Strengths, Problems, and Recommendations of Potato Staple Food Development in Zhejiang Province

Weifang FAN[1], Aiping LAI[2], Guoquan LU[2]*

1. Jinyun County Agricultural Bureau of Zhejiang Province, Jinyun 321400, China; 2. Institute of Root & Tuber Crops, Zhejiang A&F University, Hangzhou 310000, China

Abstract China launched the potato staple food strategy in 2015. The potato staple food strategy focuses on increasing potato consumption and promoting potato production through processing and use of potato staple food. This provides new opportunity for development of potato in Zhejiang Province. This paper analyzed development strengths and existing problems of the potato industry in Zhejiang Province. On this basis, it came up with pertinent recommendations for potato staple food development in Zhejiang Province, so as to guide consumption with nutrition, and guide production with consumption, to provide theoretical foundation for development of potato industry in Zhejiang Province.

Key words Zhejiang Province, Potato, Industrial development, Staple food

The potato is a starchy, tuberous crop from the perennial nightshade *Solanum tuberosum* L. Potato is the world's fourth-largest food crop, following maize, wheat, and rice. In China, it is also the fourth largest staple food, following rice, wheat and maize[1]. At present, potato yield and planting area of China rank the first place in the world. Since potato has higher economic benefits than other general crops, potato plays a strategic role in grain security and energy security[2].

On January 6, 2015, the strategic seminar of potato staple food development holding by Chinese Academy of Agricultural Sciences with participation of vice ministers of Minister of Agriculture called for launching the potato staple food strategy, and processing potato into steamed buns, noodles, and potato powder. It is expected that more than half potato will be consumed as staple food in five years. Potato is one of staple foods in Zhejiang Province. In recent years, the sown area of potato in Zhejiang remains at 0.8 million mu (including 0.7 million mu spring potato and 0.1 million mu autumn potato). The implementation of potato staple food development strategy will provide an unprecedented opportunity for potato industry in Zhejiang Province.

1 Development strengths of potato industry in Zhejiang Province

1.1 Strength in geographical location Zhejiang is bordered by Jiangsu province and Shanghai municipality to the north, Anhui province to the northwest, Jiangxi province to the west, and Fujian province to the south, to the east is the East China Sea, showing Zhejiang Province has excellent geographical location. Zhejiang Province is located in the south of Yangtze River Delta, is one of the provinces with most active economy. It has high urbanization level, convenient traffic, and high market potential. In the middle of April to May, due to long time of storage, some north potatoes will sprout and accordingly cause degradation, while potatoes of Zhejiang Province are just brought to market, so it is feasible to sell potatoes in north China and fill the gap of north market. Besides, it is feasible to transport potatoes to Shanghai and Suzhou in early spring market, to obtain considerable economic benefits. At present, Hong Kong and Macau and Southeast Asian countries still need importing 0.3 million tons of potato annually[3]. Zhejiang Province just has such transport strength, so it is able to reduce transport cost and increase foreign exchange through export of potatoes.

1.2 Strength in sales season China's potato industry system is mainly divided into northern production system and southern production system[3]. Northern areas are flat in terrain and vast in territory, suitable for mechanical operation, large area of mechanical sowing and harvesting. In northern areas, potatoes are generally sown for one harvest annually, sown in late April to beginning of May and harvested in September. In southern areas such as Guangdong and Guangxi, potatoes are generally sown in November and harvested in the next March. In late April to beginning of May, southern potatoes have gone out of market, while northern potatoes are not put into market, forming a market gap. Potatoes of Zhejiang Province just are put into market in the middle of April, so it can fill this market gap.

1.3 Strength in cultivation technologies In Zhejiang Province, potatoes are sown in spring and autumn. In recent years, potato cultivation technologies in Zhejiang Province are constantly improving. Through building greenhouses and arched sheds, it realizes slack season cultivation of potatoes and extends market period of fresh potatoes substantially. In cultivation methods, there are methods of conventional cultivation, straw-covered no-tillage cultivation, insect net batch harvest cultivation, and whole process

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* Corresponding author. E-mail: lugq10@zju.edu.cn

mechanized cultivation, etc. Straw-covered no-tillage cultivation method is suitable for crop rotation of rice and potato. It not only increases soil fertility and protects ecological environment, but also reduces cultivation costs[4]. As for prevention and control of potato diseases and insect pests, Zhejiang Province implements proper measures from planting potatoes, spraying pesticides and conducting sterilization of sick plants for instance[5]. At present, Jinhua Institute of Agricultural Machinery has introduced refined agricultural machinery, which can realize sowing, fertilization, soil and film coverage, ditching and harvesting continuously, saving labor time and cost greatly.

1.4 Strength in economic benefits Potatoes of Zhejiang Province are mainly consumed in fresh form, and supplied to areas within Zhejiang, surrounding city like Shanghai. The yield, price, and planting benefits are higher than the national average level. In the promotion of establishing high yield potatoes, economic benefits of potatoes are further manifested. In 2013, the average yield per 10000 mu was 2505 kg, with output value of 6189 yuan, net profit of 4804 yuan; the highest output value per 10000 mu reached 8937.6 yuan, net profit exceeded 7600 yuan. In the second half of 2013, spring potato of Maojiayuan in Zhuji City reached the average yield of 2798.41 kg/mu, the highest yield of 3216.64 kg/mu, making an agricultural Guiness Records in Zhejiang Province. If using greenhouse plus plastic film to keep temperature and water, potatoes can be put into market in March 20. In this period of time, the price is 4.8 – 5.0 yuan/kg, realizing maximum economic benefits.

2 Existing problems of potato industry in Zhejiang Province

2.1 Limited planting area The terrain of Zhejiang Province takes on stepped form, inclining from southwest to northeast. In southwest, the terrain is mainly mountain area; in the central part, it is mainly hilly area; in northeast, it is low lying alluvial plain. Zhejiang Province is situated in subtropical zone. Potato is highly adaptable to climate conditions, has short growth period and high yield, so it is feasible to plant in most parts of Zhejiang Province[6]. At present, potato planting area in Zhejiang Province is about 0.8 million mu, mainly distributed in remote mountain areas and hilly agricultural areas. In fact, there is more than 4 million mu winter fallow field in Zhejiang Province, more than 8 million mu mulberry and tea gardens and orchards. These are distributed in different altitudes. Except little part, most areas are suitable for planting potatoes[7]. It is feasible to develop interplanting of potatoes in mulberry and tea gardens and orchards. In central and south Zhejiang, it can realize potato - rice - potato a year, with the yield of grain up to 4 tons/mu and output value exceeding 10000 yuan/mu. In north Zhejiang, it can realize crop rotation of super hybrid rice and potato with grain yield up to 3 tons/mu and output value more than 5000 yuan/mu.

The suitable sowing period for potato is long: spring potato can be sown in January and February, and autumn potato can be sown in middle and late September; in middle and late October to middle and late November, facility potato can be sown. If winter fallow field of Zhejiang Province is fully used, it will break the limitation of potato planting area and effectively promote development of potato industry in Zhejiang Province.

2.2 Imperfect cultivation technologies The level of potato cultivation technology plays a decisive role in potato yield. Different cultivation technology can bring in the yield difference up to 1000 kg, so there is a huge potential for increasing potato yield through improving technologies. In Zhejiang Province, potato cultivation technologies mainly have following problems. Firstly, fine potato seed has low coverage. At present, 90% potato production seeds are potatoes reserved by farmers. Since the fresh potato yield is only 50-60% or lower of fine virus-free potatoes, this is the major factor restricting per unit area yield of potato in Zhejiang Province. Therefore, Zhejiang Province can focus on exploring and innovating fine potato seeds with higher ability of resisting abiotic stress through controlling functional gene groups and recombination of fine genes[1]. As long as related agricultural department introduces fine potato seeds, extends new technologies, scientific applying fertilizer, and making proper dense planting, it is quite possible to realize double the per unit area yield[7]. Secondly, the mechanization level of potato planting is low in Zhejiang Province. Zhejiang Province should constantly strengthen researches of mechanized technologies, accelerate researching and developing agricultural machinery for sowing, fertilizer application and harvesting of potatoes in hilly areas, to replace manual labor as soon as possible and provide technological support for large scale development of potato. In recent two years, Department of Agriculture of Zhejiang Province launched rice and potato rotation in Nanxun District of Huzhou City and has made preliminary success in whole process mechanized demonstration, which greatly promotes local potato production, but it is still necessary to further improve relevant machines and operation technologies.

2.3 Breeding strength to be increased Zhejiang Province has high demands of potato seeds, more than 100 kg/mu, while the coverage of fine virus-free potato seeds is low, so Zhejiang Province needs transport huge volume of seed potatoes. Because transport vehicles are short, channels are not standardized, and the temperature difference is high during transport, it is difficult to control the seed potato quality and the damage loss of seed potato is high. Through establishing seed potato breeding bases for high altitude regions, it is able to solve the problem of seed potato in Zhejiang Province, which is of great significance for promoting potato industry in Zhejiang Province. Department of Agriculture of Zhejiang Province and Zhejiang Academy of Agricultural Sciences jointly launched virus-free potato seed breeding researches. Using their method, it is able to effectively solve the problem of seed potato for autumn potato sowing in Zhejiang Province and it is expected to apply Grade A small seed potato directly to large field commercial potato production. Practice indicates that virus-free seed potato has better disease resistance, healthy growth, and higher

yield. The application prospect of small seed potato is very broad, and the cost for storage and transport is lower than large seed potato. In 2015, Zhejiang Province has established more than 10 pilot sites, using idle period of rice breeding greenhouse to carry out small seed potato breeding experiment, to accelerate localization of seed potato in Zhejiang Province.

2.4 Limited consumption market Potato is nutritious and can be used as vegetable and grain, and it is the raw material crop having largest number of processing products in agricultural production[8]. With improvement of people's living condition, post processing products of potatoes emerge in an endless stream in recent years[9]. At present, in Zhejiang Province, potato is mainly used as daily vegetable, and the consumption market is limited to fresh vegetable. If the market of potato processing products is opened, it will greatly increase market volume of potatoes. In China, potato is one of the traditional staple foods, it is easy to store and transport, and the consumption volume is high. In order to further expand market volume of potatoes, Zhejiang Province can start from developing cultivation technologies and new products, constantly expand planting area of autumn potato and facility potato, and seek to use the state-of-the-art technologies to solve the seasonal problem of potato. Besides, Zhejiang Province should speed up development of deeply processed potatoes, explore development of potato powder, vermicelli, noodle, bread, and pastries, and constantly explore market of deep processing products of potato. Zhejiang Province should set up the concept of guiding consumption with nutrition, and guiding production with consumption, and take scientific and technological innovation as lead, to stably increase market capacity of potato.

3 Recommendations for promoting potato staple food development in Zhejiang Province

3.1 Strengthening propaganda of potato nutrition knowledge to expand potato consumption market To promote potato staple food development, the first problem to be solved is the popularity of potato products in consumers and the market sales volume. Only when the sales channel of potato products is opened, may it be able to promote production of potato and promote development of potato industry. Potato is rich in many nutritional matters. Apart from plentiful carbohydrates, potato also contains many vitamins and inorganic salts, as well as dietary fiber[10]. Its protein quality is equivalent to egg protein, so it is reputed as the second bread. Government can make propaganda and guidance of nutritional value of potato through TV, newspaper, radio and other media, guide potato consumption through nutritional diet, attract more consumers to buy potato products, so as to promote potato production and processing through expanding consumption market.

3.2 Developing potato powder, mashed potato processing process and equipment Developing potato powder and mashed potato processing process and equipment and promptly changing fresh potato into potato products easy for storage and transport are of great significance for realizing potato staple food in Zhejiang Province, and researching and developing delicious, nutritional and economical potato products. At present, most potatoes in Zhejiang Province are taken in the form of fresh potato. However, in the period of storage, potatoes are perishable due to changes in temperature and humidity, leading to degradation of potato quality and waste of raw potatoes. Making potato into powders and then processing into various foods are of great significance for promoting potato staple food development. Now, Zhejiang Academy of Agricultural Sciences has developed a set of "whole cell pre-pasting potato granule full powder" production technology. This technology features low equipment investment, low energy consumption, and wide application, so it is quite suitable for small enterprises of Zhejiang Province and lays solid foundation for potato staple food development in Zhejiang Province.

3.3 Strengthening policy support and sci-tech support for potato processing enterprises It is recommended to establish demonstration enterprises, support full powder processing enterprises with production capacity above 1000 tons, and carry out traditional grain processing and local characteristic potato full powder adding experiment. For example, it is feasible to transform traditional foods and research and develop traditional products of potato full powder, such as adding to glutinous rice cake and stuffed dumplings of Ningbo, Shaoxing cake, Wenzhou rice powder, rice cake, and moon cake, etc. Besides, it is recommended to conduct experiment research of adding potato full powder into bread, cake, and biscuit, and launch demonstration extension in catering and related enterprises. Furthermore, it is recommended to carry out researches of making fresh potato as staple food and innovating technologies and products of potato staple food. At present, Institute of Root & Tuber Crops of Zhejiang A&F University has made certain achievements in development of potato series products, such as noodles and steamed buns added with certain potato powder, and also developed cakes and breads added with certain potato powder. Besides, through screening, cultivation and using color potatoes, it developed colorful diversified potato products, receiving good response in the university.

4 Conclusions

Promoting the potato staple food development is an active exploration for ensuring national grain security and promoting constant increase of farmers' income in the new situation. This is favorable for improving people's dietary structure, strengthening people's physical health, alleviating resource and environment pressure, and realizing sustainable agricultural development. According to practical situation of grain production in Zhejiang Province, the potato industry of Zhejiang Province has its unique strengths. Without grabbing water and land with wheat, rice and maize, it is able to take full advantage of winter fallow field to explore production potential. It is recommended to strengthen technological innovation, gather strengths in seed potatoes and seedlings, mechanical cultivation and value adding technologies, take advantage of

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opportunity of potato staple food development, boost potato industry of Zhejiang Province, promote consumption, expand use of winter fallow field, increase farmers' income, and raise the grain self-sufficiency level of Zhejiang Province.

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