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Natural Rubber Farming in Guangdong Province in the Context of Supply-Side Reform: A Case Study of Shanwei Reclamation Area

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Abstract The rubber industry in Shanwei Reclamation Area has grown into a leading industry in the reclamation area, but there are some problems in rubber plantations such as wind damage, neglect of supporting construction for shelter forest in the planting plan, and lack of rubber tappers. For the sustainable development of rubber farming, it is necessary to select the appropriate plot to plant rubber based on the habitat requirements of rubber trees; plan the supporting construction shelter forest network in cultivation of rubber trees; build organic rubber plantations, produce high-quality natural rubber and increase the output value of rubber plantations; use new tapping system to reduce tapping labor, improve tapping benefits and increase income of rubber tappers.

Key words Rubber, Farming, Sustainable development, Rubber tapper, New tapping system

1 Rubber cultivation in Shanwei Reclamation Area

1.1 Shanwei Reclamation Area For rubber tree cultivation, there is a need to use the growing environment of rubber and take full account of natural factors, to achieve sustainable development of the industry. Sustainable development is not only manifested in environment, ecology, *etc.*, but also in economy^[1]. Shanwei Reclamation Area (115° 49' 22" – 115° 55' 50" E, 22° 58' 32" – 23° 07' 55" N) is in the transitional zone of the Da'nán Mountains in southern Guangdong, and has a subtropical monsoon climate, with warm seasons, abundant rainfall, sufficient sunshine, long frost period and maritime monsoon characteristics. Shanwei Bureau of Reclamation administers Tongluohu Farm, Meilong Farm and Da'an Farm, with a total area of 10667 ha, mainly engaged in the production and operation of natural rubber, animal husbandry, livestock products, aquatic products, rice fruits and other industries. The suitable rubber planting area is 1667 ha in Shanwei Reclamation Area, and the rubber planting area has reached 1133 ha. The soil is red soil and the humus soil is above 1 m, suitable for the growth of the rubber tree. Rubber tree is mainly grown on Tongluohu Farm and Da'an Farm. Rubber industry has gradually become the leading industry in the reclamation area.

1.2 Rubber cultivation on Tongluohu Farm Tongluohu Farm was founded in June 1955, located at the junction of Lufeng City and Puning City, with a total land area of 5933 ha, where rubber, fruit and eucalyptus forests are mainly planted. In 1995, the area of rubber farms was 533 ha and the annual output of natural rubber was 250 t. The farm production went through the process of cutting rubber, planting fruits, cutting fruits and plant-

ing rubber successively. In terms of the primary industry, the farm is now built into the largest rubber planting base in eastern Guangdong. The new rubber plantation re-established in 2006 has contiguous planting scale of up to 733 ha.

1.3 Rubber cultivation on Da'an Farm Da'an Farm was founded in January 1960, located in the northern foothills of Lufeng City. The total land area of farm is 1333 ha, the soil is fertile and the climate is mild all year round, suitable for the cultivation of tropical and subtropical crops. The farm vigorously develops economic crops, including rubber, tea, longan and litchi. In 2007, the farm started to redevelop the second generation rubber plantation, with rubber planting area of 400 ha. The main cultivars include Reyan 7-33-97 (50%), PR107 (20%), Zhanshi 327-13 (20%) and Reken 525 (10%). By kudzu covering in rubber plantations, the farm tries to create a good ecological environment, keep the rubber plantation water and soil, increase soil organic matter content of the rubber plantation and increase the income of workers.

2 Problems

2.1 Wind damage The rubber tree is vulnerable to strong winds, and the tropical storms often break branches off and cause lodging of rubber trees. In particular, the typhoon causes a great damage to rubber tree, and a super typhoon can break down more than 70% of trees. For example, the super typhoon "Usagi" in 2013 caused a severe damage to 733 ha rubber plantations and 300000 rubber trees in Tongluohu Farm, and most of rubber trees were broken down or uprooted, with 100% of area being affected; the typhoon "Lotus" in 2015 hit the rubber in Tongluohu Farm and damaged 100617 rubber trees, with the affected area of 203 ha.

2.2 Planting plan For the new rubber plantations established in Shanwei Reclamation Area after 2006, the planting plan ignores the supporting construction of shelter forest. According to the field

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visit and survey, the rubber plantations in Guikeng Sub-Farm of Tongluohu Farm and Da'an Farm lack shelter forest, not in sight in flat, gentle slope, hill, ridge or hilltop in the rubber planting area. This reflects that the planting plan of new rubber plantations does not consider the supporting construction of shelter forest and the rubber trees lack protection system when strong typhoons and cold currents come.

2.3 Rubber tappers Rubber tapping is a special type of work, and when tapping technology reaches a certain level, tapping will not damage the tree and the rubber yield will be high. Shanwei Reclamation Area is located in Shanwei City, Guangdong Province, where the labor market is active and payment is high. Some of newly planted rubber trees in Shanwei Reclamation Area have come to the rubber tapping period, but due to low tapping price and low tapping income, no one is willing to tap and the farm is difficult to hire the migrant workers. Due to the lack of rubber tappers, the available rubber trees have not yet been tapped.

3 Recommendations

3.1 Choosing the sites with good environmental conditions to plant rubber

Rubber forest wins acclaim of FAO as the world's best economic forest and artificial ecosystem as well as pollution-free renewable natural resource^[2]. The environmental characteristics of rubber tree origin include high temperature, frequent rain, fertile soil, calm wind, fog and great humidity. Rubber trees long grow in the ecological environment of origin, gradually adapt to the local habitat conditions, and form the requirements of external environmental conditions. Only when these conditions are met can the rubber trees grow well and achieve high yield. In Shanwei Reclamation Area, rubber trees are planted close to the northern edge, susceptible to wind, low temperature and other disasters. In planting rubber, it is necessary to choose the appropriate sites to plant rubber based on rubber trees' requirements of habitat conditions, in order to maintain the normal growth of rubber trees and reduce the damage.

3.2 Supporting the construction of shelter forest in rubber plantations

The environmental protection for planting rubber is an important basis of sustainable development of rubber trees^[3]. The shelter forest in rubber plantations can effectively prevent wind, cold, drought, *etc.* and effectively reduce the wind speed of typhoon. Compared with the environmental conditions of the rubber origin, the climatic conditions are poor in Shanwei Reclamation Area and there is the risk of cold damage, so it is necessary to support the construction of shelter forest during cultivation of rubber tree. For the rubber plantations in the gentle slope area of less than 3°, the shelter forest should be based on the main wind direction and wind strength to determine forest belt direction, width, structure and forest grid size; the hilly area should be based on terrain, ridge direction and surrounding barrier as well as wind direction and wind power to determine forest belt structure and forest belt grid size and well design ridge forest belt, vertical forest belt,

horizontal forest belt and top mountain forest belt. On top of mountain, the wind is generally strong, soil is barren and there are many rocks, unsuitable for planting rubber. We can plant the shelter forest on top of mountain according to the level of the mountain.

3.3 Building organic rubber plantations to increase output value

With the heavy use of chemical fertilizers, herbicides and ethephon stimulants in rubber plantations, the quality of rubber trees has been affected, and it is difficult to produce high quality rubber trees, which can not meet the needs of aerospace industry and defense high-tech industry. The rubber trees are mainly planted in Tongluohu Farm and Da'an Farm, where geographical location is good and rubber planting area is not large, suitable for the development of small scale but efficient rubber farming, conducive to the development of organic rubber plantations and production of high-quality natural rubber. (i) To build organic rubber plantations, it is necessary to apply organic fertilizers for rubber trees and avoid the use of chemical fertilizers. (ii) When removing weeds and shrubs in rubber plantations, it is necessary to prohibit the use of herbicides and adopt artificial cutting as far as possible. (iii) Stimulants should not be used for tapping to avoid the effect of stimulants on the quality of latex. (iv) During tapping and rubber harvesting, it is necessary to strictly control the use of latex preservative and rubber harvesting time, and ensure that rubber latex does not go bad before processing. (v) During rubber harvesting, it is necessary to keep the latex clean and avoid the adulteration of tree scrap into fresh latex to participate in processing.

3.4 Adopting new tapping system to improve tapping benefit

At present, the new tapping system promoted for rubber is d/4 and d/5 tapping system. Using the new tapping system, each tapper is responsible for 4 rubber tree areas, cutting about 1200 to 1280 trees. The new tapping system can significantly reduce rubber tappers, and most of farms implementing d/4 tapping system in Hainan have achieved good results. After the full implementation of d/4 new tapping system in Hainan's state-owned Wushi Farm, the rubber production is stable and high, an increase of 8.9% compared with the d/3 tapping system. Each rubber worker is responsible for tapping about 1190 trees, with annual per capita rubber production of 3.61 t. The new tapping system can greatly reduce the tapping work and improve tapping benefits. After implementing d/5 tapping system in Guangdong's Hongfeng Farm, there are a total of 136 rubber workers and each worker is responsible for tapping 1600 trees, with per capita rubber production of 5.6 t and per capita annual income of 41240 yuan.

4 Conclusions

The production cycle of rubber trees reaches several decades, and the rubber cultivation in Shanwei Reclamation Area should be based on the growth characteristics and planting environment of rubber trees. Using planting techniques and new tapping system, it is necessary to strive to produce high-quality natural rubber to

