Article

Analysis of Factors Affecting Legume Crop Yields

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Abstract: The article examines the issues of scientific analysis of factors affecting the cultivation of legume crops and determining the degree of their influence. The research provides a systematic review of the classification of legume species, as well as the economic, natural-ecological, and organizational aspects of their cultivation. The importance of legume crops in food security, soil fertility and climate change adaptation is evident. On the basis of the research findings, more attention to legume crops cultivation is required for their economic benefits which offer potential for export and sustainable agro-ecosystem. The results suggested the necessity to establish developing strategies for LFS and targeted planting patterns by area.

Keywords: legume crops, influencing factors, yield, economic efficiency, soil fertility, climate change, food security, export potential, agro-ecosystem sustainability.

1. Introduction

Currently, on a global scale, issues such as ensuring food security-particularly providing the population with nutritious and protein-rich products, improving "proper nutrition" and "zero hunger" systems, and the sustainable development of agriculture have become one of the top scientific and practical priorities. From this standpoint, optimizing the system of production of legume crops and implementing scientific justifications for influences thereon, in particular the specific weight of such influences at various weather situations (in case with regional distribution and stratification according to propensity to climatic conditions), becomes topical [1].

Legumes, particularly the beans, mung beans (Vignaradiata L.uruback), cowpeas (Vigna unguiculuta [L] walp.), chickpeas and soya beans are not only important food sources to human health but have a potential role in soil fertility maintenance and achieving agro- ecosystem sustainability.

Through their ability to fix atmospheric nitrogen, they naturally enrich the soil and increase the yield of subsequent crops [2]. Therefore, these crops create a synergistic effect in multi-sector agro-economic systems, allowing for rational use of land resources.

However, the sharp disparity in legume production volumes across regions, their high sensitivity to climate change, uneven market demand, and the low level of implementation of agrotechnical measures are among the factors negatively impacting the development of this sector [3]. The lack of an economic evaluation of legume crops by arable farms and the insufficient use of biologically evidenced crop production patterns in practice are now also considered problems [4].

A scientific assessment that has an influence on legume yield production only helps in gaining in-depth insight into agro-economic laws and resource utilization efficiency and facilitating the organization of production being as effective as possible [5].

Therefore, it is essential that these studies comprehensively examine the interdependence of natural-climatic, economic, technological, institutional, and social factors. For instance, factors such as the condition of the irrigation system, norms for using mineral and organic fertilizers, seed quality indicators, market infrastructure, and state support mechanisms directly impact both yield levels and economic efficiency [6].

In the works of Jennifer MacMillan and Curtis B. Adams [5], mineral fertilizer savings, yield increase, and economic efficiency were studied. Two or more dryland cropping systems were tested in each plot. FAO [6] and USDA [7] state that expanding the production of soybeans, chickpeas, and other legumes across the regions of our country is considered one of the most synergistic activities, simultaneously impacting the feed and raw material base, the processing industry (oil, protein concentrates), and natural fertilization opportunities. In the works of O.A. Blagopoluchnaya and N.I. Devterova [8], the economic efficiency of growing soybeans and corn for green mass versus red clover and mixed crops was assessed depending on the increase in nitrogen fertilizer dosage. Z. Bolatova [9] focused on solving problems related to cultivating cereal and legume crops under climate change conditions and identifying issues of economic efficiency. O.A. Blagopoluchnaya and N.I. Devterova [10] focused on assessing the profitability of soybean producers and identifying sources of inefficiency and production constraints.

2. Materials and Methods

Based on the types of legume crops and their grouping, the classification of legume crops, and the aspects justifying the necessity of cultivating legume crops, the distinctive characteristics of legume production were structured.

3. Results

The scientific-theoretical study of the efficiency of legume crops is also of decisive importance for enhancing food security and export potential. This is because their products enjoy stable demand on the world market and create opportunities for producing high value-added goods. Therefore, a deep theoretical study of this issue is a necessary condition for modernizing agriculture, ensuring economic stability, and improving agrarian policy [11].

Consequently, our research paid particular attention to the types and scientifically-based grouping of legume products (Figure 1). For this purpose, they were grouped based on their botanical characteristics, seed shape and types, as well as their directions of use in agriculture. Such research indicates that based on a taxonomic approach, crop types are separated into distinct classes, which helps identify their general and specific traits.

This allowed for the comparison of different legume crops and their economic efficiency indicators during the analysis. Furthermore, through this grouping, emphasis was placed on highlighting the advantages and agro-biological specificities of legume crops under various conditions [12]. In particular, even though some types are not cultivated in our country, they should be reflected within the general group of legumes; this serves as a scientific basis for expanding non-traditional crop areas and studying foreign experience in the future. The presented grouping serves to systematically summarize the research results and acts as a methodological basis for subsequent scientific and practical analyses
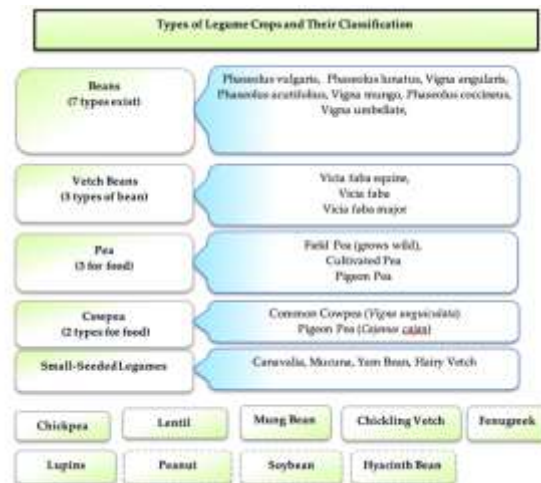
Figure 1. Types of Legume Crops and Their Classification

The scientific essence of classifying agricultural crops, including legume types, lies in creating the possibility for comparative analysis through the systematic study and grouping of their biological characteristics, agricultural importance, and climate adaptability. Such classification is of great importance in identifying similarities and differences between species, optimizing their cultivation technologies, and developing targeted recommendations by region [13]. Furthermore, the classification process serves as a fundamental scientific tool for enhancing agricultural efficiency, rational use of resources, and ensuring the effectiveness of scientific research.

The scientific study of the aspects driving the necessity for legume production is crucial for identifying priority directions in agrarian sector development. It involves joint consideration of economic, organisational, food security and natural-ecological factors. These drivers are described so that their effects on the cultivation of legumes can be analysed systematically through scientific research. As a result, we draw science-based recommendations to efficiently allocate resources in agriculture, improve productivity and establish sustainable production systems. From an economic perspective, cultivating legume crops not only meets domestic market demand but also serves to expand export opportunities and strengthen the country's foreign economic relations (Figure 2).
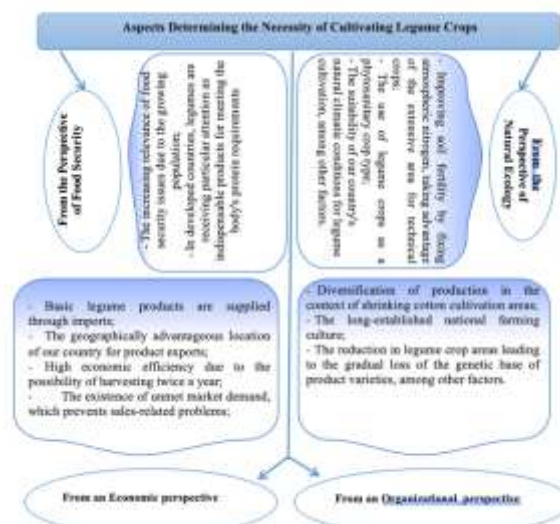

Figure 2. Aspects Determining the Necessity of Cultivating Legume Crops

From a natural-ecological and organizational perspective, legume crops play a crucial role in enhancing soil fertility, stabilizing nitrogen balance, and developing agro-ecological systems. At the same time, they are becoming major candidates for other crops

in order to decrease cotton planting area and promote agricultural structure diversification. Scientific evaluation of the parameters makes it possible to design the adequate agrotechnical and organizational condi tions for producing legume crops in various regions. This constitutes an important foundation for the pursuit of sustainable national food security, agricultural diversification and ecological stability at country level [14].

Having in mind that research on legume crops became even more relevant due to climate change. They contribute to fertilizer retention and build soil fertility, especially in the context of global warming, droughts or water resource decline. Growers can also adjust their agro-industrial system to climate change thanks to the existence of early and late-ripening varieties, adapted to various climates[15]. Under the guidance of science, cultivation technologies lifted for different agricultural situations and climate-resilient varieties are identified.

The steady markets for legume crops and their strategic value to processing industries demand scientific investigating. Research contributes to increase economic effectiveness of the production and improve competitiveness, export potential in the foreign market. Furthermore, the advantages related to long-term storage and convenient transportation of these products are scientifically evaluated, ensuring market stability. This makes legume crops a significant component within the agro-industrial system and the national economy.

4. Conclusion

Based on a comprehensive analysis of factors influencing legume crop cultivation, their classification into economic, natural-climatic, and organizational groups has been substantiated. The data obtained allowed to propose a science based typing of legume types and to identify 12 key types with their agro-biological features.

Legume crops Nitrogen as a biological fixation can fix 50–300 kg nitrogen/ha Organizational work byRhizobial fixes this diversification from banana only to tinsel based cropping system) in addition is another determinant success possibility of such crops and for this reason expansion these legumes with increase fertility at least 30-40 percent reduction for mineral fertilizer apply Iouplescu, ac., et.

Estimation of economic efficiency indicated a high export orientation of legume crops and their broad use in the processing industry. The high protein content (20-40%) of the products indicates their importance as a key resource for ensuring food security.

15 key factors driving the necessity of cultivating legume crops were identified, and their interdependence and priority were substantiated.

1. It is recommended to develop a targeted cultivation strategy for legume crops by region and create scientific-practical guidelines.
2. Measures are needed to strengthen the support of a state for the creation of processing leguminous industry, export potential.

Therefore it is suggested to prepare a plan for the large-scale application of legume crop rotation system in order to enhance soil fertility and reduce mineral fertilization use. Intensive research on breeding of drought-resistant varieties of legumes and testing of new technologies under climate change scenario is recommended.

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