Study on the Development Path of High Efficiency Water Saving Agriculture in Chengdu Plain under the Background of Rural Revitalization Strategy

Li Hui, Liao Chun-xiu
School of Electromechanical and Information Engineering, Chengdu Agricultural College, Chengdu, China, 611130
Lhdxl2005@163.com

Abstract. In order to effectively promote the overall development goal of Rural Revitalization Strategy, aiming at the problems and development potential of high-efficiency water-saving agriculture in Chengdu Plain, this paper puts forward the conservation tillage technology focusing on soil and water conservation, the water-saving irrigation and rainwater harvesting supplementary irrigation technology focusing on the efficient utilization of water resources, and the chemical irrigation technology focusing on improving the drought resistance ability of crops. The development mode of water-saving agriculture in Chengdu Plain is put forward, which is the combination of water collecting agriculture mode, conservation tillage mode, two season fixed furrow double no tillage mode and modern agricultural water-saving irrigation technology mode. It is not only conducive to food security and regional economic development, but also effectively promote the sustainable development of environmental, ecological and social benefits.

1. Introduction
With the gradual realization of the goal of building a well-off society in an all-round way by 2020, the country puts forward the Rural Revitalization Strategy with the overall goal of agricultural and rural modernization, and gradually promotes the process of agricultural and rural modernization. General secretary Xi Jinping put forward the general requirement of Rural Revitalization Strategy as industrial prosperity, livable ecology, civilized rural style, effective governance and rich life. To accomplish this general requirement, we must take the prosperity of the agricultural industry as the primary goal. Agriculture depends on soil, fertilizer and water. Sichuan is a big agricultural province, the prosperity and green development of agricultural industry is related to the implementation of Rural Revitalization Strategy. Chengdu Plain is the first area to carry out rural reform in Sichuan Province, and it is also an area where agricultural industrialization started earlier and developed faster. Chengdu Plain belongs to the water system of Minjiang River and Tuojiang River in the Yangtze River Basin. Although the water resource endowment is good, there are some problems, such as significant terrain difference, unbalanced annual precipitation, regional water shortage, engineering water shortage and allocation water shortage. Agricultural water consumption accounts for nearly 50% of the total water consumption in Chengdu Plain, so vigorously developing efficient water-saving agriculture has become a strategic choice to solve the problem of water shortage. Carrying out water-saving agriculture research is an important way for the green, ecological and sustainable development of national agricultural industry, and an important measure to boost the Rural Revitalization Strategy.
The research on the problems and solutions to the development of high-efficiency water-saving agriculture in Chengdu Plain will not only help to ensure regional food security, change the mode of agricultural development, reduce the workload of water conservancy construction, save land and water resources, promote high and stable agricultural production, high quality and high efficiency, enhance the economic strength and economic benefits of Chengdu Plain, but also help to protect and improve agricultural production. It is also conducive to improving social benefits, promoting agricultural modernization and achieving the goal of making the people rich and the country strong.

2. Development potential of water saving agriculture in Chengdu Plain

2.1. Characteristics of water resources in Chengdu Plain

Chengdu Plain is located in the middle of Sichuan Province, rich in water resources, with an average annual water resources of 30.472 billion cubic meters, and an average annual groundwater resources of 4.298 billion cubic meters [1]. The main characteristics of water resources in Chengdu Plain are as follows: (1) high density of river network. Chengdu has 12 main streams and dozens of tributaries, such as Minjiang River and Tuojia River, with crisscross rivers and ditches. The river network density is as high as 1.22 km / km². With the well-known Dujianyang water conservancy project at home and abroad, reservoirs, ponds, weirs and canals are scattered all over the city. (2) The water quality is excellent. Chengdu Plain is located in the upper reaches of the Yangtze River Basin. The river water is mainly composed of atmospheric precipitation, subsurface flow and snowmelt. Before it flows into Chengdu Plain, the river channel is mainly between high mountains and valleys, which is less polluted by human activities. Therefore, the water quality is particularly good, and most of the indicators meet the requirements of the national surface water grade II standard. (3) Low cost, easy to use. Chengdu No.6 waterworks, located in Pixian County, Chengdu Plain, is the largest gravity flow energy-saving Waterworks in China, and also the main Waterworks in Chengdu, with daily water supply of 1.4 million tons. The sixth waterworks has a unique geographical location. The water intake is adjacent to Xuyan River and Baitiao river of Dujiangyan water system. The dual water sources ensure the continuous flow of raw water in four seasons. Due to the difference of terrain, the sixth water plant takes water and supplies water to Chengdu by gravity flow, which is a unique gravity flow energy-saving water plant in China.

Although Chengdu Plain is rich in water resources, in recent years, with the acceleration of urbanization, rapid population growth, rapid economic development and water consumption, the city's average water shortage rate for many years is 1.2%. Various problems of water resources in Chengdu Plain are gradually highlighted, mainly reflected in the lower surface. (1) The intensity of water resources development is high. According to the 13th five year plan for water development in Chengdu, the inflow of the upper reaches of Minjiang River has been reduced by 10%, while the intensity of water resources development has reached 80%, far exceeding the internationally recognized warning line of 40% water resources development; the minimum ecological flow of some rivers has been unable to meet the annual average flow of 10%~30% of the ecological base flow requirements, and even the water supply and demand contradiction will be further highlighted [2]. (2) With the aggravation of river water pollution, the overall deterioration of river ecology, the increase of wastewater discharge, black and odorous water and other water problems are gradually highlighted, and the situation of water ecological environment protection and governance is very serious [3]. Chengdu is one of the real water shortage cities in China due to its engineering water shortage, regional water shortage, water quality water shortage and allocation water shortage. This has directly affected the sustainable economic development and regional environmental quality of Chengdu. It is urgent to make scientific and reasonable use and improvement of water resources and water environment.
2.2. Development potential of water saving agriculture in Chengdu Plain

2.2.1. Potential of water resources utilization
The total amount of water resources in Chengdu Plain is rich, but the average utilization rate of water resources for many years is only 12%. Compared with the national average level of 20%, there is still much room for development and utilization. The reuse rate of water resources is only about 50%, while that of developed countries has reached more than 70% [4]. Agriculture is a large water user, accounting for more than 75% of the total water consumption, but agriculture still uses the traditional flood irrigation method, which has a very low utilization rate of water resources, resulting in a huge waste of water resources.

2.2.2. Water saving potential of field irrigation
The agricultural water consumption in Chengdu Plain is large, but the utilization rate of irrigation water is very low. As of 2015, the utilization ratio of irrigation water in Dujiangyan irrigation area is no more than 0.5, which is lower than the national irrigation water utilization coefficient of 0.53. In 2014, China's water-saving irrigation area reached 29 million Hm2, accounting for 41.07% of the irrigation area [5]. Among them, sprinkler irrigation and micro irrigation accounted for 11.1% of the total irrigation area. Compared with Israel and Germany, which are developed in water-saving agriculture in the world, there is still a big gap. In 2002, the proportion of these countries reached 100%. By calculating the water-saving potential of different irrigation technologies in the field, if the water-saving irrigation technology is adopted, the water consumption can be saved by 1.966-4.915 billion m3, the saved water can increase the effective irrigation area by 405700-1.042 million Hm2, and improve the effective management probability by 10% - 28% [6].

2.2.3. Water production efficiency and water saving potential
The utilization form of water resources in Chengdu Plain is extensive and the water use efficiency is low. The water productivity of grain production in Chengdu Plain is 0.9kg/m3 (1111 m3 of water is consumed to produce 1t grain), which is lower than the average water productivity of 1kg / m3 in China (1000m3 of water is consumed to produce 1t grain), which is far lower than the level of advanced countries in the world [7]. If calculated according to the standard of average water productivity of 1kg / m3 in China, the water saving in Chengdu plain can reach 3.784 billion m3. It can be seen that in the case of increasing shortage of agricultural water, improving water productivity to achieve water saving and yield increase is the fundamental way out for green, efficient and sustainable development of modern agriculture.

2.2.4. Water saving potential of irrigation canal transportation and distribution system
The irrigation canal transportation and distribution system in Chengdu Plain is wasteful, and the management is extensive. The utilization rate of irrigation canal is only 53.37%. Nearly half of the irrigation water is lost in the process of transportation and distribution, which is a typical "engineering water shortage". Based on the agricultural water use in 2015, under the three different goals of large, medium and small, the water saving amount in Chengdu Plain is 995-3221 million m3, and the effective irrigation area can be increased by 205500-664400 hm2. The canal seepage prevention technology can effectively reduce the Canal Seepage Damage and improve the canal water utilization coefficient and agricultural water utilization rate, such as adopting different seepage prevention technologies such as masonry seepage prevention, concrete facing seepage prevention, membrane material seepage prevention and underground pipe water conveyance [8].

3. Development path of water saving agriculture in Chengdu Plain
Chengdu Plain is rich in water resources, but its utilization rate is low, which is inconsistent with the distribution of agricultural production. The level of farmland capital construction is low, the water supply per unit area is low, and the contradiction between supply and demand of water resources is
prominent. The function of soil and water conservation is weak, and the harm of natural disasters, especially drought, is more and more serious. Therefore, all kinds of water-saving measures should be adopted in line with local conditions to realize the sustainable utilization of agricultural water resources. We can rely on the construction of additional irrigation and water conservancy facilities, land reform and farmland reform, and the construction of basic farmland with drought and flood to ensure income. In order to achieve the goal of high efficiency water saving, increasing yield and income, we should build a water-saving farming system suitable for Chengdu Plain Agricultural Resources by using water-saving irrigation, conservation tillage, chemical drought resistance and other measures.

3.1. Conservation tillage technology focusing on soil and water conservation
The agricultural ecological environment in Chengdu Plain is fragile, soil erosion is serious, the soil layer is shallow, and the ability of soil and water conservation is poor, which has become the main factor restricting the development of agricultural production in this area. Therefore, conservation tillage measures should be carried out to control the loss of soil, water and nutrients, which is an important development direction of water-saving agriculture.

Farmland coverage is one of the important measures to improve farmland microclimate and increase crop yield. In Chengdu Plain, rice and wheat are the main crops, and vegetable crops with short growth period are planted in autumn. Less tillage is the main method for wheat, and rotary tillage is the main method for rice. Rice straw can be reasonably used by covering and returning to the field. The combination of tillage and straw has a great role in promoting rice and wheat seedling planting and annual stable and high yield. Rice rotary tillage can help to break the surface crust, save 2600 m³ / hm² of water annually, increase economic benefits of 15000 ~ 21000 Hm², and achieve water saving, high yield and high efficiency [9]. At the same time, cross slope tillage, plastic film mulching, rice straw mulching, ridge farming, Hedgerow edge protection and other technologies implemented in Chengdu plain can intercept rainfall, make it infiltrate in situ, change surface runoff into low runoff, and have good water and soil conservation effect.

3.2. Water saving irrigation and rainwater harvesting supplementary irrigation technology focusing on efficient utilization of water resources
Because of the large investment and low benefit in the utilization of agricultural water resources in Chengdu Plain, water-saving irrigation should be actively developed in irrigated agriculture. In order to improve the drought resistance ability of crops, chemical drought resistance and water conservation technology should be mainly used for dry land irrigation, such as hose instructor, micro self pressure spraying and drip irrigation; perennial cash crops can use the natural terrain drop, mainly drip irrigation; vegetables and conventional dry land crops can use the natural terrain drop, combined with small pressure equipment for sprinkler irrigation [10]. Hose irrigation can be used to solve seasonal drought in areas with poor economic conditions. In addition, it is an effective way to develop rainwater harvesting and supplementary irrigation project on dry slope land, to increase the resource utilization of regional precipitation, to realize the spatial and temporal allocation of precipitation, and to enhance the ability of dry land agriculture to resist natural disasters. The construction of micro water conservancy projects such as small water cellars, small pools and small mountain ponds has the characteristics of less investment, local materials, simple technology and convenient management, which provides a strong guarantee for the development of water and soil conservation, water-saving irrigation projects and water-saving agricultural production.

3.3. Chemical regulation of drought resistance and water conservation technology focusing on improving drought resistance of crops
Chemical regulation of drought resistance and water conservation technology is one of the key technologies to improve water resources utilization efficiency, increase crop yield and develop dry farming [11]. It mainly uses water retaining agent, drought resistance agent, seed chemical solution,
ground evaporation inhibitor and other chemical substances to directly apply to soil or leaf surface through seedling dipping root, or furrow application, ground spraying, foliar spraying and other ways, so as to make it absorb the water in soil and air. In case of drought, the water retained by crops can be released slowly, or it can be controlled by regulating the stomatal opening of the plant. In order to improve the water absorption capacity of crops, enhance the soil moisture and water storage capacity, reduce the transpiration intensity, promote the growth and development of roots, and achieve the purpose of water saving and drought resistance, yield and efficiency.

4. Development mode of water saving agriculture in Chengdu Plain

4.1. Catchment agriculture model
Limited by the complex topography, Chengdu Plain has a large investment and low benefit in the utilization of agricultural water resources. It mainly uses the advantages of precipitation accumulation technology and water-saving irrigation technology to implement the water-saving irrigation methods of hose irrigation, micro self pressure spraying and drip irrigation. In view of the strong permeability of sandy soil in plain, sprinkler irrigation should be adopted. In hilly areas, the irrigation system mainly uses water diversion. Usually, the surplus water of the channel or the water in non-water use season is filled into the pond. Once the water source of the channel is insufficient, the water from the pond and reservoir can be used for irrigation in time. In this way, the channel is filled with water for many times and used repeatedly, which has a strong recovery capacity, greatly improves the utilization rate of surface water, enhances the drought resistance ability, and improves the water quality. The irrigation efficiency is improved.

4.2. Conservation tillage model
The essence of conservation tillage is to improve the soil structure, reduce water and wind erosion and nutrient loss, protect the soil, reduce labor, machinery and equipment and energy input, so as to achieve the goal of high yield, University, low consumption, high quality and sustainable development [12]. In Chengdu Plain, the yield of wheat and rape increased by 195 kg / hm² and 374 kg / hm², respectively, compared with the control, by the combination of straw returning and no tillage, wheat, rape and potato no tillage and straw mulching. The total grain yield was 3140 kg / hm² higher than that of the control under the treatment of "ridge planting + straw mulching + ripening agent". This indicated that straw mulching and ridge cultivation were helpful to increase yield and water use efficiency.

4.3. Double no tillage mode of two season fixed furrow
The fixed furrow double no tillage mode is mainly suitable for "rice wheat (rape)" two cropping and two cropping fields with water source guarantee. This model integrates the techniques of no tillage continuous cropping, straw returning, dry rice seedling raising, dry rice seedling throwing and infiltration irrigation, and takes water saving and soil fertility improvement as the main contents. In this model, infiltration irrigation is used for rice, which does not need ploughing, paddling and soaking, so it can save a lot of water.

4.4. The technical mode of saving irrigation in modern agriculture
Modern agricultural irrigation saving technology can give full play to the production potential of crops and the comprehensive production capacity of cultivated land to achieve the purpose of high quality, high yield and high efficiency. Sprinkler irrigation, drip irrigation, micro sprinkler irrigation technology is the most widely used efficient water-saving technology in modern agricultural water-saving mode [13]. According to the geomorphic characteristics of Chengdu Plain, fixed sprinkler irrigation system and semi mobile sprinkler irrigation system are mainly used. Fixed sprinkler irrigation is suitable for sloping farmland with flat terrain, relatively concentrated cultivated land, and mainly planting economic crops and fruit trees. The spraying radius is 10 ~ 15m, the water...
can be sprayed 1 ~ 3m³ per hour, and the average investment is 15000 ~ 22500 yuan per hectare. The effect of water saving and labor saving is very significant. Semi mobile sprinkler irrigation, suitable for relatively scattered sloping farmland and field crops, has the advantages of small volume, adjustable spraying height, angle and radius, convenient use, water saving and labor saving.

5. Conclusion
The development of water-saving agriculture is the inevitable choice to realize the sustainable development of agriculture under the background of Rural Revitalization and development strategy, and it is also the main way to build modern agriculture. The efficient utilization of water and soil resources is not only related to the national food security and regional economic development, but also related to environmental, ecological, social benefits and other factors. According to the situation of regional water resources and the law of agricultural water demand, water-saving technology and path exploration can effectively save water, improve the utilization rate of water resources, achieve the purpose of saving water and labor, increasing production and efficiency, and gradually establish an agricultural water supply mechanism in line with China's national conditions to meet the needs of modern society and modern agricultural development.

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