Development Strategies of Qin Pepper Industry in Shaanxi Province in Northwest China

DU Yun-ke, XIN Xin*

Baoji Institute of Agricultural Science, Qishan722400, China

Abstract Qin pepper, a famous local agricultural product of Shaanxi Province, has grown in Guanzhong Area for several hundred years. In recent years, Qin pepper industry has already made considerable progresses, but it also faces many challenges. To ensure a stable planting area of over 100 000 hm^2, a total output of 1.85 million tons and a ratio of 1:2:2 among freshly used peppers, dried peppers and processed peppers in 2015, on the basis of full investigation, expert argumentation as well as research and analysis, industrialization modes of "leading enterprise + agricultural department + base", "leading enterprise + agricultural company" and "leading enterprise + specialized cooperative" are presented herein, on the principle of "appropriate centralization, scale development, company operation, and plate promotion" and in accordance with the general idea of "stabilizing area, optimizing layout; relying on technology, highlighting superior quality; leading by enterprises, and improving efficiency". Some development strategies including "optimizing layout to facilitate plate promotion; increasing science and technology input to improve industrial competitiveness; supporting leading enterprises to accelerate industrialization process; promoting industrial certification to make well-known brands" are also put forward herein.

Key words Pepper industry, Development goals, Guanzhong Area of Shaanxi Province

Pepper is an annual or perennial plant of capsicum of solanaceae. According to botany (or horticulture), capsicum is further divided into several cultigens[1]. For the general development situation of pepper industry in China and around the world, Li Meng[2], Ma Yanqing[3] *et al*. have all addressed. Though the yield and total amount of peppers in various countries around the world have accordingly increased through stimulating consumption in the recent decade, the planting area for dried pepper in China is stabilized at around 400 000 hm^2 and that of Shaanxi Province is about 100 000 hm^2, which accounts for about 1/4 to 1/3[4] of the whole country; therefore, pepper is the characteristic dominant agricultural product of Shaanxi Province. During foreign trade it is mainly exported to Southeast Asia, occident countries, Japan and Hong Kong and Macao regions of China. According to statistics of Ma Yanqing, in 2002 China has exported 91 632 tons of peppers, which accounts for 27% of the total export volume of the world. Wherein Shaanxi Province has exported 30 000 tons, which accounts for 37.5% of the export volume of the whole country and was sold at a price 80% higher than Indian peppers and 30% higher than Shanying pepper of Japan. For domestic sales, it is mainly sold in provinces such as Sichuan, Chongqing, Hebei, Guizhou, Yunnan, Shanxi, Ganshu *etc*.

In order to ease the bottleneck of industrial development, with the powerful support of Shaanxi Provincial Department of Agriculture, Baoji Institute of Agricultural Science has carried out systematic researches on aspects such as agriculture orientation, production arrangement, development goals, development modes, industrialization and impacts on increase of farmers' income by means of industrial investigation and research, expert discussion, market exploration, analysis and study *etc*. We touch on part of the content of such study to provide support for furthering optimization and upgrading of industrial structure for "the 12th Five-Year Plan", improving urban and rural residents' life, increasing farmers' income and enhancing the ability to earn foreign exchange through export.

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* Corresponding author. E-mail: xinxin7201@163.com

1 Favorable factors for industrial development

1.1 Long cultivation history and optimal ecological environment Hot line pepper is peculiar to China, where Shaanxi is the main producing area, hence it is called "Qin pepper" (Qin is a short name for Shaanxi Province) by people in other regions. From Ming dynasty it has been planted as a type of vegetable. According to *Baoji County Annals*, it is recorded that planting of peppers began from Ming dynasty and gradually became common in Qing dynasty. Today, Baoji City in the west of Guanzhong Area only has an annual planting area over 23 000 hm^2 and an annual yield over 210 000 tons, and can increase the income of Baoji by 420 million Yuan each year[6]. In both domestic and foreign trade, Qin pepper is always favored by people and reputed as "King of peppers". Its planting area usually has an altitude of 400 to 1 000 m, an annual average temperature of 10.9 to 12.4 ℃, an annual sunlight of 2 000 to 2 200 hrs, and an annual average rainfall of 600 to 677 mm. It also has superior conditions of light, heat and water, thick soil layer, flat hypsography, fertile soil and good irrigation condition. During the growing season from March to October for peppers on open ground, monthly effective accumulated temperature is 2 186 to 2 626 ℃, so heat here is completely sufficient to meet the demands of growth and development except for spe-

cific late-maturing types. In addition, monthly maximum temperature seldom exceeds 35 ℃, so there is little impact on normal process of blooming and pollination and photosynthesis. During 8 months of growing period, the average monthly rainfall is 551.3 to 591.7 mm, which accounts for 66% to 92% of the total water consumed by peppers. However, during 80% of years, annual rainfall is 451 mm, which accounts for 50% to 75%, so water is somewhat insufficient. But there is Weihe River with tens of tributaries, so it is abundant with water resources on ground and under ground, and irrigation condition is superior. During growth duration, sunshine hours are 1 418.1 to 1 518.4 hrs, while 80% of years can reach 1 134.5 to 1 214.7 hrs; therefore light is adequate. Based on above factors analysis it can be seen that Guanzhong Area with sufficient sunshine, adequate heat, and dry air is favorable for growth of Qin peppers[7]. Though rainfall is somewhat insufficient and changes greatly from year to year, but the irrigation condition is superior.

1.2 Rich science and technology resources, well-developed industry Since the second half of 20th century, research and education institutions and several private seed enterprises in Shaanxi Province have been engaged in researches on pepper germplasm resources, new variety selecting and breeding, pepper inter-planting, formula fertilization, disease-resisting and lodging-resistance mechanism, mechanical regulation, improved variety breeding, integrated cultivation technology[8] and have developed variety series such as '8212', '8819', 'Shaanjiao' and 'Baojiao' *etc*. Their scientific ability, variety level and production technology is at leading position in China.

A series of key technologies such as cultivation of optimum aged sound seedling, inter-planting of pepper and grain, production planning and fertilizer preparation, drawing of ridge for lodging resistance, disease resistance and water-saving irrigation, branch training and pruning, chemical regulation[9]. With respect to supporting services, an industry system has been formed which includes germplasm innovation, variety selecting and breeding, technology services, producing and processing, trade logistics and an integrated operation mode of producing, processing and marketing is realized.

1.3 High quality goods, smooth trade flow The competitiveness of Qin pepper not only stands on its superior ecological conditions and advanced producing technology, but also is closely related to its high quality. Qin pepper has long figure, even wrinkle, bright red color, delicious taste as well as good storage and transportation resistance. In recent years Qin pepper is mainly sold as fresh pepper, dried pepper, chopped pepper, soybean paste, chafing dish bottom material *etc*. Since Qin pepper has slender figure, thin skin and low water content, it won't mildew if stored at room temperature for 10 to 15 days as long as it is well ventilated. It is one of varieties of fresh peppers that have the longest storage and transportation life; therefore it is favored by marketing agencies.

In Shaanxi Province, there are many processing and marketing enterprises for dried pepper and pepper products. In Baoji City only, there are over 140 enterprises[10], whose products include 13 series such as dry pepper, pepper sauce, pepper powder, pickled pepper leaves, fermented soybeans with peppers, more than 50 marketing customers, and at least 70 pepper associations. A national distribution center for process and sales of pepper has been preliminarily formed. Currently fresh pepper accounts for about 20% of total sales, while dry pepper accounts for 40%, and the rest 40% is sold as processed pepper products.

2 Main development obstacles for the industry

2.1 Decreasing comparative benefits, harsh competition conditions Since Ming and Qing dynasties, Pepper in Guanzhong Area has been an characteristic advantageous industry for pepper farmers to support their families and get rich. In recent years, with lots of rural labor force abandon their lands and transfer to the secondary and tertiary industries, farmers who continue to plant peppers have expanded their planting areas and earned more; however, compared with those transferred labor force, their income is still much lower. This condition has encouraged more and more pepper farmers to give up pepper planting, which in turn leads to decrease of pepper farmers' quantity and labor force's quality. Meanwhile, with increase of overall level of commodity price, prices of means of production increase exponentially, which has nearly offset the increased income from increased yield and value of pepper, so the income of pepper farmers has hardly increased. Furthermore, since the end of the 20th century, many pepper farmers of Guanzhong Area have moved their whole families to Hainan, Guizhou, Sichuan, Xinjiang, Inner Mongolia *etc*. to join in scale production of peppers. They transported some commodity peppers back to Guanzhong Area for sales after harvest, which has struck local pepper market in Guanzhong Area.

2.2 Continuous cropping obstacle, heavier damages from diseases and pests Pepper here is the main cash crop and the only source for increasing income for farmers, so farmers attach great importance to its production and always use their best lands to plant pepper; however, due to limitations of present land system and production conditions, continuous cropping becomes an inevitable common phenomenon. Though most farmers know that during continuous cropping the root extrudes would suppress obviously the growth of seedlings, the root activity, and chlorophyll content of next season's solanaceae[11], and that continuous cropping causes rhizosphere soil changes from highly fertile "bacterial type" into lowly fertile "fungi type"[12], which in turn causes absorption area of root system decreases, and ability of root system to absorb water and nutrients gets weak, and finally causes production of pepper to decrease by 20% to 50%, Many pepper farmers have to continuously plant pepper on the same lands of their own year after year because while their own lands have nearly reached the limit of exploitation, lands of many transferred out labor force are still at hand of those labor force engaged in combined

production of both industrial and agricultural work.

Continuous cropping not only would cause obstacles, but also would aggravate damages from diseases and pests. According to investigation, attack rate of diseases on lands cultivated continuously over 3 years is 25%, and that of lands cultivated continuously over 8 years is 80%, some even have wide areas of pepper plants all killed[13-14].

Pepper diseases in Guanzhong Area mainly are epidemic or caused by virus, and damages from pests are caused by oriental tobacco budworm or cotton bollworm in particular, which always lead to "Three Falling-offs and One Death" (*i.e.* falling off of blooms, falling of fruitage, falling of leaves, and death of pepper plants). The production loss of affected lands is 10% to 30%.

2.3 Late processing, poor driving effect of leading enterprises Pepper is the characteristic agricultural product of Shaanxi Province and is well-known in China for its production technology and product quality, but its processing is very behindhand. For example, in Baoji City only there are over 140 pepper processing enterprises, but most of them organize production in a way of family workshop. Neither their scale nor their technology advantages can meet the market demands. Their products mainly remain at the level of raw materials or semi-finished products with low technology content. They have incomplete industry chain, low added value of products, non-standard production and processing, behindhand management concept, insufficient scientific quality standards, slow development of new products, poor market competitiveness and weak risk resistance ability. There exists over 50 marketing enterprises and more than 70 pepper associations. They are engaged in various marketing activities in various ways, but they do so separately and always compete by low prices and in a disorganized way. A few sellers even cheat customers, perform forced sales and thus affect the normal circulation order. Also there lacks necessary information communication among many scattered processing and marketing entities, so they can hardly catch up with market trends and grasp market opportunities, as a result of which they have to operate blindly and perform passive sales. Absence of key enterprises make Qin pepper difficult to set up a good industry image at both domestic and international markets and to form influential brands and products. Lack of standardized large scale production makes stable supply for the market impossible. Lack of stable market share forces the entire industry to fluctuate with the market, which causes pepper farmers to lose a relatively stable income. As a result, investment on biochemical products of pepper and development process of new products of high added value such as capsaicin and capsicine etc. would slow down; extension of industry chain would retard and the development of this industry would become inactive.

3 Development goal

It is expected to ensure a stable planting area of over 100 000 hm^2, an overall production of 1.85 million tons and a ratio of 1∶2∶2 among freshly used peppers, dry peppers and processed peppers by 2015.

3.1 Development strategies stabilizing area, optimizing layout; relying on technology, highlighting superior quality; leading by enterprises, and improving efficiency.

3.2 Development principle Appropriate centralization, scale development, company operation, and plate promotion.

3.3 Basic modes "leading enterprise + agricultural department + base", "leading enterprise + agricultural company" and "leading enterprise + specialized cooperative".

4 Development strategies

4.1 Optimizing layout, plate promotion To meet different levels of market demands and enrich the supply of non-staple food for rural and urban people, connoid pepper and fascicled peppers (red ciuster peppers) are to be planted appropriately in rain-fed agricultural area in east part of Guanzhong Area based on the climate, soil and various planting habits different regions in Guanzhong Area. In regions with guaranteed water source, integration and promotion of plastic film covered cultivation technology shall be facilitated. In the whole Guanzhong Area, people should take full advantage of the good chance of vegetable base construction of facilities in Shaanxi Province, exert the already built sunshine greenhouse and facilities of medium and large greenhouses in nearby plains of Jinghe River and Weihe River to plant cayenne pepper, bell pepper *etc.* They should make good use of high altitude, cool weather and great temperature difference between day and night in Taibai, Fengxian, Chencang regions to develop production of pollution-free mountainous region peppers to ensure year round supply and surplus during booming season. In regions suitable for Qin pepper in river-nearby plains, speed up the pace of land circulation and encourage centralized large scale cultivation and scale production. Take the road of optimization, standardization, centralization and specialization, improve the scientific level of pepper industry, and realize balanced increase of benefits of each link of the industry chain.

4.2 Increasing technology input, improving industrial competitiveness Expansion of protected filed grown pepper areas and participation of foreign technology type enterprises have brought new germplasm and complete sets of production and operation concepts for pepper industry in Guanzhong Area, and also formed unprecedented challenges for traditional pepper industry. To adapt to year-round production and balanced supply, new varieties with different growth duration and commodity characteristics should be cultivated and supporting technologies should be developed to adapt to different cultivation conditions and seasons; also cryogenic storage, cold chain transportation and pollution free technologies should be established. To meet requirements of different usages such as dried pepper, pepper paste and fresh fruits, special variety should be cultivated. In addition, with the increase of consumption of pepper leaves and further improvement of devices for pigment extraction process, varieties such as the type with useful leaves and fruits and type of high pigments as well as supporting technologies will also become new areas that worth close attention

and strong promotion.

Due to influences of continuous cropping obstacle and increasing damages from diseases and pests, usage of pesticides and fertilizers are increasing, which would always cause soil pollution and over-standard hazardous and noxious substances, so it is a requirement of overall industry development to reinforce research on farming system and prevention and treatment of main diseases and pests, build pollution-free production base, improve product quality from the source and improve its industrial competitiveness. To solve this problem, it requires (i) guidance of government policies for strong support from various industries; (ii) improvement of financial environment for multi-channel capital input; (iii) technology innovation for technical support; (iv) system and mechanism innovation, that of production links in particular. Current ways through cooperation among agricultural enterprises for scale planting of Qin pepper and various production cooperatives (associations) of pepper are a beneficial explore to solve some serious problems in pepper production in many years, improve product quality and increase income per unit and worth attention and recognition from governments.

4.3 Supporting leading enterprises, accelerating the industrialization process The essence of agricultural industrialization is to establish an agricultural economy operation mode and industrial organization form with a combination of science, economy and education and a chain of production, processing and marketing, which are characterized by regionalization of layout, industrialization of production and integration of operation for agricultural and rural economy, with guidance of market and focus on efficiency and relying on progress of technologies and drive of enterprises[15]. To upgrade current pepper industry, it is necessary to support leading enterprises, equip each link of pepper production and storage with modern science and technologies and accelerate the industrialization process. According to their own goals, governments of each level may find for a batch of enterprises which have positive growth, strong influence and great performance to provide special support, improve investment environment through discount-interest loans, reduction or exemption of taxes and credit support *etc*, enhance both soft and hard conditions as well as service ability, and attract nationally and internationally well-known brands to settle in Guanzhong Area. By introducing and fostering local leading enterprises that are active and have strong competitiveness and through radiation of these enterprises enhance industrialization level of pepper and realize the goal of improvement of enterprise benefits, increase of farmers' income and development of the industry.

4.4 Increasing industrial certification, creating famous brands In recent years due to continuous cropping obstacle and heavier damages from diseases and pests, more and more importance is attached to construction of pollution-free green bases. By means of optimization of cultivation system, rotation of crops, prevention and control of pests, integration of supporting technologies, continuous cropping obstacle and damages from diseases and pests can be mitigated or reduced to a certain extend. However, to radically solve this problem, we should start from pollution-fee green peppers, perform certification of pollution-free green products, reinforce inspection of quality control and supervision of fresh fruits, dried peppers and pepper made products, and protect legitimate rights and interests of pepper farmers, leading enterprises and general customers. Based on the development experience of apply industry in Shaanxi, pepper industry should increase its efforts to create China famous brands during the process of development and transfer the product advantages of Qin pepper into advantages of brands and famous brands and export advantages for earning of foreign exchanges through export. We should further expand domestic and foreign markets through good brands, realize product innovation through technology innovation, grasp an important market share and make pepper a large and strong industry.

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