O‘ZBEKISTON RESPUBLIKASI OLIY TA’LIM, FAN VA INNOVATSIYALAR VAZIRLIGI

MIRZO ULUG‘BEK NOMIDAGI O‘ZBEKISTON MILLIY UNIVERSITETINING JIZZAX FILIALI

KOMPYUTER ILMLARI VA MUHANDISLIK TEXNOLOGIYALARI

mavzusidagi Xalqaro ilmiy-texnik anjuman materiallari to‘plami

2026-yil 25-26-sentabr

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Kompyuter ilmlari va muhandislik texnologiyalari. Xalqaro ilmiy-texnik anjuman materiallari to‘plami – Jizzax: O‘zMU Jizzax filiali, 2026-yil 25-26-sentabr. 315-bet.

Xalqaro miqyosidagi ilmiy-texnik anjuman materiallarida zamonaviy kompyuter ilmlari va muhandislik texnologiyalari sohasidagi innovatsion tadqiqotlar aks etgan.

Globallashuv sharoitida davlatimizni yanada barqaror va jadal sur’atlar bilan rivojlantirish bo‘yicha amalga oshirilayotgan islohotlar samarasini yaxshilash sohasidagi ilmiy-tadqiqot ishlariga alohida e’tibor qaratilgan. Zero iqtisodiyotning, ijtimoiy sohalarni qamrab olgan modernizatsiya jarayonlari, hayotning barcha sohalarini liberallashtirishni talab qilmoqda.

Ushbu ilmiy ma’ruza tezislari to‘plamida mamlakatimiz va xorijlik turli yo‘nalishlarda faoliyat olib borayotgan mutaxassislar, olimlar, professor-o‘qituvchilar, ilmiy tadqiqot institutlari va markazlarining ilmiy xodimlari, tadqiqotchilari, magistr va talabalarning ilmiy-tadqiqot ishlari natijalari mujassamlashgan.

Mas’ul muharrirlar: DSc.prof. Turakulov O.X., t.f.n., dots. Baboyev A.M.

Tahrir hay’ati a’zolari: p.f.d.(DSc), prof. Turakulov O.X., t.f.n., dots. Baboyev A.M., t.f.f.d.(PhD), prof. Abduraxmanov R.A., p.f.f.d.(PhD) Eshankulov B.S., p.f.n., dots. Aliqulov S.T., p.f.n., dots. Alimov N.N., p.f.f.d.(PhD), dots. Alibayev S.X., т.f.f.d.(PhD), dots. Abdumalikov A.A, p.f.f.d.(PhD) Hafizov E.A., f.f.f.d.(PhD) dots., Norbekova B.Sh. p.f.f.d.(PhD) dots. Sindorov L.K., t.f.f.d.(PhD), dots. Nasirov B.U., b.f.f.d. (PhD) O‘ralov A.I., p.f.n., dots. Aliqulov S.T., t.f.f.d.(PhD) Kuvandikov J.T., i.f.n., dots. Tsoy M.P., Sharipova S.F., Jo‘rayev M.M.

Mazkur to‘plamga kiritilgan ma’ruza tezislarining mazmuni, undagi statistik ma’lumotlar va me’yoriy hujjatlarning to‘g‘riligi hamda tanqidiy fikr-mulohazalar, keltirilgan takliflarga mualliflarning o‘zlari mas’uldirlar.

Uchinchi bosqich – belgilarni tanlash. Oldingi jadallik qiymatlari, tezlik, zichlik, vaqt ko‘rsatkichi va yo‘l sharoitlari orasidan bashorat uchun muhim bo‘lganlari tanlanadi.

To‘rtinchi bosqich – neyron tarmog‘ini o‘qitish. Ma’lumotlar o‘qitish va test qismlariga ajratilib, model o‘qitish to‘plamida moslashtiriladi.

Beshinchi bosqichda modelning aniqligi alohida test ma’lumotlarida tekshiriladi. [6]

Harakat jadalligini qisqa muddatli bashorat qilish usullari transport oqimidagi o‘zgarishlarni oldindan ko‘rish imkonini beradi. Bunday prognozlar yo‘l harakatini boshqarish, svetoforlarni boshqarish rejimlarini takomillashtirish, tirbandlik ehtimoli yuqori bo‘lgan vaqtlarni aniqlash va transport oqimini muqobil yo‘nalishlarga taqsimlash kabi vazifalarda axborot sifatida xizmat qilishi mumkin. Bashorat natijasi boshqaruv qarorining o‘zi emas, balki qaror qabul qilishni qo‘llab-quvvatlovchi hisob-kitob natijasi sifatida qaraladi. [5]

XULOSA

Xulosa qilib aytganda, harakat jadalligini bashorat qilish transport oqimlarini samarali boshqarishda muhim ahamiyat kasb qilqdi. Transport oqimining ko‘p omilli va ehtimoliy ko‘rsatkichlari uni faqat sodda matematik bog‘lanishlar orqali ifodalashni qiyinlashtiradi. Sun’iy intellekt va neyron tarmoqlari oldingi mavjud ma’lumotlardan foydalanib, jadallikning vaqt bo‘yicha o‘zgarish qonuniyatlarini o‘rganish imkonini beradi. Shu asosda transport ma’lumotlarini yig‘ish, ajratish, tanlash, neyron tarmog‘ini o‘qitish, test qilish va kelajakdagi qiymatlarni bashoratlashdan iborat uslubiyot shakllantiriladi.

Foydalanilgan adabiyotlar ro‘yxati:

1. May A.D. Traffic Flow Fundamentals. – New Jersey: Prentice Hall, 1990.
2. May A.D. Traffic Flow Fundamentals. – New Jersey: Prentice Hall, 1990.
3. Treiber M., Kesting A. Traffic Flow Dynamics: Data, Models and Simulation. – Berlin: Springer, 2013.
4. Goodfellow I., Bengio Y., Courville A. Deep Learning. – Cambridge: MIT Press, 2016.
5. Haykin S. Neural Networks and Learning Machines. – Pearson, 2009.
6. Azizov Q.H. Harakat xavfsizligini tashkil etish asoslari. – Toshkent: Fan va texnologiya, 2009.

THE ROLE OF INTELLIGENT MODELS IN REPEATED CROP SELECTION AND YIELD PREDICTION UNDER AGRO-CLIMATIC CONDITIONS

t.f.f.d. Khasanov Dilmurod
Department of Computer Science and Programming, Jizzakh Branch of the National University of Uzbekistan named after Mirzo Ulugbek
tatusf2015@gmail.com
Shirinboyev Ravshan
Department of Computer Science and Programming, Jizzakh Branch of the National University of Uzbekistan named after Mirzo Ulugbek

I. Introduction

In Uzbekistan, the growing demand for agricultural products is increasingly associated with population growth, rising food consumption, and a greater need for natural and high-quality products. Under these conditions, improving the efficiency of land and water use has become an important task for the agricultural sector. One promising approach is the wider use of repeated cropping, where a second crop is cultivated after the main crop has been harvested within the same agricultural season. Proper selection of such crops can increase land productivity, improve food supply, and support more efficient use of available agricultural resources.

The selection of a suitable repeated crop depends on many interrelated factors, including temperature conditions, precipitation, humidity, soil characteristics, irrigation availability, vegetation period, and the type of the previously cultivated crop. Because these factors interact in a complex manner, selecting an appropriate crop using only conventional decision-making approaches may be difficult. In addition, the same crop can demonstrate different productivity levels under different regional and agro-climatic conditions.

Artificial intelligence and machine learning methods provide an opportunity to analyze such multidimensional agricultural data and identify hidden relationships among climatic, soil, and productivity indicators. In this context, classification models can be used to determine the most suitable repeated crop for a given set of agro-climatic conditions, while regression and forecasting models can estimate its expected yield. Such an approach can support the development of intelligent decision-support systems capable of providing region-specific crop recommendations.

Therefore, the development of models and algorithms for repeated crop classification and yield prediction based on agro-climatic parameters is a relevant scientific and practical task for Uzbekistan. Such intelligent solutions can contribute to more rational use of agricultural resources, higher land productivity, and improved satisfaction of the growing demand for natural agricultural products.

II. Socio-Economic and Agricultural Relevance of Repeated Cropping in Uzbekistan

The relevance of increasing agricultural productivity in Uzbekistan is closely associated with demographic growth and expanding food demand. According to the National Statistics Committee, the permanent population increased from 31.02 million in 2015 to 37.54 million in 2025, corresponding to an increase of approximately 6.52 million people, or 21.0%, within ten years. Population growth directly increases the demand for vegetables, cereals, fruits, potatoes, legumes, and other agricultural products and places additional pressure on limited land and water resources.

Consumer demand has also expanded substantially. Household final consumption expenditure increased from approximately UZS 173.5 trillion in 2015 to UZS 1,175.0 trillion in 2025 at current prices. Similarly, annual retail turnover per capita rose from approximately UZS 2.01 million in 2015 to UZS 12.70 million in

2025. These nominal indicators are partly affected by price changes and therefore should not be interpreted purely as physical consumption growth; nevertheless, they illustrate the considerable expansion of the consumer market and household demand over the last decade.

Table 1. Selected demographic, consumption, and agricultural indicators relevant to repeated cropping

Indicator	Earlier value	Recent value	Change
Permanent population	31.02 million (2015)	37.54 million (2025)	+21.0%
Household final consumption expenditure	UZS 173.5 trillion (2015)	UZS 1,175.0 trillion (2025)	≈ 6.8 times
Retail turnover per capita	UZS 2.01 million (2015)	UZS 12.70 million (2025)	≈ 6.3 times
Agriculture, forestry and fisheries share	–	17.3% of sectoral structure, 2025	Major economic sector
Agricultural output	–	UZS 538.9 trillion, 2025	+4.4% year-on-year
Repeated crops on land released from grain	–	898 thousand ha, 2025	More than 12 million tons of products

Agriculture continues to occupy an important position in the national economy. In 2025, agriculture, forestry and fisheries accounted for approximately 17.3% of the sectoral structure of Uzbekistan's GDP, while the total volume of products and services generated by the sector reached UZS 538.9 trillion, representing a 4.4% increase compared with 2024. These figures indicate that even relatively small improvements in land-use efficiency and crop productivity can have meaningful economic and food-security implications.

The importance of producing safe and natural food has also become more visible during periods of heightened public-health risk. International evidence from the COVID-19 period showed a substantial shift toward health-oriented and organic food consumption. Global organic retail sales exceeded EUR 120 billion in 2020, increasing by approximately EUR 14 billion in a single year, while FiBL associated this exceptional growth partly with increased attention to health and food quality during the pandemic. Another household survey reported that 51% of respondents increased their consumption of organic and natural foods, including fruits and vegetables, during the pandemic. Although these figures are international rather than Uzbekistan-specific, they demonstrate a broader tendency for health risks to increase consumer attention to the quality and natural origin of food products.

Under increasing demand, simply expanding cultivated land is neither always feasible nor sustainable. A more practical strategy is to increase the productivity of existing agricultural land. In this context, repeated cropping provides an important

opportunity because agricultural fields released after the harvest of an early or main crop can be used again during the same year. Official data show the scale of this opportunity in Uzbekistan: in 2025, repeated crops were cultivated on approximately 898 thousand hectares of land released from grain production, generating more than 12 million tons of agricultural products. In addition, repeated crops were planted on about 319.2 thousand hectares of household plots.

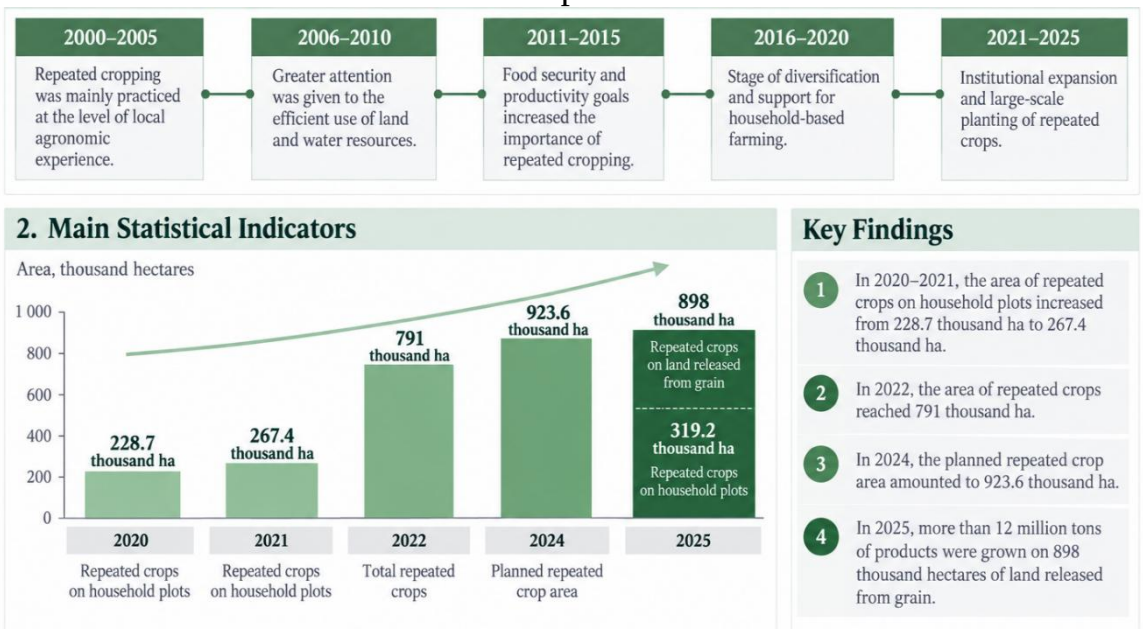


Figure 1. Growth of repeated cropping in Uzbekistan (2000-2025)

These statistics demonstrate that repeated cropping is already an important component of agricultural land use in Uzbekistan. However, its effectiveness depends on selecting a crop that is compatible with the remaining growing period, accumulated temperature, soil conditions, water availability, humidity, precipitation, and other agro-climatic factors. An unsuitable crop may lead to low yield or inefficient use of water and land, whereas an appropriate crop can increase annual production from the same cultivated area.

Consequently, the problem can be formulated not only as an agronomic decision but also as an intelligent classification and prediction task. Given a vector of agro-climatic and agricultural parameters

$\mathrm{X} = [x_1, x_2, \ldots, x_n]$ an intelligent model can first determine the most suitable repeated crop, $\hat{C} = f(\mathrm{X})$, and subsequently estimate its expected yield, $\hat{Y} = g(\mathrm{X}, \hat{C})$. Thus, demographic growth, expanding consumption, increasing demand for safe agricultural products, the economic importance of agriculture, and the large-scale practical use of repeated cropping together provide a strong basis for developing classification and yield-prediction models for intelligent repeated-crop selection under the agro-climatic conditions of Uzbekistan.

III. Conclusion

Repeated cropping is an important approach for improving the efficiency of agricultural land use in Uzbekistan, particularly under conditions of population growth, increasing food demand, and limited land and water resources. The effectiveness of repeated cropping depends strongly on agro-climatic conditions, soil characteristics, irrigation availability, and the remaining vegetation period. Therefore,

the development of intelligent classification and yield-prediction models can support the selection of suitable repeated crops for specific regional conditions. Such systems can contribute to higher land productivity, more efficient resource use, and improved agricultural decision-making.

References

[1] National Statistics Committee of the Republic of Uzbekistan, "Number of Permanent Population of the Republic of Uzbekistan," Tashkent, 2025.

[2] Ministry of Economy and Finance of the Republic of Uzbekistan, "Analytical Report on the Fulfillment of Target Indicators in Agriculture, Forestry and Fisheries by the End of 2025," Tashkent, 2026.

[3] National Statistics Committee of the Republic of Uzbekistan, "Gross Value Added of Industries at Current Prices: Agriculture, Forestry and Fisheries," SIAT Statistical Database, 2026.

[4] Research Institute of Organic Agriculture (FiBL), "Global Organic Market: Unprecedented Growth in 2020—Organic Retail Sales Grew by 14 Billion Euros and Exceeded the 120-Billion-Euro Mark," 2022.

[5] T. van Klompenburg, A. Kassahun, and C. Catal, "Crop Yield Prediction Using Machine Learning: A Systematic Literature Review," *Computers and Electronics in Agriculture*, vol. 177, art. 105709, 2020, doi: 10.1016/j.compag.2020.105709.

[6] A. Chlingaryan, S. Sukkarieh, and B. Whelan, "Machine Learning Approaches for Crop Yield Prediction and Nitrogen Status Estimation in Precision Agriculture: A Review," *Computers and Electronics in Agriculture*, vol. 151, pp. 61–69, 2018, doi: 10.1016/j.compag.2018.05.012.

[7] M. A. Jabed and M. A. A. Murad, "Crop Yield Prediction in Agriculture: A Comprehensive Review of Machine Learning and Deep Learning Approaches, with Insights for Future Research and Sustainability," *Heliyon*, vol. 10, no. 24, art. e40836, 2024, doi: 10.1016/j.heliyon.2024.e40836.

[8] S. Khaki and L. Wang, "Crop Yield Prediction Using Deep Neural Networks," *Frontiers in Plant Science*, vol. 10, art. 621, 2019, doi: 10.3389/fpls.2019.00621.

[9] S. Khaki, L. Wang, and S. V. Archontoulis, "A CNN-RNN Framework for Crop Yield Prediction," *Frontiers in Plant Science*, vol. 10, art. 1750, 2020, doi: 10.3389/fpls.2019.01750.

[10] A. K. Srivastava et al., "Winter Wheat Yield Prediction Using Convolutional Neural Networks from Environmental and Phenological Data," *Scientific Reports*, vol. 12, art. 3215, 2022.

[11] H. Afzal et al., "Incorporating Soil Information with Machine Learning for Crop Recommendation to Improve Agricultural Output," *Scientific Reports*, vol. 15, art. 8560, 2025, doi: 10.1038/s41598-025-88676-z.

[12] M. S. B. Alam, V. Esichaikul, A. Lameesa, S. F. Ahmed, and A. H. Gandomi, "An Approach for Crop Recommendation with Uncertainty Quantification Based on Machine Learning for Sustainable Agricultural Decision-Making," *Results in Engineering*, vol. 26, art. 105505, 2025, doi: 10.1016/j.rineng.2025.105505.