Abstract—The cultivation and processing of moringa oleifera is an emerging biological industry. This paper, based on the review of the status of moringa oleifera industry, analyzed the main approaches adopted in Yunnan province to develop the moringa oleifera, scrutinized the achievements and challenges in the development through the industry-related policies, and then probed in to the effective measures for moringa oleifera industry growth in Yunnan. Finally, the corresponding suggestions and countermeasures are put forward to promote the overall development of moringa oleifera industry in Yunnan.

Keywords—Yunnan Province; Moringa oleifera industry; development issue

I. INTRODUCTION

Moringa oleifera, also named drumstick tree, the miracle tree, originated in India. It is a drought-resistant, sun- and heat-loving deciduous tree of the family Moringaceae. It tolerates a wide range of soil conditions and precipitation. Boasting unique values, the tropical crop can be applied widely and integrates flavor, nutrients and health protection, thus being called the miracle tree. Its products like moringa leaves, drumstick pods, moringa seed and moringa powder can be largely seen in India, Africa, Southeast Asia and South America etc., Countries in European and America mostly leverage it to produce aviation lubricating oil, health care products, skin care and beauty products. It was early in 19th century that the moringa oleifera has been introduced from India to China. Taiwan is the first region in China to plant them for commercial use, while in the mainland China, Yunnan takes the initiate to grow them, followed by Hainan, Fujian, Guangdong, Guangxi, Sichuan, Hunan etc. [1].

As an emerging industry, the moringa oleifera has gained the worldwide attention. Its influence on our country and the rest world becomes increasingly prominent alongside the development of the society and the improvement of living standards. It not only enriches the “basket” (the vegetable diversity), improves the ecological environment, but also plays an active role in promoting foreign exchanges and cooperation. Therefore, this paper, based on the achievements realized and challenges encountered by the Yunnan province while developing the

II. DEVELOPMENT STATUS OF MORINGA INDUSTRY

A. Development Status of Moringa Industry at Home and Abroad

In 2015, the world’s moringa plantation remained basically stable and traditional moringa planting countries were still widely distributed. Countries and regions with more moringa plantations were mainly concentrated in Asia (mainly India, Sri Lanka, Malaysia, the Philippines and the Arabian Peninsula), Africa (including Zimbabwe, Kenya, Ghana, Tanzania, etc.) and tropical countries in America [1]. As the origin of Moringa, India, was at the forefront of the world in the collection of germplasm resources, breeding, cultivation, and development of moringa. The global moringa plantation area was currently about 765,000 mu. India, the largest producer, had a planting area of about 570,000 mu.

<table>
<thead>
<tr>
<th>Country or region</th>
<th>Year 2014</th>
<th>Year 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Cuba</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Taiwan, China</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>China</td>
<td>3.8</td>
<td>9</td>
</tr>
<tr>
<td>sum</td>
<td>71.3</td>
<td>76.5</td>
</tr>
</tbody>
</table>

(Source: Research data analysis)

In the proportion of plantation, India’s global proportion has dropped from 79.94% to 74.51%, and the proportion of moringa planting area in mainland China has increased from 5.33% to 11.76%, an increase of more than 120% (Fig. 1).
Thanks to the ecological consumption and healthy life, the domestic development of moringa in 2015 was rapid. In Yunnan, Hainan, Fujian, Guangdong, Guangxi, Sichuan, Hunan and other provinces, there has been an upsurge in growing moringa [2]. In 2015, planting bases or planting sites of moringa were mainly located in Honghe Prefecture, Pu’er City, Yuanjiang County in Yuxi City, Yuanmou County in Chuxiong Prefecture and other places in Yunnan Province; Chengdu (greenhouse planting), Shuangliu, Jiangyou, Mianyang and Panzhihua in Sichuan Province; Xiamen, Shishi and Quanzhou in Fujian Province; Shaoguan, Qingyuan, Foshan, Zhongshan and other places in Guangdong Province. In addition, there were sporadic cultivation in Hainan, Chongqing, Hunan, Guangxi and other places (Table II).

The planting area of moringa in China is about 90,000 mu currently, mainly distributed in Yunnan, Sichuan, Guangdong, Fujian and Hainan. Among them, 63,000 acres in Yunnan, an increase of 40,000 acres from 23,000 acres in 2014, is still the largest in the country, accounting for about 70% of the country’s planting area; about 10,000 acres in Guangdong, an increase of 8,000 acres compared to 2014, is the largest increase; about 4,000 acres in Fujian, about 3,000 mu in Sichuan and about 10,000 mu in other provinces (Fig. 2).
China National Forest Products Industry Association established the moringa industry development promotion committee in 2015, hoping to standardize industrial development; the Ministry of Science and Technology organized the National moringa Industry Technology Innovation Strategic Alliance whose members are all engaged in moringa-related enterprises and institutions such as planting, production, sales, scientific research, teaching and service and Guangdong Agricultural Reclamation Group Corporation, Yunnan Agricultural University, South China Agricultural University and other scientific research institutes and moringa industry enterprises became the first batch of member units. The main tasks of the alliance are to build platforms, formulate regulations, control quality, and regulate the market. By building the “two platforms” of the moringa industry expert group and the moringa industry alliance, the alliance aims to create “three bases” of technological innovation, production test demonstration, and processing demonstration and to achieve the combination of industry, education and research, industry self-discipline, and avoid exaggerating publicity and malicious hype, thus guiding the sustainable and healthy development of the moringa industry.

B. Development Status of Moringa Industry in Yunnan Province

Yunnan is located on a plateau with complex and diverse landforms, which is a special geographical location of the thermal zone with sufficient light and heat, and rich and diverse land and climate resources. It is a rare tropical treasure in China and has created unique natural conditions for the development of moringa. With the support of the moringa industry system of the Ministry of Agriculture, 10 demonstration counties have been established in Yunnan. At the end of 2017, the domestic continuous planting areas were about 100,000 mu, which were distributed in Yunnan, Hainan, Guangdong, Fujian, Guangxi, Sichuan, Guizhou and other places, and more than 60% of the areas were distributed in Yunnan. The moringa plantation in Yunnan Province were mainly distributed in more than 30 counties and cities in Chuxiong, Honghe, Xishuangbanna, Dehong, Pu’er, Lincang, Baoshan, Lijiang and other prefectures or cities. As of December 2015, the planting area, output, and enterprises of moringa and the number of professional cooperatives ranked first in the country.

<table>
<thead>
<tr>
<th>Prefectures or Cities</th>
<th>Acreage</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pu’er</td>
<td>20000</td>
<td>Lancang, Jingdong, Jinggu, etc. along the Lancang River and Mojiang County. Huaqiang Biotechnology Co., Ltd. has more than 2.27 million moringa seedlings. The construction of a modern production plant of 1100 square meters has been completed, and the commissioning and installation of four product lines have been completed. The main products are moringa wine, moringa beverage, moringa leaf powder, moringa fresh bar soft canned food and moringa cosmetics.</td>
</tr>
<tr>
<td>Chuxiong</td>
<td>16000</td>
<td>Distributed in Yuanmou, Shuangbai, Lufeng, Dayao, Mouding and other counties. Among them, Yuanmou County is China’s largest moringa plantation base with more than 11,300 acres. The main products of Yunnan Shangu Biological Research and Development Co., Ltd. are Xiangguanyuan tea, moringa powder, moringa beverage, moringa noodles, moringa cereal, moringa milk, etc.</td>
</tr>
<tr>
<td>Honghe</td>
<td>10000</td>
<td>6000 acres in Honghe County, 3000 acres in Yuxi County, and 1,000 acres in other counties.</td>
</tr>
<tr>
<td>Dehong</td>
<td>5500</td>
<td>Tianyou Technology Development Co., Ltd. in Dehong prefecture has three trademarks: Paler Calcium, Six Grams of moringa and Deqian. It has realized the annual processing of 1,000 tons of pure moringa fresh leaves and an annual output of 250 tons of high-purity moringa products and 30 million yuan of production capacity in output value. Yunnan Dehong Senbao Technology Development Co., Ltd. products are mainly moringa tablets, compressed biscuits, noodles, tea, etc.</td>
</tr>
<tr>
<td>Baoshan</td>
<td>5000</td>
<td>Mainly in Lushui. Chunfengyuan Agricultural Development Co., Ltd. Baoshan city has established more than 5,000 acres of plateau ecological moringa plantation base in the mode of company plus farmer plus land lease. The main products are moringa noodles, moringa tea, moringa powder and other products. Direct sales franchise stores were established in Kunming, Beijing, Guangzhou, etc.</td>
</tr>
</tbody>
</table>
III. MAIN MEASURES OF MORINGA INDUSTRY IN YUNNAN PROVINCE

A. Focusing on the Creation and Extension of the Entire Industry Chain

During the development of moringa oleifera in Yunnan, most moringa plantation enterprises and cooperatives have their own planting bases, or jointly develop planting bases with other enterprises and farmers; at the same time, except some specialized cooperatives, most companies have processing workshops that pay more attention to the product processing, new product development and product sales. Dehong Tianyou Company in Dehong owns 2,000 acres of planting manor in Dehong[3], and it will be expanded to 20,000 acres in the future. The company cooperates with Yunnan Agricultural University and Yunnan Plateau Characteristic Agricultural Industry Research Institute to develop moringa series products and it boasts three trademarks; Yunnan Rehe Company has more than 1,500 acres of planting bases in Baoshan and Nujiang. The company also produces a variety of moringa products. These companies attach great importance to the advancement of the whole industry chain of moringa, and has basically formed a one-stop development model of “planting, scientific research, production and marketing”.

B. Attaching Importance to the Development and Intellectual Property Protection of Moringa Products

During the development of the moringa industry, product research and development must be highly valued. Most enterprises cooperate with scientific research institutions to increase scientific research cooperation and promote the depth and breadth of product research and development. The increasing awareness of intellectual property rights protection in the moringa industry will help enterprises produce more moringa products with novelty, creativity and practicality to enhance their core competitiveness, and meanwhile help to achieve fair and just and sustainable development of the market [4]. Moringa enterprises take the initiative to apply for invention intellectual property rights. In the current major moringa oleifera cultivation provinces, how to stay ahead of the market competition requires scientific research institutions and local companies to promote scientific and technological development and emphasize intellectual property protection.

C. Wider Application of “Company Plus Base” Moringa Planting Model

Most of the moringa enterprises in Yunnan use the “company plus base” planting management model. For example, Yunnan Shangu Company has built 11,000 acres of moringa base in Yuanmou, Chuxiong; Pu’er Huajiang Company has built its 2000 acres of base in the dry and hot river valleys of the stinky water, Lancang, Jingdong, Jinggu, etc in Pu’er. There are 2,000 acres of moringa manor in Dehong, and Yunnan Sangao has a base of 800 acres in the Mojiang River in Pu’er. The self-built base can provide stable raw materials for the production of enterprise products, ensure the normal supply of products in the market, and reduce the risk of raw material purchases for enterprises. However, the effect may not be obvious for driving farmers shake off poverty in poverty-stricken areas.

D. Strengthening the Ecologicalization and Diversification of Product Processing

Yunnan enterprises and professional cooperatives pay more attention to the strict control of the safety and efficiency of moringa leaf materials while scientifically using, protecting authorized patents, improving innovation ability and R&D capacity. The selection of planting sites, cultivation management, drying time and methods of raw materials, and each link of harvesting are strictly carried out in accordance with food standards. In addition to traditional moringa leaves, moringa seeds, moringa health tea, moringa noodles, and moringa chips, relying on scientific research institutions and enterprises’ own R&D capabilities in 2015, they have developed and produced ecological and safe moringa nutritious powder, moringa lozenges, moringa capsules and moringa yoghurt, moringa instant noodles, moringa cosmetics, moringa sleep enzymes and other products, currently there are nearly 30 kinds of moringa ecological products [5].

E. Implementing Marketing Promotion and Consumer Group Cultivation

Moringa oleifera and moringa products are an emerging industry and emerging product. At present, there are not many markets and consumer groups who know about products. All parties in Yunnan have stepped up their marketing efforts. The 2015 Yunnan Plateau Special Modern Agriculture Shanghai Exhibition Promotion Conference and Beijing Exhibition Promotion Conference organized by the People’s Government of Yunnan Province have increased the awareness of moringa consumer groups in first-tier cities; Enterprises implement the “go global” strategy and increase marketing efforts in eastern
IV. ACHIEVEMENTS MADE BY THE DEVELOPMENT OF MORINGA INDUSTRY IN YUNNAN PROVINCE

A. Outstanding Research Results of Moringa

In 2015, the Yunnan Provincial Department of Science and Technology approved and implemented the “Yunnan Moringa Industry Science and Technology Development Plan” and supported five moringa research projects. Outstanding results have been achieved in the introduction of germplasm resources, breeding of seedlings, standardized cultivation techniques, product development, etc. Yunnan Provincial Department of Agriculture adopted and implemented the “Yunnan Moringa Industry Development Plan (2015-2020)”, which provided ideas for the development of Yunnan moringa. A scientific research team composed of 6 units including Yunnan Agricultural University and Yunnan Plateau Characteristic Agricultural Industry Research Institute completed the moringa gene map. The team has worked hard for more than 1 year to decipher the 316 million base pairs of moringa oleifera. The analysis of the genome will bring the research of moringa oleifera to the era of molecular breeding, and provide an important basis for the breeding, pharmacological research, pest control and promotion of Moringa Yunnan Agricultural University, Yunnan Plateau Characteristic Agricultural Industry Research Institute and other scientific research departments and units adhered to the research on moringa oleifera, gathered a group of research teams and leading enterprises engaged in moringa basic research, industrialization development, and accumulated moringa essential oil, moringa yogurt, moringa cosmetics, moringa oleifera sleep enzyme and other high-end scientific research achievements, hence providing a powerful guarantee for the large-scale development of the moringa industry in Yunnan Province.

B. Shifting to the National Promotion Stage Gradually

In 2013, the whole country gradually became aware of moringa oleifera and its products. In 2014, large-scale publicity reports at the national level, scientific research institutions and enterprises quickly followed up, and moringa oleifera began to enter the vision of consumers [7]. In 2015, Yunnan Province introduced a series of moringa specialty products by guiding enterprises to cooperate with scientific research institutions to form a whole industry chain development of moringa from planting, processing, sales and service. With the Internet platform, it launched a new online to offline, factory-to-consumer business model. These technologies and models bring better product experience and lifestyle for consumers in other provinces while constantly expanding the development space of moringa in the national health industry. In the process of national promotion, Yunnan scientific research institutions and enterprises have always been at the forefront of the country. The moringa industry in Yunnan has been transformed from planting and production to the nationwide channel promotion stage.

C. Moringa Products Marching towards the Middle and High-End

Yunnan moringa oleifera industry has not only ranked at the forefront of the domestic moringa development, but also entered the high-end market of mature moringa oleifera products. The moringa oleifera reduced hydrodynamic classic set, the moringa oleifera repairing powder, and the moringa hydrating facial powder developed by Pu’er Huaying Biotechnology Co., Ltd. are all produced using the most advanced technology in the world, and the products have become popular among the market. The natural gamma-aminobutyric acid moringa enzyme series products developed by Yunnan Daye Dihong Biological Technology Co., Ltd. and Yunnan Agricultural University, Yunnan Plateau Characteristic Agricultural Industry Research Institute, Yunnan Pu’er Tea Research Institute, and other scientific research institutes have also gained attention and praise from consumers.

D. Mature Products Entering the International Market

Yunnan moringa industry has not only ranked among the forefront of the domestic moringa development, but also many mature products have entered the international high-end moringa products market [8]. The moringa reduction hydrodynamics classic suit developed by Huaying Biotechnology Co., Ltd., the moringa beauty powder, and the moringa hydrating facial powder are all produced using the most advanced technology in the world. Once the products are listed in Hong Kong and France, they become popular and are in short supply.

V. PROBLEMS IN THE DEVELOPMENT OF MORINGA INDUSTRY IN YUNNAN PROVINCE

A. Relatively Chaotic Development of Moringa Products

Although the province has a unified development plan, blind planting and expansion have followed. Some product development lacks scientific and technological guidance, and individual enterprises operate in a decentralized manner with a low degree of scale; the promotion and marketing of the moringa industry cannot keep up, and even individual enterprises start vicious competition, and counterfeit and inferior products flood into the market. The development of moringa in Yunnan Province mostly stays at the initial stage, the advantages are not obvious, the characteristics are not outstanding, and it is still difficult to form an agricultural industrial system with considerable scale.

B. Lacking R&D of Moringa Technology

The development of moringa products is mainly engaged by small and micro enterprises in Yunnan Province, and only a small number of enterprises have strong talents and technologies, and their independent research and development capabilities are extremely weak. At the same time there are few institutions involved in moringa research, few professional researchers engaged in moringa, and few funding allocated to moringa scientific research. These factors have directly restricted the development and technology promotion of moringa products, resulting in the weak technical training force, and the lagging technology promotion service system.
C. Ambiguous Market Position of Moringa Product Development

The development of moringa products in Yunnan Province lasts several years, but among the vast number of consumers, there are not many people that know moringa oleifera and moringa products. Through the online questionnaire designed by the questionnaire star network platform, about 62% of consumers do not know about moringa oleifera and moringa products. Enterprises and research institutions do not have enough knowledge about the consumption preferences of moringa consumers. Most companies developing moringa products have to find their own market. Moringa is only sold in restaurants as food. There is no scientific research and analysis on the market position of moringa product development, and the target group is not clear, which hinders the development of moringa related products in Yunnan and the development of the entire moringa industry.

D. Relatively Low Consumer Acceptance

Yunnan lacks sufficient promotion of moringa products [9]. This is mainly reflected in two aspects: First, there are only a few enterprises and research institutions engaged in the development, production and research of moringa, and market consumers know rarely about moringa oleifera and they do not understand the nutrition ingredients contained in moringa oleifera, therefore it is impossible for them to actively purchase related products developed by moringa oleifera. The second is that the research on the content, quality, and efficacy of moringa nutrients is in the preliminary stage. Without a more authoritative determination, it is difficult for consumers to grasp the true condition of moringa products; hence consumers will doubt the excellent properties of moringa, which seriously hinders consumers’ awareness of moringa oleifera.

VI. COUNTERMEASURES AND SUGGESTIONS ON MORINGA INDUSTRY DEVELOPMENT IN YUNNAN PROVINCE

A. Building A Province with Rich Moringa Oleifera

At present, the number of the leading enterprises engaging in processing and selling moringa oleifera and the specialized cooperatives in Yunnan is the highest nationwide. Moreover, the leaves and the products made from moringa oleifera have been sold with good performance in both volume and sales. Departments at various levels in Yunnan should attach great importance to the moringa oleifera industry, carry out scientific and rational guidance on the basis of the its good development base, establish and improve the moringa industrial technology system, strengthen the eco-ecological and standardized planting, and encourage and support the enterprises and cooperatives. They can attempt to declare Yunnan as the home of China's moringa, focus on building a province with large moringa planting capacity, to hold the leading position of moringa in the country and maintain a good product image in the consumer's mind.

B. Improving the Market System of Yunnan Moringa Oleifera Products

Make clear the position of the moringa oleifera products in the market, and introduce the current products into the relevant markets. Increase exclusively the special windows for the moringa oleifera products in the seed market, vegetable market and so on. At the same time, include the products into the agricultural products network to get people familiar with the moringa oleifera. Explore new forms of moringa oleifera industry development, under the guidance of the health concept, actively develop the medicinal value of moringa oleifera, so as to improve the market system of Yunnan moringa oleifera products.

C. Accelerating the Scientific Talent Team Building

With the science and technology innovation and entrepreneurship talent training and recruitment program in Yunnan province, high-level science and technology talents can start businesses in Yunnan to increase the innovation capability of the special industry, accelerate the cultivation of pioneers, experts and teams of the Moringa technology innovation. With the innovation-oriented enterprises and high-tech companies, a platform can be built for enterprises and experts to conduct scientific cooperation, technological exchanges and talent training and deliver performance, in a bid to address the talent and resource shortage and weakness in research and development, add the talent goal into the strategic planning of the enterprises.

D. Enhancing the Research and Development Capability

Strengthen the basic research on the moringa oleifera to address the key issues like preservation and delivery. Set up the technological innovation platform and the exchange and cooperation platform. Breed fine varieties of the moringa oleifera. Put more efforts in the research and development of new grain and oil, vegetable, fodder, health supplements and medicine with the moringa oleifera. Establish an alliance of scientific research and technological breakthroughs, with large and medium enterprises in Yunnan as the main body, provincial institutions of agriculture and forestry, and agricultural science institutes as technical support units, to forge a technology innovation system with strong technologically innovative ability and coordinated problem-solving capability.

E. Strengthening the Propaganda and Guiding the Rational Consumption

Focus on prefectures and cities where there are opportunities to make the emerging moringa oleifera industry into plateau characteristic agriculture. Promote the cooperation among prefectures, cities, colleges, and R&D enterprises, stick to the model of integration development of first-, second- and third-tier industries with enterprises as the main body. All links in the whole industrial chain, from planting, R&D, deep processing, marketing, and services should all be attached with great importance. Meanwhile, governments should release accordingly some guarantee policies and incentives for enterprises, farmers, and customers, making the products acknowledged by policies and markets, and raising its reputation. By taking advantage of the social media of huge influence, publicize the value of moringa oleifera, to help people get real, comprehensive understanding of the products [3]. Moreover, lessons should be drawn from the development of other characteristic products like panax notoginseng, dendrobium nobile and maca. Avoid deifying moringa oleifera, exaggerating publicity or malicious hype; instead, we should guide scientific and rational consumption, to ensure the
sustainable and healthy development of the moringa oleifera industry.

F. Promoting the International Cooperation and Exchanges

Governments should play a guiding role in the international scientific and technological cooperation, promoting multilevel scientific and technological cooperation, innovation and exchanges among enterprises, colleges, scientific research institutions, international organizations and other subjects at home and abroad. In the global cooperation, conduct the systematic integration and re-innovation on the introduced technologies and try to acquire the independent intellectual property rights. Encourage the application for major scientific and technical project. What’s more, they can take an active part in academic conference or scientific activities related to moringa oleifera, recommend experts to work in international agricultural, forestry academic organizations and institutions. Take part actively in the international process of the industrialization and the development of relevant international standards so as to raise the international influence of moringa industry in Yunnan province.

The emerging characteristic moringa oleifera industry in Yunnan province is still in its initial development. The development of it should rely on edges of Yunnan characteristic plateau agriculture, learn from the other characteristic plateau agriculture industry in Yunnan and take into consideration the foreign and domestic market demands. The moringa oleifera breeding in Yunnan can be accelerated with the improvement of deep processing. More efforts can be made to publicize the moringa oleifera and guide the rational consumption. Moreover, quicken the pace of expert team building and technological innovation. Carry forward the international cooperation and exchanges to enhance the global presence of Yunnan’s moringa oleifera industry so as to boost the whole development.

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