RESEARCH ON ECONOMICAL UTILIZATION STRATEGY OF AGRICULTURAL WATER RESOURCES IN YELLOW RIVER BASIN OF INNER MONGOLIA, CHINA

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Abstract:

The Yellow River basin in Inner Mongolia is an important part of the ecological barrier in northern Xinjiang, but in recent years, due to the influence of climate change and human activities, the instability and mutability of the Yellow River water resources have increased, and the water use contradiction has become prominent. Agriculture, as the main water industry in the Yellow River Basin, has a relatively low water resource utilization efficiency. Through analyzing the current situation of agricultural water resources utilization in the Yellow River Basin of Inner Mongolia in the past ten years, this study found the existing problems in the comprehensive and efficient utilization of agricultural water resources in the Yellow River Basin of Inner Mongolia, including strengthening agricultural water-saving irrigation and promoting the construction of high-standard farmland. Strengthen water-saving technology transformation in irrigation district, and do a good job in the transformation of scientific and technological achievements; Construct a cascade water price system and popularize water-saving consciousness; Actively promote the conversion of water rights, strengthen the cooperation between agriculture and enterprises, and put forward solutions, trying to find a precise water-saving path in terms of improving the efficiency of agricultural water-saving irrigation, innovating key technologies for agricultural water-saving, and realizing the green development of water-saving agriculture. It provides scientific basis for sustainable and healthy development, rational and optimal allocation and orderly management of the Yellow River water resources in Inner Mongolia.

Keywords : Inner Mongolia Yellow River basin, Agricultural Water Resources, Conservation and Intensive, Efficient Use

Introduction

The Yellow River is the largest surface water supply source in northwest and North China. With 2% of the country's surface runoff, it is responsible for 15% of the country's arable land irrigation, 12% of the population's water diversion, and the production and living water supply tasks for more than 50 large and medium-sized cities. Long-term high-intensity water resources development and utilization make the Yellow River basin's own system weak ability to withstand external stress. In addition, the basin is located in arid and semi-arid climate zone, with less river

water and more sand, water and sand imbalance, water and soil loss and flood and drought disasters in the basin are serious, and the ecological environment is fragile. Located in the southwest of Inner Mongolia, the Yellow River Basin in Inner Mongolia is an important energy base and grain production base in China, an important ecological barrier in China, and an important area for winning the battle against poverty. It plays an irreplaceable role in building a security and stability barrier in northern Xinjiang. However, in recent years, due to the impact of climate change and human activities, the instability and mutability of the Yellow River's water resources have increased. Meanwhile, the water resources waste behavior of overdevelopment and utilization of water resources and disorderly water consumption have frequently occurred in the region, resulting in prominent water use contradictions, prominent water ecological environment problems, and expanding the scope of the vicious circle of water resources shortage. The shortage of water resources in the Yellow River Basin of Inner Mongolia has become the main bottleneck restricting the economic and social development of the basin. At present, the exploitation and utilization degree of water resources along the Yellow River in Inner Mongolia is as high as 80%, which is close to critical overload, far exceeding 40% of the common river basins in China. The exploitation and utilization of groundwater in Hohhot, Baotou, Wuhai, Bayannur and other places has been in a critical overload state, and the exploitation level of Ordos, Ulanqab, Alashan and other places has exceeded 70%. However, agricultural water has long been the industry with the largest proportion of water consumption in the Yellow River Basin, and its water resource utilization efficiency is relatively low. To improve the efficiency of agricultural water resources utilization in the Yellow River Basin of Inner Mongolia, improve the strategy of agricultural water use, and continuously promote the conservation and intensive use of agricultural water resources are the key to solving the shortage of water resources and the imbalance between supply and demand in the Yellow River Basin of Inner Mongolia.

Current situation of agricultural water use in Yellow River basin of Inner Mongolia

The utilization efficiency of agricultural water resources in the Yellow River Basin of Inner Mongolia has been lower than the national average for a long time due to the constraints of funds, policies and other factors, and is far lower than 70% of farmland irrigation water utilization efficiency in developed countries. Agricultural modernization is relatively lagging behind, and the development level of efficient water-saving irrigation is low. The carrying capacity of groundwater resources has been unable to support the current scale of agricultural irrigation, and the efficiency and management of agricultural water use need to be strengthened. Based on the analysis of water use in the Yellow River Basin of Inner Mongolia in recent 10 years, as shown in Figure 1, it can be seen that the main water use of the Yellow River Basin of Inner Mongolia is agricultural water, and agricultural water consumption is much higher than that of other industries. The annual average value of agricultural water consumption is 7.343 billion m^3, and the coefficient of variation is 0.025, indicating stable water consumption. It is maintained between 7.091 billion m^3 and 7.702 billion m^3 throughout the year, showing a fluctuating trend as a whole, and the annual water consumption of agriculture is 8.07 times that of the second highest water consumption industry. The Yellow River basin is the main area of agricultural cultivation in Inner Mongolia, and the proportion of agricultural water use is high for a long time, staying at 75.09% ~ 87.58%. However, the proportion of agricultural water use shows a downward trend as a whole. First, the total water supply of the Yellow River basin increases year by year, but the increase of agricultural water consumption is not obvious. Resulting in a decline in the proportion of water used by other industries. It can be seen that the key difficulties in the comprehensive and efficient utilization of water resources in the Yellow River Basin are to improve the efficiency of agricultural water use, reduce the proportion of agricultural water use, and free up more water resources to be allocated to other industries.

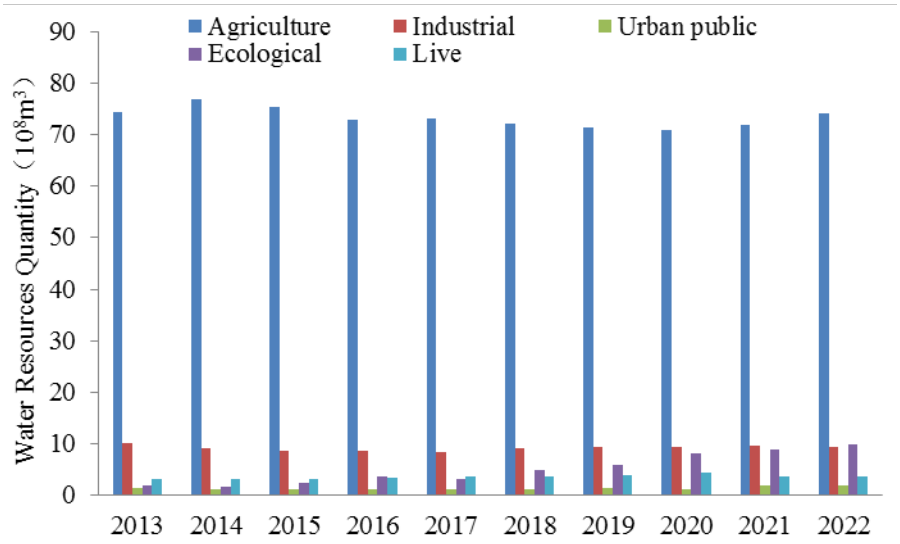

Fig1 Water consumption of various industries in the Yellow River Basin of Inner Mongolia in recent ten years

Agricultural water consumption in the Yellow River Basin of Inner Mongolia, as the main way of water consumption, has been maintained at a high level for a long time. According to the analysis of water consumption in agricultural subdivisions in the Yellow River Basin of Inner Mongolia, it can be seen from Figure 2 that agricultural irrigation water consumption is the main way of agricultural water consumption, and agricultural irrigation water consumption has been maintained between 6.287 billion m^3 and 7.110 billion m^3 for a long time. Agricultural irrigation water accounted for 84.49% ~ 95.82% of the total agricultural water use. Agricultural irrigation water overall showed an increasing trend year by year, while forestry water, grassland water and animal husbandry water, on the contrary, showed an overall decreasing trend year by year, with the highest values appearing in 2013 and 2014. Therefore, improving farmland irrigation water conditions, strengthening high-standard farmland construction, effectively controlling farmland irrigation water, and improving water use efficiency are important ways to solve the efficient use of water resources.

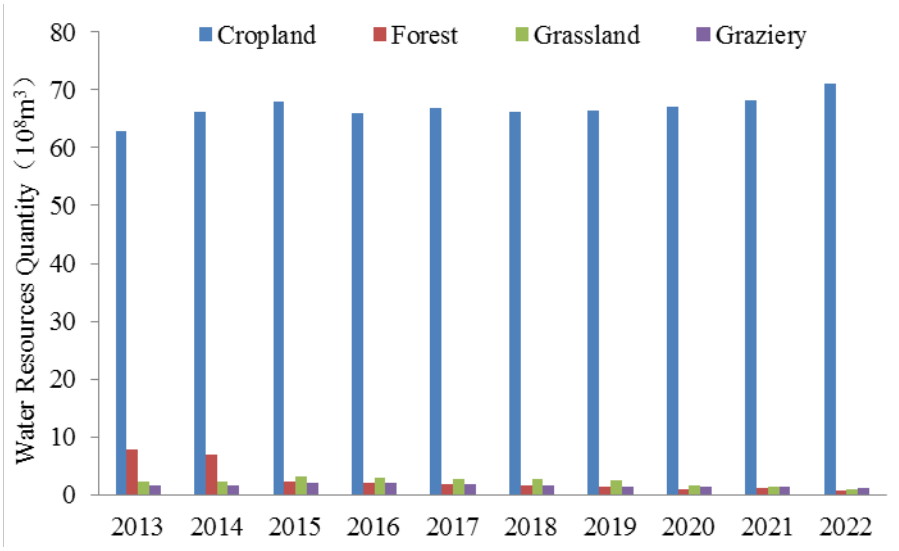

Fig 2 Water consumption of agricultural subdivision in the Yellow River Basin of Inner Mongolia in recent ten years

There is a problem of agricultural water use in the Yellow River basin of Inner Mongolia

1. Shortage of water supply

Affected by climate change and human activities, the supply of water resources fluctuates greatly in the semi-arid region of the Yellow River in Inner Mongolia, and the available water resources are limited due to the impact of the 87th water index, which belongs to the coexistence of resource water shortage and engineering water shortage. Affected by seasonal changes, the Yellow River runoff is concentrated in the year, and the natural runoff from July to October in flood season accounts for about 58%. The annual runoff varies greatly. The maximum annual runoff of the main stream section is generally 3.1-3.9 times of the minimum value, and that of the tributaries is generally 5-12 times. Regional distribution is uneven, the annual runoff above Lanzhou accounted for 62% of the whole river, the annual runoff between Longmen and Sanmenxia accounted for 19% of the whole river, and the annual runoff between Lanzhou and Hekou town accounted for only 0.3% of the whole river. According to the statistics of the Water Resources Bulletin of Inner Mongolia Autonomous Region in 2022 and the results of the third Inner Mongolia National Water Resources survey and evaluation, the total amount of conventional water resources available in the Yellow River basin of Inner Mongolia is 9.072 billion m^3, and the total water resources of the Yellow River in Inner Mongolia in 2022 will be 5.038 billion m^3, 1.273 billion m^3 of surface water and 5.033 billion m^3 of groundwater. The overlap of surface water and groundwater resources is 3.765 billion m^3.

2. Low utilization efficiency of agricultural irrigation water

In the water resources utilization types of the Yellow River Basin in Inner Mongolia, agricultural water accounts for more than 75%, while agricultural irrigation water accounts for 90% of agricultural water use. It can be said that the Yellow River water resources in Inner Mongolia are mainly applied to farmland irrigation in the Yellow River Basin in Inner Mongolia. However, the utilization coefficient of agricultural irrigation water in the Yellow River Basin in Inner Mongolia is generally low due to the influence of agricultural planting scale and irrigation water use methods. Among them, Bayannur City has the highest water consumption, but the lowest irrigation coefficient is only 0.47, which is far lower than the effective utilization coefficient of farmland irrigation water 0.572 in 2022 nationwide. It can be said that the efficiency of agricultural irrigation water directly affects the water resource utilization efficiency of the city. The overall results show that the construction of water-saving irrigation measures in the Yellow River basin of Inner Mongolia is progressing slowly, the proportion of water-saving irrigation is still low, and the agricultural irrigation water still has a serious phenomenon of flood irrigation. Agricultural irrigation water is affected by multiple factors, and the long-term improvement of water resource utilization efficiency is not obvious. The differences in irrigation technology, water consumption and water use efficiency are particularly prominent among regions in the Yellow River Basin. Advanced irrigation technology can realize efficient utilization of water resources for agricultural irrigation. In the process of promoting water-saving irrigation technology, due to the differences in economic development level, water resources reserves and agricultural planting structure of different regions, As a result, the effect of promoting and applying water-saving technology in various regions is not satisfactory. The low penetration rate of water-saving equipment and the low price of agricultural water make farmers or enterprises reluctant to invest in water-saving facilities, so it is difficult to promote the use of high-cost water-saving equipment, and farmers cannot get any form of reward after saving water, which affects the enthusiasm of water-saving.

3. The transformation of water rights is slow

Water right conversion is to use water right as a kind of commodity to trade between different water users, so as to better play the benefits of water resources. The contradiction between supply and demand of water resources in the Yellow River Basin of Inner Mongolia is prominent, resulting in waste of agricultural water and shortage of industrial water. However, the conversion of water rights is promoted slowly, especially in Hetao area, where industry and agriculture are clustered and conversion industry projects cannot be initiated due to lack of water source. Meanwhile, water supply projects in irrigation areas are old, with low water supply efficiency, serious waste of water resources, low price of agricultural water and low benefit of irrigation areas. Water-saving renovation projects are also difficult to carry out. At present, water rights conversion in Bayannur City has been carried out for nearly ten years, only the first phase of water rights transfer project has been completed, achieving 2.3 billion m^3 of water saving, and the second phase of water rights transfer project has been started, with a planned water saving of 2.1 billion m^3. Compared with the 1.396 billion m^3 of farmland irrigation water saving potential in Bayannur City, there is still a large space for implementation. Accelerating the implementation of water rights conversion is an effective way to solve the shortage of water resources in the Yellow River Basin of Inner Mongolia and improve the comprehensive and efficient utilization of water resources.

4. Backward information management of water resources

In the era of information for the whole people, the management of water resources needs to use information means more. The application of water conservancy informatization in water resources management can make the work of water resources management more convenient and intelligent, and can better guarantee the standardization and scientific nature of water resources management. In the process of "multi-use water", the lack of new science and technology leads to the maximum utilization of the scarce water resources. The water consumption of industrial construction industry and enterprises in all cities can not be monitored in real time. Agricultural irrigation Wells have not yet installed large-scale metering facilities, resulting in great waste. In the process of installing metering facilities for agricultural irrigation Wells, some projects are only installed to complete the task, without subsequent use teaching and equipment maintenance, resulting in the installed metering facilities are not used, wasting the investment of funds and human and material resources.

Economical utilization strategy of agricultural water resources in Yellow River basin of Inner Mongolia

1. Strengthen water-saving irrigation in agriculture and promote the construction of high-standard farmland

Water-saving irrigation project is the core foundation of efficient utilization of agricultural water resources. In order to promote the efficient use of agricultural water resources, it is necessary to start from the existing irrigation facilities, repair and utilization, and at the same time, combine with water-saving technology and engineering technology, and constantly innovate the development model of agricultural water-saving, so as to better improve the utilization efficiency of agricultural water resources and achieve the purpose of saving agricultural water resources. The development of water-saving irrigation technology based on sprinkling irrigation and drip irrigation is one of the effective ways to save water in agriculture. In the well irrigation area,

combined with land leveling, the implementation of small bed irrigation. At the same time of sprinkler irrigation, the development of underground water transmission pipeline can make use of terrain elevation difference to develop self-pressure sprinkler irrigation, drip irrigation, micro-irrigation and small pipe trickle irrigation, which can effectively reduce the water loss in each link of water transmission. In combination with facility agriculture, we will focus on developing micro-irrigation, drip irrigation and micro-pipe water transport irrigation under film in greenhouses, and build high-efficiency water-saving demonstration areas. Strengthen the matching of newly opened water sources and water-saving measures, and construct and use them simultaneously. When conditions permit, double irrigation in Wells and channels is carried out to carry out the utilization of salt and light mixed pouring technology to fully improve the utilization rate of water.

With high-standard farmland as the main battlefield, we will steadily advance the construction of farmland water conservancy infrastructure, complete and strengthen weak links in farmland infrastructure, carry out projects in consecutive pilot counties for high-efficiency water-saving irrigation and high-standard farmland construction, implement the construction of large reservoirs, explore the construction of water-system connectivity projects, and divert water from other areas to divert water from large river basins such as the Yellow River, so as to realize the task of drought-resistant agricultural irrigation in dry years. Speed up the construction of high-efficiency water-saving irrigation projects, improve irrigation methods, promote the integration of water and fertilizer technology at the same time, establish energy-saving irrigation and high-efficiency planting patterns compatible with high-efficiency water-saving irrigation, and greatly improve the production efficiency of irrigation water. We will vigorously strengthen the construction of water-saving projects based on pipe irrigation, sprinkler irrigation and micro-irrigation, increase the transformation and expansion of water source projects and irrigation district projects, accelerate the construction of auxiliary facilities for the final canal system, and improve the system of farmland water conservancy projects. Irrigation management of agricultural water supply shall be strengthened. Each water supply unit shall, within the scope of the water resource intake permit approved by the State, formulate an annual water use plan based on the planting area, water demand, meteorology and rainfall of the irrigation area, and optimize and adjust it at any time according to the actual situation, so as to control the annual water use within the plan and expand the irrigated area.

2. Strengthen the transformation of water-saving technology in irrigation areas and do a good job in the transformation of scientific and technological achievements

The main water use of the Yellow River water resources in Inner Mongolia is farmland irrigation water, which is mainly concentrated in the large irrigation area of Bayannur City. The utilization coefficient of farmland irrigation water is relatively low, and a large amount of water resources are wasted. According to the actual situation of the region, adopt local conditions and targeted strategies to carry out water-saving technology transformation, gradually eliminate outdated irrigation technology, and establish a drought-resistant water-saving model with modern water-saving facilities such as sprinkler irrigation, hose micro-spraying, drip irrigation under film, underground seepage irrigation and other related technologies as the core. Hose micro-spray technology is easy to be accepted and adopted by farmers because of its simple operation, one-time investment cost and easy popularization. It not only avoids land compaction, but also saves water, increases production and raises the commodity rate of agricultural products, providing an

efficient and water-saving solution for agricultural irrigation. Another technique, drip irrigation under film, is characterized by increased temperature and moisture retention and precise and efficient irrigation. The technology combines mulch cultivation with irrigation technology, making the average water use only a quarter of that of traditional irrigation and half that of sprinkler irrigation. It not only realizes the integration and controllability of watering, fertilization and application, but also increases the fertilizer utilization rate from 30%-40% to 50%-60%, and effectively reduces the number and amount of pesticide use. Through the unified operation of tillage, seeding, mulching, irrigation and fertilization, drip irrigation technology under film significantly improves the level of precision and intensification of agriculture. In the implementation process, the establishment of water-saving technology promotion service system, break the traditional concept, let farmers deeply understand all kinds of agricultural water-saving irrigation technology, and then stimulate their enthusiasm for use. Actively build all kinds of demonstration areas, through the field to demonstrate the benefits of various water-saving technologies, so that farmers intuitively feel the actual benefits of water-saving irrigation. Timely promotion and application of newly developed water-saving technology and accelerating the application and transformation of water-saving technology achievements can strengthen the construction of water-saving technology promotion service system.

3. Build a cascade water price system and popularize water-saving awareness

The key to saving water in agriculture lies in farmers, and the core lies in ideological understanding. Therefore, we should combine the reward and punishment mechanism with publicity and education, give full play to the subjective initiative of farmers, mobilize their water-saving enthusiasm, cultivate conscious water-saving consciousness, and establish a water-saving consciousness guarantee mechanism. While actively promoting water-saving technology, governments at all levels should strengthen publicity, use modern media platforms to publish water-saving irrigation information, report project results and popularize preferential policies, so that farmers can truly understand the importance of water-saving irrigation and consciously choose to use agricultural water-saving technology, so as to promote the efficient use of agricultural water resources. At the same time, a water-saving incentive mechanism for agricultural water use should be established. According to the actual amount of water saved through water-saving measures in each banner county, those large-scale operation entities, farmers' water cooperative organizations and grain farmers who actively promote water-saving technologies, implement water-saving measures and save water by adjusting planting structure will be rewarded. The specific criteria of the reward shall be jointly formulated by the local finance and water conservancy departments according to the water-saving efficiency and local financial situation, and the reward amount of different water-saving amounts shall be announced. The reward method should take into account the specific situation of local agricultural water use, and may be financial or material reward for those new agricultural operating entities, rural collective economic organizations, farmers' water use cooperative organizations and farmers that adopt water-saving facilities and adjust planting structure to save water. Other incentive measures such as priority water rights can also be explored to stimulate the awareness and enthusiasm of water users to take the initiative to save water in various ways. The management of agricultural water price adopts a hierarchical method, according to the size of irrigation area and the nature of investment, choose government pricing or negotiation pricing. For major projects in large and medium-sized irrigation areas, government pricing is usually adopted, but if conditions permit,

prices can also be set through negotiation.

4. Actively promote the conversion of water rights and strengthen cooperation between agriculture and enterprises

The efficient use of agricultural water resources cannot be separated from a sound management system. Under the strictest water resources management assessment system, the rigid constraints of water resources should be strengthened, water should be determined by water, and water use plans should be formulated according to water allocation plans and planning. Actively promote the implementation plan of water right conversion, broaden the scope of water right conversion, take into account the designed irrigation area, actual irrigation area, actual water consumption and water quota of each region, re-verify the water amount, and apply for water intake permits, so as to clarify the irrigation water intake right. Further refine agricultural water consumption indicators and allocate them to various water users such as farmers' water cooperation organizations, rural collective economic organizations and agricultural water users. To carry out the identification and registration of agricultural water rights and clarify the initial water rights. On the premise of total agricultural water consumption control, in accordance with the spirit of the Water Law and the relevant documents of the Ministry of Water Resources, the total index of agricultural irrigation water consumption in the region, the designed irrigation area, the actual irrigation area, the actual water consumption and the water quota are re-approved, the water intake license is applied for, and the irrigation water intake right is clarified. Based on the total water consumption control index of the administrative region of each league city and the average water supply of the region for many years, according to the irrigation water quota and combined with the administrative divisions, the water administrative department and the Sumu government at the grass-roots level will break down the agricultural water consumption index to the water users such as farmers' water use cooperation organizations, rural collective economic organizations, and agricultural water users to clarify the water rights. Implement specific water sources, and issue initial water rights certificates to water users in combination with collective land transfer.

Carry out pilot water rights trading, promote the establishment of water rights trading platforms, cultivate water rights trading markets, actively explore various forms of water rights trading circulation, and encourage the transfer of water-saving volume among water users. Water users with the same region or the same peasant water use cooperative organization shall have the priority to transfer the amount of water saved; the transfer within the same peasant water use cooperative organization shall be coordinated by the peasant water use cooperative organization and consultations among water users on an equal basis; the cross-peasant water use cooperative organization shall be coordinated by the administrative unit of the irrigation district; the competent water administration department or the administrative unit of the irrigation district shall repurchase the amount according to the situation of water saving. Ensure water users to obtain water-saving benefits. On the premise of meeting the regional agricultural water consumption, the amount of water-saving can be transferred across regions and industries with the approval of the original water intake permit examination and approval authority, allowing water rights trading to meet the new reasonable water demand, and encouraging social capital to participate in the construction of water-saving water supply water conservancy projects to get priority access to new water resources.

Conclusion

Taking the utilization of agricultural water resources in the Yellow River Basin of Inner Mongolia as the research object, this paper briefly analyzes the situation of agricultural water resources in the Yellow River basin of Inner Mongolia and the existing problems in the conservation and utilization of water resources, focusing on the analysis of countermeasures for the conservation and utilization of agricultural water resources. It tries to find a precise water-saving path in improving the efficiency of agricultural water-saving irrigation, innovating the key technologies of agricultural water-saving, and realizing the green development of water-saving agriculture. Subsequently, it is necessary to strengthen the research on the water-saving potential and water resources carrying capacity of the whole agricultural industry chain in the Yellow River Basin of Inner Mongolia. To realize the collaborative research of water consumption, quality and efficiency, attach importance to the whole process and key links of agricultural water-saving in the Yellow River Basin of Inner Mongolia, and realize energy conservation and emission reduction, production and ecological coordination based on the optimal allocation of water resources, water supply, food, energy and ecological coordination, and the process regulation, quantity, quality and efficiency coordination between irrigation areas and field water use. Finally, a comprehensive technical solution for the integration of water, fertilizer and medicine in farmland is formed. On the basis of controlling the total amount of agricultural water and adhering to the red line of resources, environment and ecology, the use of fertilizers and pesticides is reduced, and zero or negative growth is achieved.

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