Remote seeding diagnostics in the Chechen Republic

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Abstract. This research work discusses and illustrates the development of theoretical concepts of remote diagnostics of soils and technical potentials for diagnosing the germination, growth, and development of potato seeding process on the territory of Ltd. Scientific production firm “Sady Chechni”. In addition, the issues considered in this research article allow us to create the technological methods and techniques that allow more efficiency determine the need for agricultural crops to optimize their macro – and micronutrients.

1. Introduction

The constantly increasing volume of introduction into the practice of agricultural production of precision technologies, ensuring the optimization of financial costs for growing crops and reducing the pesticide load on agroecosystems, determines the need to create modern information monitoring systems that associate the latest achievements of space and aviation information technologies, as well as systems of high – performance ground measurements. Nowadays, scientific and technological progress and, above all, the level of development of information technology allows implementing scientific and methodological developments in the form of digital platforms for managing the agro-industrial complex at different levels of its organization [1, 2, 3]. This applies to both the automated collection of natural-agronomic and production indicators, and the operational analysis of limiting factors and threats for the development of preventive response measures in accordance with the target function. Prototypes of such platforms (ANT, ExactFarming, Cropio, Agrivi, etc.) allow real-time monitoring of the state of crops, documentation, forecasting and planning of agricultural operations at the enterprise level [4, 5]. The functionality of such information systems currently does not provide an assessment and management of the seeding diagnostics and the needs of the crop under the influence of climate change and anthropogenesis. Only the services of actual weather and its short-term forecast are available for planning agro-technical operations, visualizing the results of agrochemical monitoring, monitoring crops and recording yields with the identification of fertility zones. The most developed information systems such as commercial products are in the USA, Canada, Denmark, Holland, Australia and New Zealand (table 1).
### Table 1. Comparative analysis of commercial information systems (digital platforms) in the field of agricultural production management in terms of accounting for soil-agro-ecological and weather-climatic factors.

| Information system                                      | Accounting for soil-agro-ecological and weather-climatic factors |
|---------------------------------------------------------|---------------------------------------------------------------|
|                                                         | Weather (W) and climatic (C)                                  |
|                                                         | Agrodepletion                                                 |
|                                                         | Waterlogging or drought                                       |
|                                                         | Compaction                                                    |
| Decision Support System for Agrotechnology Transfer (DSSAT) Cropping System Model | W                                                             |
| The Agricultural Production Systems iMulator (APSIM)     | W                                                             |
| STICS (Simulateur mulTI disciplinaire pour les Cultures Standard) | W                                                             |
| Soil Navigator Decision Support System                   | W                                                             |
| Cropio                                                  | W                                                             |
| LandCaRe Decision Support System [50]                   | W and C                                                       |

In addition to the tasks of increasing the efficiency of management of an agricultural enterprise, information systems of the agro-industrial complex are being developed in the interests of executive authorities in the system of statistical accounting, remote seeding diagnostics, land supervision in the framework of state monitoring of lands, and the implementation of economic policy measures. The Ministry of Agriculture of the Russian Federation is developing the Unified Federal Information System of Agricultural Lands (UFI SAL) in order to ensure accounting of such lands, consolidate information on their qualitative characteristics and actual use under the state monitoring program [6,7].

2. **Methodology and results**

Unfortunately, the land and soil management in the digital transformation of agriculture in the Chechen Republic is developed very poor, therefore, in the Agricultural ministry there is a new program that works to digitalize the land and soil management information, where the soil relief map with soil types on the map was digitalized (figure 1).
Figure 1. The typical soil types of the Chechen Republic.

From the figure above (figure 1) the typical soil types of the Chechen Republic are demonstrated on the digitalized map, where Ltd. Scientific production firm “Chechen gardens” illustrated between “Grozny” and “Gudermes district” on the soil type – leached carbonate chernozems. The chemical soil tests showed that, the type of leached carbonate chernozems characteristically has poor nitrogen, surplus phosphorous and very little potassium.

In the Ltd. Scientific production firm “Sady Chechnya” potato seeds were sown in the field (figure 2) in the beginning march of 2020, however, after 90 days, from the figure bellow, (figure 2) within remote sensing data, the growing plants were diagnosed to be in the lack of nutrient, the plants were need for nitrogen (figure 3). The usage of the remote diagnostic programs minimizes risks of the crop failure, as the program helps to determine the needing of the sown crops in the field.

The first stage of the development of a software prototype for remote diagnostics of crops should include substantiation of organizational and methodological approaches to the creation, development and operation of an information system that provides access to analytical services for remote diagnostics for agribusiness entities in the target region of the Chechen Republic, taking into account different types of soil.
3. Conclusion

To sum up, the remote diagnostics of crops determines the relevance of creating information services for inventorying and monitoring the state of crops, crops under conditions of climate change and anthropogenic impacts, assessing the risks associated with soil degradation, lack of nutrients and scenario modeling of programmed measures. Such software products are of particular relevance both for agricultural farms and for the entire agro-industrial complex of Russia, where a strategy should be developed to counteract various processes that retard the growth and development of the planted material, including with the use of environmental and economic mechanisms.

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