The Role of Crop Protection Industry in Conservation Tillage Development in China

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ABSTRACT

Syngenta China is the subsidiary of Syngenta AG Switzerland based in Basel. The company is committed to sustainable agricultural development globally.

In China, Syngenta collaborates closely with many stakeholders in the research and extension of new technology to support the development of sustainable agriculture.

In the last two decades, it successfully worked with the research institutes and extension agents at provincial and grassroots levels in promoting the no tillage cultivation on wheat, canola, and rice along the Yangtze River especially in Sichuan and the rice no-tillage practice in southern China. In the last ten years, no or minimum tillage on corn in the Yellow River delta was gaining popularity. Syngenta was also engaged in the development of this conservation agriculture practice which provides significant economic, social, and environment benefits to the rural society.

At present, the company engages in a five- year research project with the Agriculture Machinery Department of the Ministry of Agriculture in the study and development of no-tillage practice on spring corn in northwest of China.

This paper reports the current progress of the study and the challenge in the development of no-tillage practice as the country places importance and puts in more efforts in promoting this technology.

1. INTRODUCTION

Syngenta is formed by the legacy company of ICI, Ciba & Sandoz which have over 100 years business operation experience in China. Syngenta is an agribusiness company based in Basel of Switzerland focusing on seeds, crop protection product (CPP) and biotechnology globally. Its subsidiary, Syngenta China, invests in China on seeds and CPP with a value of more than USD150 million in the production and marketing of these products for both domestic and export markets.

China has 7 per cent of the total global arable land but has to feed more than 20 per cent of the global population. The arable land is shrinking due to rapid urbanization and

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industrialization, thus it needs technology to increase the unit output to deal with this challenge. Sustainable agriculture is the key approach to continue this outstanding achievement. The high quality seeds, CPP, fertilizer and good farm management of irrigation, machinery and cultivation methods are key components of this advanced technology.

All stakeholders engaged in agriculture understand the importance to well manage this advanced technology in a sustainable way to support sustainable agriculture and get the right balance of the economic, environment and social benefits to the society. However, the majority of the 700 million farmers are with relatively low educational levels, low income and till smallholdings.

It is a big challenge for any industry or stakeholder engaged in agriculture to develop and transfer the new technology to this unique community in order to support the development of sustainable agriculture. This paper reports the work done by the Syngenta China and presents the role of the industry in sustainable agriculture.

2. MODULE OF COLLABORATION

The key success factor in conducting the business is to understand end-user's or farmer's need and provide a solution to solve their problem during production. Their need is not just on the product but the complete solution. Thus, Syngenta's product offer must be combined closely with the farming technique and provide the additional benefit to not only the grower but also to the public. The appropriate technology is needed to be studied or tested for local adaptation. Thus, there was a need to conduct activities at the local level to support the business operation successfully.

2.1 New Technology Development

China has high investments in research and there are significant results. However, in terms of application from research results into commercial use, it is relatively low.

Since 1980, Syngenta has been working with academic or research institutes in identifying the new techniques which have potential market commercially. It has further collaborated with the extension authorities at all levels to promote among the farmers the use of technologies.

In these initiatives, funding is provided by the company with the research idea and results having great relevance to the market needs. Various sectors are working together in generating research ideas, and verifying and developing new technologies as part of the steps in extension work.

Since research work is initiated and funded by the company, all the risks are absorbed by Syngenta.

2.2 Long-term Investment

The Syngenta Agricultural Research, Education and Rural Community Development Fund was established and co-managed by the Foreign Affairs Department of the Ministry of Agriculture (MOA) and Syngenta China. During the first five years from 2001 to 2005, the company focused on scholarships and small research projects which had proven as valuable model for future agricultural development

Based on this success, the second five-year plan started from 2006 and expanded the scholarship programme to ten agriculture universities for both bachelors and masters degrees. The scholarships also covered key conservation agriculture research projects, rural community service by agriculture students and safe food production. Under this platform, there is more interaction and collaboration with the students and universities regarding new technology development, potential collaboration projects, and campus recruitment.

The sponsorship for post graduate studies and PhD studies and research is being run under a separate programme managed directly by Syngenta United Kingdom.

3. PROGRESS OF CONSERVATION AGRICULTURE TECHNOLOGY DEVELOPMENT

The company's mission is not just meeting the farmer's need but also considering the benefits to the public, thus in its new technology development, Syngenta is focusing on those supporting sustainable agriculture development. It engages in conservation agriculture technology development activities, with some good results for farmers' use.

Success in Research and Good Adoption of Technologies by Farmer

3.1.1 No-Tillage Cultivation of Wheat and Canola in Sichuan

The original idea to develop this cultivation method is to overcome problems related to field management during the rainy autumn season to improve drainage and muddy field conditions for wheat farming. However, the test on the no-tillage practice failed during the early 1980s because the weeds problem could not be managed. It was only after the introduction of the contact kill herbicide, 'Gramoxone' (active ingredient of Paraquat), that success in weed control was attained in the mid 1980s.

The benefits of no-tillage cultivation method have overcome this field management problem with significant labor costs and a little increase in yields. Thus, adoption among farmers was accelerated and reached 6 million Mu (15 Mu = 1 Ha) in five to ten years time. The key drivers of this farming technique are cost savings (labour, cattle and fuel) and more convenience in farming. The overall benefits are summarized as follows:

- Cost savings: There is no need to plough the field with either cattle or tractor and the savings is 4-6 man-days per Mou. The overall savings per Mou is estimated at RMB 60-80. Gross income per Mou is estimated at RMB 400-500.

- No ploughing: The soil is not ploughed, thus, the risk of soil erosion is minimized and the moisture content at different levels of the top soil is higher than the one in conventional ploughed field. The capability of the plant to resist any stress, e.g., drought, is enhanced.

- Higher yield: The deep ditch is dug surrounding the field if no tillage practice is employed. It plays a role in drainage during the wet season or in the wet areas. During the dry season, the no tillage field retains higher soil moisture. This contributes to higher yield production. The practice of this no tillage cultivation method has shown the following results of yield increase: Wheat production at 21-48 kg/Mou; Oil seed rape at 23-44 kg/Mou.

- Improvement in soil structure: The soil structure has been further improved with higher organic matter content.

3.1.2. No-Tillage Cultivation of Cotton/Rice and Canola/Wheat Along Downstream of Yangtze River

The cropping pattern along Yangtze River is more or less similar to Sichuan which is wheat and canola in winter and rotated with cotton or rice in summer. The success of no tillage practice in Sichuan further expands the technique into the cotton, rice and canola/wheat no tillage areas in Anhui, Jiangsu, Hubei, and Hunan.

After the harvest of wheat or canola, cotton seedling will be transplanted directly into the field without any ploughing of the land. A spray of non selective herbicide like Glyphosate or Gramoxone will be done if there are any weeds established before the transplanting operation. The obvious benefit is the savings from ploughing the field which is about RMB 30-50 per Mu and the associated savings in time. The field is not ploughed and thus soil erosion and water evaporation are minimized. In 2004, the area grown under no-tillage of canola – cotton – canola/wheat is estimated at 5.5 million Mu and the area of no-tillage of rice – canola/wheat is 14 million Mu in 2004.

3.1.3 No-Tillage Cultivation of Rice in Sichuan and South of China

Due to the success of the winter crops under no tillage, the farmers in Sichuan further expanded this technique into the summer crop of rice because they experienced significant economic benefits in costs and labour. In the rice no tillage cultivation, there is additional benefit of water savings. The experience from Meishan indicates that there is 100 cm^3 water savings during the early stage of the field preparation and transplanting. The intangible benefit in water savings also improves the community's demand for water during the high season. There are other benefits of no-tillage.

The economic, environment and social benefits are well recognized by the farmers and driving the development of no tillage cultivation technology. However, there are also other effects of crop residue treatment as follows:

Farmers usually burn the straws of wheat and rice that causes a significant air pollution and disturb the air traffic in Chengdu around the airport. Right now, the straw is returned to the field and eventually increases the organic matter content in the field.

The wheat straw is buried in the drainage of no-tillage paddy fields. Since it is soaked in water, the break down process is sped up.

The rice straw is laid on the no-tillage wheat soil bed after seed sowing which inhibits the re-germination of weeds. Thus, the technology reduces the weed problem during the growing period and eliminates the use of other herbicides in field management.

The rice no tillage technique is further expanded in other parts of South China like Zhejiang, Hunan, Jiangxi, Guangdong, and Guangxi.

3.1.4. No or Minimum Tillage Cultivation of Corn in the Yellow River Delta

The availability of labor in corn production is low due to migration. Thus, chemical weed control is adopted by using Gramoxone for the mid season weed control. Due to its fast action on weeds, it is also a good tool to clean up any established weeds for the practice of no tillage cultivation on corn to avoid any competition between the growth of corn and weeds. The mixture of Gramoxone with pre-emergence herbicide can provide weed control in no tillage cultivation. The field is not ploughed and the cut straw of wheat is used to cover the top soil to minimize the evaporation of soil moisture. The benefit is not only for the farmer but also to the environment. The use of herbicide speeds up the development of no tillage cultivation of corn in the Yellow River area. It is estimated that 60-70 per cent in the area is under no or minimum tillage.

4. THERE IS SUCCESS IN RESEARCH BUT FARMER ADOPTION OF THE TECHNOLOGY IS LAGGING

4.1. Soil Conservation on Citrus Plantation on Slope in Zhejiang Province, in Cooperation with the Environmental Resources and Soil Fertilizer Institute of Zhejiang Academy of Agriculture Sciences, Hangzhou, China

The application of herbicides in the hilly red soil orchards could efficiently control the water and soil loss by 30-47 per cent and increase fertility in terms of organic matter and NPK by 10-14 per cent compared with traditional hand weeding. The annual soil erosion is 167.8 t/hm^2. The recommended weed management programme on the slope orchard plantation does not only prevent soil erosion and improve soil fertility but also results in slight economic benefit of yield due to an increase of 4-8 per cent.

In the weeds control programme, there are two choices of herbicides: one is the long-lasting Glyphosate with higher soil erosion risk and the other kind is the one of quick effect called Gramoxone with less soil erosion risk. However, the farmer is more keen on the long-lasting weed control result although both are at more or less similar in terms of cost. This

choice for weed control only demonstrates that the farmer has less concern on the environmental benefits if there is a similar alternative choice.

4.2 Soil Conservation on Economic Plantation on Yangtze River Origin in Sichuan in Cooperation with the Sichuan Academy of Forestry, Chengdu, China

A good weeds management programme in orchards and tea plantations on slopes with significant water and soil erosion prevention and fertility retention benefits were identified in the three years research study project. The erosion could be reduced significantly with different herbicide treatment programmes compared with hand weeding in the peach orchard with annual erosion of 777.3t/km^2/yr and in the tea plantation of 106.9t/km^2/year at different levels of slope. However, due to the economic benefits between the different types of herbicides used, it is not very significant as farmers still prefer the method with higher levels of erosion risks but longer lasting. The alternative with better environmental benefits is not the priority choice of the farmer.

5. ON-GOING RESEARCH WITH HIGH POTENTIAL FOR COMMERCIAL ADOPTION

5.1 No Tillage Cultivation of Corn on Slopes in Southwestern China in Cooperation with Guangxi Maize Research Institute, Yining, Wuyu , Guangxi

Research results showed that the yield of maize between no-tillage cultivation with weeds controlled by Gramoxone is similar to the traditional hand-weeding cultivation. Studies have shown that the soil erosion in fields applied with Gramoxone no-tillage treatment was 43 per cent less than in maize land which was traditionally cultivated. The economic analysis showed that the cost of Gramoxone no-tillage maize was reduced by 46 per cent compared with that using traditional cultivation method and the total income was increased by RMB 825 yuan/ha (USD 100/Ha).

The study indicates obvious economic, environment and social benefits to the farmers and the society but most farmers still had very low incomes as there was no motivation to improve crop production efficiency. Thus, it took a relatively longer time to promote the technologies at the farmers' level, especially their adoption.

Extension work has lagged behind because there is not much enthusiasm from the extension agents in the local areas, like in Guangxi Province. Extension agents in these areas need to convince the farmers to change their cultivation practices. Such change needs a long time to happen and requires a process and a lot of resources.

Since 2005, the technology was replicated in Yunnan Province because there was more corn grown in the slopes. There were also more extension agents at the grassroots level to support the Puer and Xishuanbanna prefectures for the significant economic development of the tourism and tea industries which required high labour costs. Farmer acceptance of technologies in these areas was high but there was a need to scale up adoption rates.

5.2 No Tillage Cultivation of Corn in Northwest (NW) China

The conservation cultivation of corn in NW is a project under the Agriculture Machinery Department of the Ministry of Agriculture. It needs Crop Protection Protect (CPP) to overcome the weeds problem in this cultivation technique. The project kicked off from 2006 and run until the 2007 season. The knowledge in selecting the right partner of CPP for this no-tillage cultivation has been established. Seed treatment is important for the seedling to have good protection during the early stage.

Due to the dry climate in the NW areas, the pre-emergence herbicide treatment's performance is affected in the no tillage practice, it is important to have an early post emergence herbicide for weed control. The earliest treatment

The technique in using Syngenta novel herbicide "Calaris" (active ingredient of Mesotrione) was on hand after the trials in 2006 and 2007. The large-scale demonstration of the use of CPP to support the no-tillage spring corn would be conducted in 2008. The outcome of this farming technique is to minimize the sandy dust problem in NW after the previous crop. The residue of the last season corn plant is cut and the base of the stalk is left behind. During the next season, corn seed is sown using a machinery planter without ploughing the soil. There is significant economic benefit for it does not need tillage. This then translates into a savings of at least RMB 30-40 per Mu for the tillage by tractor. If half of the savings is for CPP, the overall savings is till maintained at RMB 15-20 per Mu. The environmental benefit is significant in reducing the soil erosion causing the sand dust and also building up organic matter in the top soil to improve soil fertility.

6. CHALLENGE

Farmers are mostly driven by economic returns in considering the adoption of any new technology. Thus, the economic benefit is the key element of any new idea and research project, despite the fact that the practice has strong environmental or other tangible benefits especially during the stage of extension for farmer adoption.

It is a long process from idea, research, development and transfer to farmers for commercial production or use of any technology. The industry has to pay for most of the cost and bear the risk of investment return throughout the whole process.

Any new technology brings with it new issues after a period of time. Thus, there is a need for an on-going study to minimize related and associated problems. For example, the no tillage practice of wheat and rice and the crop residues in the field might change the pest occurrence pattern, and it requires further study to manage the potential new problem.

Large-scale promotion of any new technology to support conservation agriculture requires a lot of extension efforts, resources, and partnership. New collaboration module needs to be identified, tested and piloted. The technology itself and the model of extension for large-scale adoption need to be studied.

Farmers are provided with high quality branded products to secure farming activities are in line with sustainable agriculture. However, the awareness about intellectual property rights (IPR) in the distribution channel is low, low quality and fake products are imitating the quality branded ones and these have become rampant in the market place. While the initial efforts in developing a technology is being taken by the non ethical imitator, it is not only the industry that suffers from low returns of investments but the farmer also suffers from potential higher costs and definitely, a high risk in terms of inferior quality products. This risk might be further transferred to the public.

7. CONCLUSION

It needs a high level of partnership with all related stakeholders from research and development, to extension for farmer adoption to support the development of conservation agriculture based on work done in China for the last two decades. It is not only a long process but also requires more efforts from all stakeholders, especially industry commitment and government support.

With the commitment from the industry, more companies and resources could be allocated to support conservation agriculture. The required government support could be provided through the following:

Consider to provide favourable treatment for companies engaged in conservation agriculture research and development projects with independent research institutes. If products are fit or good for conservation agriculture, incentives could include speeding up the registration, tax reduction for the project research and development, etc.

The agricultural extension system at all level provides the network support and/or endorsement in the scaling up of those technologies or products/activities which are proven beneficial to conservation agriculture development.

More resources should be allocated to product quality, regulatory and IPR compliance enforcement.

High level of cross governmental function works among the Agriculture Enforcement Team, Technical Supervision Bureau, Administration of Industry and Commerce, is needed to maintain a high level of market discipline and protect farmers' interest.

It is very important to minimize the risks on the return on investment. Once the market order is getting more disciplined, company and industry interests are secured commercially. It is anticipated that more engagement and commitment will come from the industry to support conservation agriculture development in China.

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