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PROGRESS ANALYSIS AND OUTLOOK OF DONGYING BASE

Soundar Mallik
Research Centre on Agriculture and Environment, CREA-AA, Rome, Italy.

Abstract: The Yellow River Delta is an important ecological functional area in my country and a key area for achieving national food security. This article reviews the recent research progress of Ludong University's Dongying base for the high-quality development of modern agriculture integrating industry and education, and analyzes several important research issues surrounding ecological protection and high-quality development in the Yellow River Delta from the perspectives of food security and ecological environment protection, pointing out These are the scientific challenges that need to be overcome, and the prospects for major research areas such as comprehensive management and efficient utilization of saline-alkali soil are prospected.
Keywords: Dongying Base; Yellow River Triangle; Comprehensive management of saline-alkali land; Ecological protection; High-quality agricultural development

1 MAIN TESTS CARRIED OUT AT DONGYING BASE

The Yellow River Delta is one of the youngest deltas and new lands in the world, as well as the youngest wetland ecosystem. The ecological environment is fragile, and the interaction of river-sea-continent forms a unique geographical environment. The Yellow River Delta region is rich in water and soil resources, but is troubled by salinity and alkali. The land is seriously abandoned and the land area with development potential exceeds 5,000 km2. The research and development, application and industrial development of saline-alkali land management and agricultural utilization technologies not only meet the development needs of the national strategy, but also have broad market prospects. Saline soils are widely distributed in my country, which has raised diversified scientific issues and distinctive research objects for the study of saline soils in my country [1]. The occurrence of salinization and the formation of saline soil are mainly controlled by the migration and redistribution of water and salt in the soil under the influence of natural and artificial factors. The soil water and salt movement process and Its regulatory mechanism is still the core of saline soil research [2]. At present, the improvement and salinization control of saline soil include physical, chemical, hydraulic and biological approaches. The essence is to directionally adjust soil salinity by changing the upper and lower boundary conditions of the soil and related soil-water-air-generation parameters. The movement and aggregation process [3]. At the local level of geography, agricultural practice research and service in my country, the experimental station plays an important scientific and technological support and demonstration function. To this end, Ludong University and the Dongying Municipal Government established the "Ludong University Dongying Base for the High-quality Development of Modern Agriculture with Integration of Industry and Education" (hereinafter referred to as the Dongying Base).

The Dongying base relies on the provincial key discipline of "Physical Geography" and the innovative team building of agricultural hydrology and water resources, closely follows the major technical needs of modern efficient agriculture and environmental safety, and closely follows the current status and trends of the development of disciplines for efficient utilization of coastal water and soil resources. The main land use types of the Yellow River Delta, multi-scale, real-time monitoring of dynamic changes and mutual feedback mechanisms of water, fertilizer, salt, and heat in vegetation and soil, clarifying soil hydrological processes and their ecological effects from the perspective of the earth's critical zones, and regulating them through different technical measures , to meet the ecological and environmentally friendly land use requirements of water conservation, quality improvement, efficiency enhancement, and pollution reduction. The completion of the research base can serve as the basis for Ludong University to engage in related field work in the Yellow River Delta in the future. It can also be used as an ideal place for campus-site integration and student internship. It is an important step to implement the "major national strategy of ecological protection and high-quality development of the Yellow River Basin" This important measure is of great significance for regional data observation in the Yellow River Delta, ensuring regional food security, and effectively serving the local area through scientific research.

1.1 Groundwater Level Control and Ecological Island Construction Technology

The groundwater level in the Yellow River Delta is shallow and highly mineralized. The regulation of water and salt in farmland must not only maximize the potential of groundwater resources, but also prevent soil salt accumulation. In underground saline water areas, if agricultural production is to be achieved, the groundwater level needs to be controlled below the critical groundwater level and within the overlap range of groundwater production subsidies. The ecological island experiment achieved the purpose of controlling different groundwater levels by raising the surface height (1, 1.5 and 2 m), which provided innate conditions for salt leaching, and then used brackish water irrigation technology to utilize the brackish water underground to The surface soil is washed and desalinated to achieve the purpose of "soil improvement, water saving, and salt control" [4]. This method can construct different allocation models for efficient utilization of water and soil resources in saline soil areas based on different habitat conditions (soil salinity and groundwater level). The relevant results can be promoted and applied in high-salinity saline-alkali areas such as Dongying City Modern Agriculture Demonstration Zone. It is of great significance for the research on the efficient utilization of saline-alkali land. The expected radiable area is 666.67 hm2 of land with high saline-alkali content in Dongying. The research results have been applied for 1 domestic invention patent and 1 international patent.

1.2 Comprehensive Soil Improvement Technology in Saline-Alkali Soil

Soil improvement experiments mainly focus on problems such as high alkalinity, extremely low organic matter content, and poor soil structure in saline-alkali soils. Field in-situ experiments and simulation studies are carried out, using chemical improvement measures such as desulfurization gypsum and superphosphate, and organic material improvement measures such as straw and lignite. Humic acid, leguminous green manure, dealkalization No. 3, using different types of local halophytes to make different modified biochars, using technologies such as metagenomic analysis, isotope labeling and aggregate classification to explore different improved fertilizer methods Effects on soil physical and chemical properties and crop yields, study the impact of low-cost improved products on soil nutrient retention in saline-alkali lands, reveal the interaction mechanism between plant roots-soil-microorganisms in coastal saline-alkali lands, and clarify the role of improved fertilizer measures in improving soil fertility in saline-alkali lands Influence mechanism, select the optimal combination method to promote efficient agricultural utilization of saline-alkali land, and integrate different organic-inorganic key technologies for improving saline-alkali land in coastal areas. It enriches the theory on the evolution process of soil fertility in saline-alkali land from an academic level, and provides technical approaches for the healthy development of soil and increased crop production and efficiency in the area from an application level. The study found that adding straw, straw + desulfurization gypsum can significantly reduce the pH and alkalization degree (ESP) of coastal saline-alkali soil; compared with straw alone, straw + desulfurization gypsum can reduce soil alkalization degree and sodium adsorption to varying degrees. ratio (SAR) and soluble Na+ content, but increased soluble Ca2+, SO42content and organic carbon content. To clarify the soil organic carbon (SOC) turnover process under the composite improvement measures of straw and desulfurization gypsum, and to reveal the key factors that the composite improvement measures affect SOC retention. Returning a medium amount of straw to the field (10 t hm2) + desulfurization gypsum (29 t hm2) is a better combination of improvement measures in this area. This method has a significant effect on saline-alkali soils with medium and low salinity. The area of land with moderate saline-alkali content in Dongying that is expected to be radiated is 1333.33 hm2.

1.3 Bioconversion Technology of Livestock and Poultry Manure

Agricultural environment-friendly animal husbandry relying on bioconversion and recycling technology of livestock and poultry manure has always been the direction of sustainable development in my country. Today, poultry and livestock manure is mostly treated with natural drying method and pit-type high-temperature fermentation method and then applied to farmland as organic fertilizer. , which not only affects the living environment of surrounding residents, but the remaining heavy metals, antibiotics, and pathogenic bacteria have caused serious pollution to the surface, groundwater, and soil. Based on the development concept of combining agricultural waste resources with planting and breeding, the black soldier fly eco-industrial technology is introduced, using the 7 to 10 days of feeding process of the black soldier fly larvae, combined with the heat production of the insect body and the role of its own beneficial bacteria, Ferment and decompose livestock and poultry manure, leaving dry and soft insect manure sand and commercial larvae. Its prepupae contain 32% protein, 37% fat, 19% minerals, and 9% chitin. The crude protein in the adult stage can be as high as 57.6%, and 21.6% fat. It can be directly used as high-protein commercial feed. For sale, worm manure sand is a high organic matter soil improvement preparation. Based on the high organic matter content and low nitrogen and phosphorus content of insect excrement sand, we used the halophytes Suaeda salsa and the commercial crop rice, the pioneer halophytes in saline-alkali soil improvement, to carefully combine and screen the rhizosphere of halophytes in the Yellow River Delta for efficient phosphorus solubilization. bacteria, nitrogen-fixing bacteria and other highly efficient salt-tolerant functional growth-promoting bacteria, combined with greenhouse pot simulation and field in-situ experiments, using a variety of interdisciplinary technologies such as isotope labeling, core microbiome analysis, metagenomics and proteomics to clarify livestock and poultry manure The resource product preparation promotes the growth of halophytes and improves the saline-alkali soil with different salinities in the Yellow River Delta. The expected radiable area is 666.67 hm2 of land with medium and high saline-alkali content in Dongying, and relevant research results are being applied for national patents.

1.4 Wetland Ecological Protection

Wetland ecological protection is an important ecological project and an important part of the construction of national ecological civilization. As the most complete, vast and youngest wetland ecosystem in my country's warm temperate zone, the Yellow River Delta has huge socio-economic benefits and irreplaceable ecological and environmental functions. However, due to changes in the natural environment and interference from human factors, the Yellow River Delta wetland ecosystem has suffered great damage, with degraded ecological functions and prominent environmental problems. Tamarix Chinensis, the most important community species in the Yellow River Delta, plays an irreplaceable role in maintaining the stability of coastal wetland ecosystems. On the one hand, Tamarix can increase soil organic matter, reduce soil salinity, and improve soil structure; on the other hand, Tamarix has functions such as preventing soil erosion, weakening coastal erosion, and maintaining bank stability. Therefore, focusing on the species Tamarix in the Yellow River Delta, we systematically conducted research on the above-ground physiological and ecological characteristics of Tamarix, the growth and distribution patterns of underground parts, and its response to the water and salt environment in the root zone, and clarified the transpiration water consumption patterns of Tamarix, water sources, and its response to environmental stress. The response mechanism, etc., can reveal the growth and development patterns and ecohydrological processes of the above and below ground parts of Tamarix in the Yellow River Delta, and ultimately provide theoretical guidance for the protection and restoration of the Yellow River Delta wetland ecosystem.

2 RECENT RESEARCH FOCUS

2.1 Groundwater Level Control and Salt Source Isolation Soil Construction

Traditionally, soil water and salt control measures have been diverse, including various soil improvement, irrigation, and water conservancy projects with the characteristics of water saving, salt control, and green efficiency. The core is to inhibit the upward movement of salt (such as mulching) and improve soil by reducing evaporation. Regulation can be achieved through structures that promote salt leaching (such as amendments), create barriers to block the upward movement of salt (such as partitions), or increase soil drainage to speed up soil salt discharge (such as hidden pipes) [3]. With the continuous deepening of materials science research in recent years, new methods for physical control of salinization such as degradable mulch films, biomass materials, porous adsorbent materials, and nanomaterials have emerged. Recently, Swallow and O'Sullivan tested a new plant bionic desalination method based on the principle of plant bionics. They designed and produced desalination materials that imitated the water absorption principle of vascular plants, added them to the soil, and used natural evaporation to remove groundwater Soil salts are precipitated through a crystallization process and then removed directly from the surface [5]. Indoor tests have shown that this method can quickly reduce the soil salt content from 8% to 0. 8%, and the salt removal effect is very obvious, but there is still a lack of field application effect verification. Generally speaking, the mechanism of physical control measures is relatively clear and highly operable. The control effects vary according to soil texture, profile configuration, meteorological and groundwater conditions, irrigation water quality and quantity, etc. The saline soil in the Yellow River Delta has shallow groundwater. To improve the fertility of lowand medium-yield fields and to develop high-quality agriculture in saline-alkali areas, groundwater management and control is the core, and blocking salt sources is the guarantee. Key technologies based on the optimization and control of groundwater are developed to build a soil that effectively blocks salt sources. Models (such as straw, mulch layer; natural water-stagnant layer in soil profile) can provide theoretical basis and technical support for saline soil improvement and efficient agricultural production in the area. Underground pipe salt drainage can be achieved by laying a perforated drainage pipe network at a certain depth underground to keep the groundwater level below the critical burial depth, which is suitable for low-lying areas, shallow groundwater burial depth, or secondary salinization irrigation areas [6]. However, it should be noted that the Yellow River Delta is rich in groundwater resources, and if utilized properly, it is also a resource. Based on this, we redefine the "groundwater benefit interval" the interval where the groundwater level is regulated below the critical groundwater level and the groundwater production subsidy overlaps, and this is used as the theoretical standard for groundwater regulation [7]. First, analyze the soil salt control factors based on groundwater benefit intervals; secondly, construct a groundwater benefit interval model and conduct scenario analysis to determine the range of groundwater benefit intervals in different subdivisions of the Yellow River Delta region; finally, explore the salt control factors constructed by the platform field combined with the salt barrier soil. Source isolation effect, or the use effect of underground pipes for salt drainage, and clarify the response of the groundwater benefit range to different salt rejection and salt drainage modes.

2.2 Research on the Mechanism of Efficient Utilization of Multiple Water Sources

The shortage of fresh water resources has become one of the bottlenecks restricting the development of the Yellow River Delta's high-efficiency ecological economic zone. Efficient and reasonable "increase revenue and reduce expenditure" is very necessary to alleviate the pressure on fresh water resources. In terms of safe utilization of unconventional water resources, Liu Haiman et al. [8] found that after irrigation with high-salinity salt water and covering it with plastic film, the steam water under the film condenses into fresh water and forms a thin layer of desalination on the surface, providing a suitable microorganism for crop emergence. The soil water and salt environment of the domain; Guo et al. [9] found that shallow underground salt water was extracted for freezing irrigation in winter. After the melt water infiltrated, the salt water separated and infiltrated in stages significantly reduced soil salinity and SAR, and the salt water froze. Irrigation has a better desalination effect than direct irrigation of salt water or fresh water. Water-saving irrigation provides an important basis for regulating water and salt in the root zone of saline soil. A large number of studies have shown that drip irrigation under film is beneficial to forming a local desalination environment in plant roots. Lei Hongjun et al.[10] aimed at the problem of soil hypoxia during the irrigation process and used aerated drip irrigation water and fertilizer integration to simultaneously transport a large number of microbubbles and water and fertilizer to the root zone; however, insufficient leaching under water-saving irrigation caused soil salinity to Surface accumulation and how to maintain the interannual soil water and salt balance have attracted much attention. Using brackish water resources for farmland irrigation can save a lot of fresh water resources, but if used improperly, it will lead to secondary soil salinization and deterioration of physical properties such as soil structure. In view of the above problems, there is an urgent need to carry out systematic research on the use of brackish water for farmland irrigation: 1) Improve the "collection-transmission-irrigation-drainage" drainage and saltwater conservancy facilities of precipitation, and improve the salt leaching efficiency during rainfall or freshwater irrigation; 2) Based on the differences in water and soil resource characteristics, evaluate the applicability of different brackish water irrigation methods (rotating irrigation, mixed irrigation, ridge and furrow irrigation); develop scientific irrigation time, frequency and amount according to the water demand at different stages of crop growth period, Reveal the impact mechanism of brackish water irrigation on crop growth, development and quality; 3) Explore the mechanism of brackish water irrigation methods on regional soil security, and clarify the effects of brackish water irrigation and mulching measures (straw, mulching film) on soil water, heat and salt in saline-alkali soils. The mechanism of influence of brackish water irrigation and soil amendment on soil carbon pool and nitrogen pool is analyzed; 4) From the rational use of brackish water resources and brackish water irrigated crops, high-quality and high-yield crops (yield, quality) , comprehensive analysis and demonstration from the perspective of soil security (fertility, structure), explore brackish water irrigation methods suitable for local hydroclimatic characteristics and dynamic distribution of soil salinity, explore the applicability of long-term brackish water irrigation under climate change conditions, and realize the regional ecological environment Protection and sustainable utilization of soil, providing scientific reference and management basis for the scientific utilization of brackish water resources and the sustainable utilization of saline-alkali land resources.

2.3 Comprehensive Planting model of Agricultural Economics and Animal Husbandry Cycle

Obstructive factors such as high soil salinity, low fertility, and limited water resources are common in the saline-alkali land of the Yellow River Delta. The corresponding traditional planting model often adopts methods such as flooding with water to suppress salt and increasing the application of chemical fertilizers. This is in serious conflict with the limited water resources. At the same time, it is easy to cause fertility loss and environmental pollution. This problem is expected to be solved to a certain extent through the cyclic development of agriculture, forestry, and animal husbandry and the exploration of high-quality resources and the rational allocation of regional resource systems. Under the influence of high-intensity human transformation, soil salinity barriers are rapidly reduced and production functions are rapidly improved. However, the formation and stability of ecosystems are lagging and long-term. The ecological management of saline soil refers to taking into account farmland production and ecological functions. Short-term and long-term, resource-saving and environmentally friendly governance methods [11]. Rozema et al.[12] pointed out that biotechnology can help solve the global irreversible soil salinization problem. Halophytes can grow on land with a high degree of salinization and can make full use of seawater and marginal water resources to avoid shortages. fresh water resources to improve saline-alkali land. Zhao Zhenyong et al. [13] found that planting samphire and Suaeda salsa in severely saline soil can take away a large amount of salt from the soil (about 5000 kg per hectare). In this way, on the basis of the transformation of severely saline-alkali land, the farmland ecosystem can be further constructed. In the farmland system, through the coordinated development of food crops and cash crops (forage), we vigorously develop the nitrogen fixation efficiency of leguminous crops, optimize the internal structure of the system, reduce the use of chemical fertilizers, and explore diversified planting systems (cropping rotation, rotational rest, rotational fertilizer, rotational tillage , no-tillage) on soil salinity, soil quality, nitrogen increase, phosphorus water retention effect, and water and fertilizer use efficiency, providing a theoretical basis for green production in saline-alkali farmland. Quantify the health of the comprehensive planting model system through indicators such as "sustainability index", "agricultural economic assessment", "soil health index" and "environmental footprint" to achieve the combination of land use and land cultivation, agriculture and animal husbandry, and economic benefits. The combination of social benefits and ecological benefits ensures that agricultural production is in a virtuous cycle and sustainable development in the long term.

2.4 Soil Health and Bioaugmentation Technology in Saline-Alkali Lands

The saline-alkali soil around the Bohai Sea has high soil salt content, high groundwater levels, low natural soil desalination rate, low soil organic matter content, poor soil structure, and underdeveloped soil layers, which restricts the rapid improvement of cultivated land quality. However, as a resource, saline-alkali land can provide a growing environment for halophytes and provide a substrate for the development of saline-alkali agriculture. Biological improvement refers to improving the salt tolerance and stress resistance of plants and adaptive planting on saline soil, using plant root growth to improve the physical and chemical properties of saline soil, or maximizing plant biomass and removing the root zone part of the harvest. The main mechanisms of salt content are plant salt tolerance, improvement of soil quality due to plant growth, and desalination of plant harvests [14]. Most halophytes and salt-tolerant plants, such as Suaeda, Salicornia, and Tamarix, have special osmotic adjustment mechanisms or salt secretion mechanisms that allow them to grow in soils with high salinity. Many studies have shown that the combination of multiple materials can significantly improve the conditioning effect of saline soil. Composite microbial inoculants and fertilizers are prepared through the combination of various functional microorganisms, which have shown good results in improving and repairing saline soil. Effect. In recent years, the development of molecular biology has made it possible to clone and express salt-tolerance genes [15]. Based on this, focusing on soil health and the green development of saline-alkali agriculture in the saline-alkali areas around the Bohai Sea, a variety of interdisciplinary technologies such as high-throughput sequencing, core microbiome analysis, metagenomics, and proteomics were used to analyze the indigenous resistance to saline-alkali lands with different origins around the Bohai Sea. The environmental suitability mechanism of halophytes, its water retention effect on shallow soil in saline-alkali soil and the degree of inhibition of soil salt return, and the mechanism by which mycorrhizal fungi assist plants in salt-alkali soil tolerance and acquisition of nitrogen and phosphorus nutrients in low organic matter content saline-alkali soil ; Study the establishment, colonization and response process of soil core functional microbial communities to microhabitats, promote beneficial rhizosphere microbiota to improve soil health and increase crop productivity, while utilizing naturally occurring "antagonistic microorganisms" in the soil that are common to crops Biological control of pathogenic bacteria; excavating and utilizing the "microhabitat" function of the soil to reduce ecological and environmental problems such as high production costs, soil acidification, low quality of agricultural products, accumulation of harmful substances, and agricultural non-point source pollution caused by high application of chemical fertilizers and pesticides.

2.5 Technologies for Increasing Nutrient Efficiency and Rapidly Increasing Organic Matter in Saline Farmland

As one of the most important types of lowand medium-yield fields in my country, 26% of the area with soil organic matter content in saline cultivated land is less than 1%, so it is of great significance to improve the quality of its cultivated land. A key point in the rapid improvement of soil fertility in the saline-alkali land of the Yellow River Delta is to promote the formation of good surface soil structure (mainly aggregates). Organic matter is an important material basis for promoting the formation and stability of soil aggregates. Soil organic carbon is generally considered to be an important "binding agent" for improving the formation and stability of soil aggregates; the high salt content (especially exchangeable Na+) of saline-alkali land soils is generally considered to be a "binding agent" that destroys the formation and stability of soil aggregates. Dispersant". Research shows that adding exogenous organic matter increases the "binding" effect of soil organic carbon, which can "offset" the "dispersion" effect of exchangeable Na+ to a certain extent, and promote the formation and stability of soil aggregates in saline-alkali land. In addition, soil salinization significantly affects the migration, transformation, absorption and utilization process of nitrogen, phosphorus and other macronutrients in farmland. Another key point in the rapid improvement of soil fertility in the Yellow River Delta saline-alkali land is to promote the formation of surface soil carbon, nitrogen and other nutrient pools. Increasing the application of organic matter is an important way to solve the soil fertility problem in saline-alkali land. The decomposition of soil organic matter can provide various nutrients, especially nitrogen, because soil minerals in saline-alkali soils generally do not contain nitrogen. In addition to the applied nitrogen fertilizer, the main source of soil nitrogen in saline-alkali soils is provided by the decomposition of organic matter. In addition, organic matter is also an important source of phosphorus, sulfur, calcium and trace elements in saline-alkali soils. Therefore, soil organic matter is the material basis of soil fertility, which can continuously supply various nutrients needed by crops and improve the nutritional level of crops. Xiao et al. [16] found that biochar can improve soil quality, increase soil pores, improve saline soil while increasing available nutrients in the soil, prolong fertilizer efficiency, reduce the leaching loss of soil ammonium nitrogen, and improve crop nutrient absorption and use. In saline soil, phosphorus has poor mobility and easily combines with soil glue Ca2+ to form precipitation. At the same time, the large amount of Na+ in saline soil causes soil soluble phosphorus to exist in the form of sodium phosphate, which harms crop growth and reduces the bioavailability of phosphate fertilizers [17], so the research on phosphorus in saline soil is more carried out from the aspect of phosphorus activation. The soil layers in the saline-alkali lands around the Bohai Sea are underdeveloped and the cultivation level has not yet been formed. The soil organic matter in the saline-alkali lands is extremely low, with poor soil structure, few nutrient types, and a single composition of microbial flora. And under special habitat conditions such as high salt and high pH in saline-alkali land, the process of accumulating large amounts of organic matter in the saline-alkali land itself is extremely slow. In response to these problems, in-situ field experiments and simulation studies were carried out, and technologies such as metagenomic analysis, isotope labeling, and proteomics were used to study the return of straw and the application of organic matter in different crop systems on the basis of exogenous application of soil amendments and salt reduction measures. The influence mechanism of fertilizer/biochar on nutrient retention, reveal the interaction mechanism between plant roots, soil and microorganisms in coastal saline-alkali land, explore the response rules of the special habitat in this area to different salinity levels, and elucidate the return of straw to the field, legumes The mechanism of fertilization measures such as crop fertilization and organic fertilizer/biochar application to improve soil fertility in saline-alkali areas, and the integration of key technologies for improving coastal saline-alkali soils with different organic matter.

2.6 Multi-Source Data Fusion of Salinization Evolution and Multi-Scale Simulation of Water and Salt Migration Process

Accurately obtaining the multi-scale and multi-element spatiotemporal dynamics of soil salinization is of great significance for accurately analyzing the evolution mechanism of salinization driven by natural and artificial factors. In recent years, with the continuous development of remote sensing and near-earth sensing technology, multi-element, multi-scale, integrated monitoring of soil salinization has become possible, such as aviation/satellite optical/microwave remote sensing images, magnetic sensing geodetic conductivity meters , ground penetrating radar, etc. In terms of nearground sensing monitoring of soil salinization, Xie et al. [18] constructed a regression model between magnetic earth conductivity and soil salinity, and quantitatively evaluated the spatiotemporal evolution of soil salinization in the estuary area in the past 10 years.. In recent years, domestic scholars have paid more attention to the fusion between different scales, observation elements and data to improve the inversion accuracy of soil salinization. For example, Chen Junying et al. [19] constructed a system based on UAV multispectral remote sensing and GF-1 The model of satellite remote sensing data realizes the upscale monitoring of soil salinization using UAV-satellite remote sensing. At present, the research on scale transformation of soil salt movement is not yet mature. The main reason is that salt movement is based on soil hydrological processes. Its driving factors and control factors are more complex and have strong time and space dependence. Future research should strengthen observations at different scales. Integrate data to construct a universal scale conversion function. The soil solute transport model is an effective method to describe the water and salt transport laws of saline soil. Currently, the more mature commercial water and salt transport numerical models include HYDRUS, DRAINMOD, SHAW and COMSOL, among which HYDRUS is currently the most widely used model. , can better simulate the migration and transformation process of water, heat and multi-component solutes in the saturated-unsaturated seepage zone under point source intersection conditions [20]. At present, more and more studies adopt data assimilation methods, using water and salt transport models as model operators, using large-scale observation data as driving data, and using assimilation algorithms to assimilate observation data into the model to improve the evolution of soil salinization. Regular prediction ability. For example, Yao et al. [21] used the ensemble Kalman filter algorithm to assimilate the magnetically induced earth conductivity data into the HYDRUS model, which improved the estimation accuracy of the spatiotemporal dynamics of soil salinity.

3 OUTLOOK AND PROSPECTS

3.1 Theory and Technology of Efficient Water use and Precise salt Control in Saline Soil

The regulation of water and salt in the saline-alkali land of the Yellow River Delta is not only a local problem, but also a problem for the lower reaches of the Yellow River and even the entire Yellow River Basin. The Yellow River ecosystem is an organic whole, and the differences between the upper, middle and lower reaches must be fully considered. Water resources are very scarce in the saline soil area of the Yellow River Delta, and the management of soil salinity disorders is highly dependent on water resources. Under the rigid constraints of water resources that "determine by water, act according to the amount of water", the efficient and safe use of "water" will still be the core of future water and salt regulation of saline soils. It is necessary to focus on the optimal allocation mechanism of water resources at multiple scales such as river basins, irrigation areas, landscapes, and fields, and analyze the theory and system of water-saving irrigation that matches crop phenology; it is necessary to deepen the research on the optimal regulation of water and salt in water-saving saline soils, and Elucidate the mediumand long-term evolution rules of salinization under various water-saving conditions, further expand the regulation mechanism and technology of soil water and salt balance under brackish water and salt water utilization conditions, and establish a comprehensive consideration of farmland soil hydrological processes , crop growth and salt characteristics. Mechanism model, research on real-time water allocation technology and products in irrigation areas, and build an integrated model of efficient water control technology in modern irrigation areas. Although the current salty farmland habitat model has initially achieved optimal management of crop yield and irrigation to a certain extent, it lacks in-depth consideration of the impact of salt stress and the coupling relationship between soil water, salt, heat, air, fertilizer, and microorganisms. It cannot adapt to the current needs of improving soil fertility of saline farmland, increasing crop yields and increasing agricultural efficiency [22]. It is urgent to fully combine regional climate characteristics, water resources endowment and soil conditions to study the changing trends of crop yield, water use efficiency and soil quality (salinity) under different irrigation treatments, soil improvement measures and fertilization management and other agronomic measures, in order to better understand the trend of crop yield, water use efficiency and soil quality (salinity content). Efficient water use at scale enables precise control of soil salinization at field and regional scales.

3.2 Co-Adaptation of Agricultural Water Use and Ecology under Changing Environment

In today's world, the impact of climate change on agriculture and the ecological environment is becoming more and more prominent, and the international resource policy game is deepening. The water and salt regulation of the Yellow River Delta saline-alkali land needs to fully consider the impact of climate change. Irrigation and drainage management of saline soil needs to be determined based on the actual situation of water and salt movement under different formation and driving mechanisms. With the impact of climate change, frequent extreme weather and movement of rainfall belts in recent years, the water resources pattern needs to be redistributed and rebalanced. Research on irrigation and drainage management under the background of soil salinization is crucial. At present, a lot of research in this area has been done at home and abroad, but not much can truly clarify the coupling relationship between land use change and climate change. Especially how to implement it regionally to guide production is a very challenging issue.. Therefore, there is an urgent need to study and predict the changes in crop water demand and crop yields under future climate change scenarios, propose strategies and measures for different regions in the lower reaches of the Yellow River to cope with climate change, evaluate the water footprints of different technical solutions, and carry out research on water resources, energy, and food in the basin. Collaborative optimization research, research and development of optimal allocation plans and optimization technologies for watershed water resources under changing environments [23]; research on the driving mechanism and ecological effects of soil salinization evolution under the background of global climate change, and the impact of soil salinization and vegetation ecology on water-saving scenarios Response and process simulation, analyze the soil-vegetation-hydrology coupled response and collaborative adaptation mechanism in saline soil areas; explain the quota allocation of agricultural water use and wetland ecological water use in the Yellow River Delta saline-alkali land, which can not only strengthen wetland ecological protection, but also promote high-quality regional agriculture develop.

3.3 Soil quality and Soil Health of Saline Farmland

As one of the main types of lowand medium-yielding fields in my country, salinized farmland improves soil fertility and nutrient storage capacity, which is of great significance to increasing grain production and increasing carbon emissions. The saline soil in the Yellow River Delta is newly formed soil with extremely low soil organic matter and huge soil carbon sequestration potential. In today's "carbon neutrality" craze, it is necessary to focus on the principles of regulating soil organic carbon and improving carbon sink capacity in saline farmland, exploring the theory of "organic matter-nutrient pool-biological function" synergistically driving the cultivation of fertile tillage layers in saline farmland, and expanding the scope of saline farmland cultivation. The carbon sequestration mechanism and potential of waterlogged habitats; further, study the inhibitory mechanism of salinization on soil nutrient storage and supply, the mutual feedback mechanism of soil structure conditioning and nutrient storage capacity expansion, and the carbon stabilization and conservation of agricultural and animal husbandry waste resource utilization. The nitrogen mechanism promotes the improvement of carbon sinks in saline land by expanding nutrient storage and capacity [1]. In addition, it is necessary to focus on the biological mechanism of improving the salt tolerance threshold of plants through genetic engineering methods and rhizosphere microorganism intervention, and through the salt rejection and salt accumulation mechanism of halophytes and functional bionic materials, the screening, domestication and efficient colonization mode of beneficial functional microorganisms , promote the directional regulation and conservation of healthy saline soil habitats, promote the reduction of soil salinity barriers and the improvement of soil quality and functions, and improve the productivity of saline soils. "Plant salt accumulation" provides an important idea for improving the biological adaptability of saline soil. Although halophytes have better biological salt absorption effects, there are often frequent salt exchanges between soil and groundwater in saline soil areas. "Plant salt accumulation" The long-term effectiveness of biological adaptation improvement in saline soils remains to be observed in the long term.

3.4 Big Data and Informatization of Saline-Alkali Farmland

Recently, my country has made positive progress and results in monitoring the evolution of soil salinization and integrating multi-source data, simulating and scaling soil water and salt transport processes, optimizing irrigation and drainage management of saline farmland, and safe utilization of marginal water. In general, the multi-element and multi -scale "satellite (satellite remote sensing) air (drone patrol) ground (ground measurement)" observation data of soil salinization is constructed, and machine learning algorithms are used to carry out multi-dimensional data fusion and assimilation , to accurately deduce the spatiotemporal evolution process of salinization and reveal the driving mechanism of salinization has become a hot topic in future research. There is an urgent need to establish a land resources monitoring system that integrates air, space and ground to achieve barrier-free integration of massive data obtained from underground, near-Earth, aerospace drones and satellites, optimize multi-dimensional and massive data through algorithms, and realize plant observation from air, space and ground. , soil, hydrology, and meteorological information integration; further integrate existing experimental observation data, combine indoor and field experimental observations and numerical models, use deep machine learning, develop theories and algorithms to characterize soil properties in space and time, and optimize digital land Mapping technology informs and parametrizes big data to guide precision agricultural production, situational awareness, early warning predictions and assisted decision-making, achieve efficient utilization of regional water and land resources, and promote the construction of "smart agriculture" in the Yellow River Delta and even the entire province. Obviously, development in this area can rely on the current relatively advanced Internet of Things, big data, artificial intelligence and cloud platform technologies to establish an advanced smart agricultural water resources management system through the digital transformation of agricultural water and the assessment of soil salinization characteristics. and a comprehensive saline-alkali land management and control system.

4 CONCLUSION

Generally speaking, according to the current scientific needs and national needs, relying on the rich saline soil resources of the Yellow River Delta, the Dongying base will give full play to the advantages of Ludong University in geography, agronomy, biology, environmental science and other disciplines based on the existing work. , focusing on the frontiers of disciplines, expanding international exchanges and cooperation, strengthening theoretical research, developing high and new technologies, facing industries and fields such as agriculture, resources, ecology, environment, etc., and actively serving my country's "grain storage in the land, storage of grain in technology" and the "Yellow River Basin" National strategies such as "Ecological Protection and High-Quality Development" play an important role in the country's food security, ecological security, and high-quality development. It is hoped that with the strong support of the school, the Dongying base will be built into an internship training base for our school students, a test demonstration base for relevant scientific research, and a condition guarantee base for scientific project applications.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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