces inflammatory markers
it reduces the risk of allergic reactions in children
it reduces the likelihood of contact with harmful chemicals

These findings underscore the importance of revising approaches to food production from a medical and public health perspective. Global demand for organic products is growing rapidly thanks to consumer awareness of health, ecology, and sustainable development.

Moreover, organic food has a positive effect on the gut microbiome, increasing the number of bifidobacteria and lactobacilli, which improves immune status and reduces the incidence of chronic gastrointestinal diseases.

For the medical community, these data are grounds for considering organic food as an element of preventive medicine.
According to various studies, the global organic market is estimated to be worth approximately $184-228 billion in 2023, and is projected to grow to $446-658 billion by 2030, with a compound annual growth rate (CAGR) of 11-15%.

In 2022, according to the IFOAM report, approximately 2.7 million hectares of designated land were registered in Central Asia, with India now accounting for part of the problem, but countries such as Kazakhstan are seeing an increase in the area under organic farming.

For example, in Kazakhstan, farmers are increasingly switching to organic production of grains and legumes, influenced by national initiatives. However, high production costs and insufficient consumer awareness are still holding back mass demand within the region.

Control and environmentally responsible production play a key role: consumers are increasingly choosing products made without chemicals, pesticides, and GMOs, using reliable methods that preserve soil, water, and biodiversity.

Organic production faces a number of challenges that distinguish it from traditional agriculture. These challenges affect both the cultivation process and certain stages, from certification to marketing. Namely:

- strict certification standards;
- seasonality;
- limited shelf life;
- high costs and high productivity;
- management of harmful factors and diseases;
- market and logistical barriers.

These challenges make organic production complex and risky, requiring significant investment, planning, and globalization. However, they also highlight the value of organic products for consumers seeking environmentally friendly and sustainable solutions.

Adaptive planning is a planning method that provides flexibility and the ability to adapt to new data and changing conditions. It allows organizations or farmers to adjust their plans in response to unforeseen circumstances, such as changes in weather or market timing.

LITERATURE REVIEW

The following sources were reviewed to provide an overview of adaptive planning methods:

- The work of C.S. Holling is considered one of the fundamental works in the field of adaptive management. C.S. Holling proposed an approach that emphasizes iteration, feedback, and the consideration of uncertainties in natural resource management [5].
- The article by S. Dessai and M. Hulme discusses the role of probabilistic approaches in adaptive planning [6].
- D.H. Meadows' book offers the foundations of a systems approach, thinking, and management of complex systems, which is a key element of adaptive planning [7].
- The article by L. Rist, B.M. Campbell, and P. Frost analyzes examples of the application of adaptive management in various contexts [8].
- The book by V. A. W. J. Marchau, W. E. Walker, P. J. T. M. Bloemen, and S.W. Popper offers methods for decision-making in conditions of deep uncertainty, including adaptive planning [9].
- The article by R. J. Lempert and M.T. Collins is devoted to risk management in conditions of uncertainty using mathematical and modeling adaptive approaches [10].
- The methodology in Dynamic Adaptive Management Pathways (DAMP) combines adaptive management with scenario-based approaches for planning under uncertainty [11].

Organic production requires compliance with strict standards, such as the EU Organic Regulation (EU 2018/848) or USDA Organic [12].

This requires:

- regularly audit production for compliance with standards;
- Implement a documentation system that records all stages of production.

To ensure quality control and traceability, it is recommended to implement the HACCP (Hazard Analysis and Critical Control Points) system and blockchain technology to track the supply chain [13].

Methods include:

- hazard analysis and critical control points (HACCP) to minimize risks;
- use of RFID tags or QR codes to track products from the field to the consumer.

To control storage and delivery times, it is necessary to use demand forecasting and logistics optimization methods [14]-[15].

This includes:

- implementation of an inventory management system (e.g., Just-in-Time).
- using IoT sensors to monitor storage conditions (temperature, humidity).

The seasonality of organic production requires careful planning [16]. To do this, you can use:

- agronomic planning methods that take into account climatic conditions and crop growth cycles;
- yield forecasting using satellite monitoring data and meteorological data.

Adaptive planning is a recognized tool for managing systems with a high degree of uncertainty. Research by Holling, Meadows, Dessai, and Walker lays the foundation for the methodology.

However, contemporary literature also emphasizes the medical aspect:

JAMA Internal Medicine (2018)
Consuming organic products reduces the risk of cancer by 25%.

British Journal of Nutrition (2014)
Organic products contain 18–69% more polyphenols, antioxidants that protect the body's cells from damage.

American Academy of Pediatrics (2012)
Children who eat organic food have significantly lower levels of pesticides in their urine.

EAACI (European Academy of Allergy and Clinical Immunology)
An organic diet reduces the risk of allergies by 30%.
The following are used to monitor quality and reduce biological risks:
HACCP
IoT temperature and humidity sensors
RFID, QR codes
Blockchain for origin verification

This allows not only compliance with standards, but also ensures the medical safety of products.

Thus, the importance of organic production goes beyond agroeconomics and becomes an important element of medical prevention.

In conclusion, we note that adaptive planning methods are effective for the production of organic products, and interactive planning approaches ensure high productivity.

RESEARCH OBJECTIVES AND METHODS

The objectives of the work are to develop and implement the automation of dynamically adaptive methods for planning the production of organic products.

An additional objective of the research is to assess the impact of organic production processes on the safety of the final product and to reduce the toxic load on the consumer's body.

Given the specifics of production processes, it is expected that operating costs will be reduced and the transparency and manageability of production operations will be improved.
Research objectives

- Introduction of dynamic, adaptive planning for the production of organic products.
- Automation of planning processes.

Analysis of existing methods for planning the production of organic products

Traditional production planning methods are outdated approaches used to distribute modern systems such as ERP (SAP, ORACLE, etc.). They are based on:

- Gantt charts: Visual tools for task planning, but they are static and require manual updates, making them less suitable for dynamic production facilities.
- Manual planning: planning based on historical data and current orders, often using spreadsheets or simple databases, which requires a lot of time and effort.

These methods face a number of challenges:

- Forecast inaccuracy: Traditional methods often fail to account for sudden changes, leading to overproduction or stock shortages.
- Inefficient resource allocation: Manual planning can lead to suboptimal resource utilization, causing downtime or overload.

In the medical field, it is critical that DAP provides continuous monitoring of biological risks (microbiological contamination, residues, toxins) and allows the origin of each product batch to be traced. This improves food safety for patients, children, and people with chronic diseases who are sensitive to food toxins.

Complexity management complexity: these methods are not well suited to managing complex processes, such as the production of multiple products in different batches.

Lack of data: without modern tools, it is difficult to obtain updates the first time around, making it difficult to respond quickly to problems.

High administrative costs: Manual processes require a lot of time and effort, which increases costs and risks.
These problems are less suitable for modern manufacturing systems, where flexibility and responsiveness are required. Studies such as [What's Wrong with Traditional Planning Methods? | SHEA] (https://sheaglobal.com/what-is-wrong-with-the-traditional Methods-of-planning-mrp/) confirms the need to transition to more modern criteria to improve efficiency.
Let's implement dynamic adaptive planning (DAP) for organic production.
The main problems in planning organic production are:

- unpredictability (weather, crop yields).
- freshness restrictions (short shelf life).
- logistics (strict delivery deadlines).
- demand (market instability).

There is a scientific methodology for adaptive planning—an approach to managing production or systems that requires flexibility and adaptation to changing conditions.

This method is based on the principles of feedback, iteration, and uncertainty accounting. It is widely used in areas such as natural resource management, urban planning, climate research, and the development of complex technical systems.
The main principles of adaptive planning are:

- Iterativity: Plans are developed and adjusted online or in stages, taking into account new data and changes in the environment.
- Feedback: Continuous monitoring and evaluation of results allow for timely changes to plans.
- Flexibility: Plans must be flexible enough to adapt to new conditions or unexpected events.
- Accounting for uncertainty: Adaptive planning recognizes that the future cannot be accurately predicted and focuses on managing risks and uncertainties.

Adaptive planning basically boils down to almost stationary planning, such as switching to plan A or B, etc., if necessary. At the same time, it is a whole range of activities for technologists and specialists to consider different options for adapting production.

In this paper, we will consider methods (DAP) for online adjustment of organic product production planning to climatic and other changes in production conditions.

Hereinafter, we will refer to this methodology as dynamic adaptive planning of organic product production (DAP).
Effective dynamic and adaptive planning of organic product production processes requires a comprehensive approach that includes the use of various scientific methods.

Scenario planning, dynamic programming, adaptive control, machine learning methods, modeling and simulation, as well as reactive planning — all these methods can be useful for optimizing production processes and ensuring resilience to force majeure situations.

Thus, the DAP approach has the potential to implement modern technologies for real-time monitoring and analysis of organic product manufacturing data.

The main thing is that the chosen methodology really allows you to respond quickly to changes and maintain the efficiency of the production process, namely, it allows you to:

1. Real time: Planning must respond to events in real time. This means that the system must be able to track the current state of production and predict possible changes.
2. Forecasting and modeling: For effective correction, models that predict the impact of climate change and other factors on production processes must be used. These models will help to make timely adjustments to plans.
3. Automation: Automation plays an important role in making the process truly dynamic. It will minimize human involvement in routine operations and speed up decision-making.
4. Flexibility: The system must be flexible enough to easily adapt to various changes, whether weather conditions, fluctuations in demand, or other external factors.

To illustrate the method, let's consider a conceptual model (the actual model takes up several volumes) of organic wheat production, which will clearly show the key points, advantages, and effects of using DAP in organic production.
Structure of the DAP model for organic wheat production:

1. Land preparation component:
    - Verification of land certification as organic, without the use of synthetic chemicals. Term: 3 years.
    - Monitoring crop rotation and improvement through cover crops and the addition of compost or manure.
2. Seed selection component.
    - Checking organic seed certificates to avoid GMOs and chemical treatment.
    - Checking seed planting dates.
    - Control seed storage (warehouse temperature, etc.).
3. Planting component.
    - Control of planting processes in accordance with established recommendations.
    - Monitoring of recommendations during planting to prevent the spread of pests and diseases.
4. Vegetation and harvesting component.
    - Control of pests, insects, weeds, etc.
    - Monitoring of recommendations on fertilizers, implementation using compost, manure, or green manure.
    - Control and monitoring of vegetation.
    - Harvest control.
5. Warehouse and logistics component.
    - Control of new crop certification.
    - Warehouse and packaging control.
    - Logistics control.
    1. The following modules are available:
    1. 24.7 Dispatcher Module: round-the-clock control and monitoring of all components.
    2. 24/7 management module: for key managers and technology analysts for operational production management.
    3. Testing module: experimental laboratory for the production of new products.
    4. Supply chain management and traceability (SCM) module: SCM optimizes processes from raw material procurement to finished product delivery. For organic products, it is important to consider certification and environmental standards at every stage.
    5. NSI database module: a database of regulatory and reference information and forecasting.
    6. Analytics and Reports Module: analytical tools (e.g., Google Analytics, Mixpanel, Power BI) are used to collect data on how users interact with the application.

The main module is the NSI database, which contains all the logic for planning the DOP, with all components sequentially specified and logically linked. For traceability, implementation steps are specified and various planning scenarios are laid out [2,5,7], from which it is naturally impossible to deviate (logical control of the system).

The team of analysts and technologists always has the opportunity to develop a minimum viable product (MVP) through the testing module, test it, collect feedback, and improve the planning of new product production in subsequent iterations [1,6].

Before starting a project, the team conducts a risk analysis using methods such as Ishikawa diagrams (cause-and-effect analysis) or Monte Carlo modeling to assess potential problems, make forecasts, and develop strategies to eliminate them.

In case of force majeure situations, it is possible to manually control and adjust the plan through the control module.
The DAP methodology is based on our modernized AJILA methodology[2,3,4], which in turn is based on an empirical approach that includes four key elements: responsiveness, transparency, inspection, and adaptation.

Scientific methods, such as experimentation and A/B testing, can be used to test hypotheses and make data-driven decisions.
We have supplemented the AJILA methodology with responsiveness to change, which involves iterative development, corresponding to the scientific method, where hypotheses are tested and refined by technology analysts during production.

Improving product quality: Continuous testing and feedback allow us to create products that better meet user needs.
Thus, the integration of scientific methods into AGILA allows us to create higher quality products, minimize risks, and make informed decisions at every stage of development.

Based on the data, the team decides which features to improve and which to remove. For example, if the data shows that users rarely use integration with IoT devices, the team may reconsider its priorities.

The Analytics and Reports Module includes customer support and decision support systems (DSS), where DSS helps analyze data on demand, supply, and production capacity, which is especially useful for organic production, where it is important to consider many variables.

Farmers must consider market demand, prices, and costs to ensure economic sustainability. Although models for organic farming rarely differ, they use common tools such as budgeting and cash flow forecasting.

The supply chain management and traceability (SCM) module for transparency of production processes, certification tracking, and quality control methodologies is based on blockchain system methodology and principles.

The Odoo ERP system was chosen for implementation and automation. As a flexible ERP solution, it allows for process automation, traceability, and logistics optimization, which is especially important for compliance with organic requirements and freshness management.

The advantage of Odoo over other similar systems such as Oracle, SAP, etc., lies in its flexibility, pricing, and operating costs. Odoo allows you to quickly change your plan depending on changes in process conditions, as well as its flexibility in accounting for the specifics of organic production and use as a modular ERP system.

It should be noted that economic benefits have been achieved by optimizing routes using logistics modules in ERP (Odoo Inventory, Delivery). Short shelf life requires fast delivery to consumers, especially for fresh products.

The analytics and reports module uses the Odoo CRM system to analyze customer behavior and forecast the future, as well as actively using online sales (Odoo eCommerce) for direct access to users.

Resource planning has also been implemented: purchasing technical seeds, fertilizers, land, certified suppliers, and Odoo CRM tools for analyzing weather, historical data, and weather forecasts.

The higher price of organic products requires precise marketing and distribution planning to justify the costs.
Example: Organic cheese is 50% more expensive, but users are not always willing to pay more without clear benefits.

Modules that require strict control of documents or production processes are connected to sensors (soil, heat) for online data transfer and integration with IoT, with electronic signatures for documents.

Example of an operational change: when pests are detected by sensors, biological treatment is initiated.
Novelty of organic product planning

- Application of a cost-effective new methodology Dynamic adaptive planning of organic product production.
- A universal method for planning organic product production for automation has been developed.
- A model of end-to-end integration of all processes (NSI database) has been proposed and combined into a single system for control, monitoring, and error minimization.

Evaluation of the effectiveness of the DAP model in practice.
Based on data from a pilot project conducted at the A.I. Baraev Scientific and Production Center for Grain Farming (Astana), we present the results of a comparative analysis:
Traditional planning:
Frost → No reserve resources → Crop losses.
Drought → No possibility to quickly adjust irrigation → Reduction in yield.
DAP:
Frost → Automatic activation of greenhouses/shelters → Minimal losses.
Drought → Rapid redistribution of water resources → Maintenance of optimal humidity levels.
An example with figures.
Let's consider the case of organic vegetable production.
Traditional approach:

- Yield: 80% of potential
- Losses from climate change: 20%
- Costs for reserve resources: 10% of the total budget

DAP approach:

- Yield: 95% of potential
- Losses from climate change: 5%
- Automation and monitoring costs: 15% of total budget

Summary table:

Approach	Yield	Climate loss	Resource costs
Traditional	80%	20%	10%
Spring	95%	5%	15%

This example shows that although the initial costs of implementing DAP may be higher, the long-term benefits lie in reduced losses and increased overall production efficiency.

Let's consider a typical example: a traditional expenditure plan (in Kazakh tenge (KZT)) for planting strawberries on one conditional hundred square meters (2022).

Expense item	**Plan**	**Facts**	**Notes**
planting material	60 000	60 000	
site preparation	6 500	12 000	The 184.6% overrun is due to the early spring and frosts.
Irrigation system	2 800	2 800	
Fertilizers and plant protection products	1 500	2 300	The 153.3% overspending is due to rising fertilizer prices.
Labor costs	6 000	11 000	The 183.3% cost overrun is due to the emergency recruitment of seasonal workers.
Other expenses	2 000	4 000	The 200% cost overrun is due to operating costs for rescheduling work.

Expected yield:
1 plant = 0.6 kg per season (depending on variety and care)
600 bushes = 360 kg per 100 square meters
At a price of ~1000 tenge/kg: 360,000 KZT in revenue.
Facts about the harvest:
At a price of 1000 tenge/kg: 180,000 KZT in revenue.
Total: 50% loss of income.

According to research by the European Academy of Allergy and Clinical Immunology (EAACI), eating organic foods reduces the frequency of allergic reactions in children by up to 30%. The absence of synthetic pesticides reduces the immune load and lowers the risk of chronic inflammatory conditions. These effects are especially important for patients with asthma, dermatitis, and food intolerance.

Now let's look at an example of DAP expense planning (2023), as well as planting strawberries on one conditional hundred square meters.

Expense item	**Plan**	**Facts**	**Notes**
Caring for the harvest	6 500-11 500	9 300	Overspending due to late spring and frosts
Irrigation system	2 800-6 500	2 800	
Fertilizers and plant protection products	2 300-2 700	2 300	
Labor costs	6 000-10 000	8 000	Overspending due to a violation of logic
Other expenses	2 000-4 000	2 500	Operating cost overruns due to unforeseen work shifts

Expected yield:
At a price of ~1000 tenge/kg: 270,000 KZT in revenue/
Total loss of income by 20% overall compared to last year.
TOTAL: Optimized expenses and increased income in dynamics.

CONCLUSION

Thus, organic products are not only environmentally and agriculturally valuable, but also medically valuable. Their regular consumption reduces toxic load, improves nutritional status, supports gut microbiota, and helps reduce the risk of developing chronic diseases. The introduction of GAP systems improves the quality and safety of food products, which directly affects the health of the population.

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