Development paths of China's agricultural Pharmaceutical industry under Eco-agriculture background

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Abstract: Using pesticides has double effects. On one hand, it contributes to pests control and regulates the growth of crops; On the other hand, it does harm to the environment. To develop ecological agriculture should not only emphasize the output level of agriculture to pursuit of economic efficiency, but also need to keep the ecological environment protected and focus on the social benefits during the development of the industry. As a large agricultural country in the world, China is vigorously promoting the development of ecological agriculture, which is bound to put forward to developing the pesticide industry and green ecological development requirements to promote the transformation and upgrading of agricultural pharmaceutical industry. This paper discusses the mechanism of pesticide pollution on the ecological environment and analyzes China's agricultural problems in the pharmaceutical industry. Then study on the development of Chinese green pesticides and try to find the proper paths of agricultural pharmaceutical to achieve industrial upgrading.

Keywords: Ecological agriculture, green pesticide, pharmaceutical industry.

INTRODUCTION

The pesticides are in order to prevent pests and regulate the growth of crops, whose common types include insecticide, herbicide and plant growth regulator. If being used in the right way, the pesticides can eliminate the pests and control insect-borne disease. Or the herbicides can also prevent the weed absorbing nutrients, which will have positive effects on the crop products. However, the pesticides are often over-used because they are highly effect, widely using, saving time and efforts, which on one hand it will increase agricultural production costs and on the other it will damage the agricultural ecological environment.

As agriculture is the most closely industry combined with the natural, it is far-reaching to ecological civilization. Agro-ecosystems are an important subsystem ecosystem, and its ability for sustainable development is directly related to the development of the countries in the region. In 1980, a national symposium on agro-ecological economy is held in Yinchuan at the meeting China's first used the term of "ecological agriculture. Construction of ecological agriculture is an important part of nation-building ecological civilization, and it is the focus of research for scholars now.

The development of ecological agriculture is not only a way to keep sustainable development in agriculture, but also an important content of the construction of ecological civilization. The development of ecological agriculture is focusing on environmental protection, agricultural products quantity and quality safety. From the perspective of ecological construction, ecological agriculture reflects the essence of green production, green agriculture and can also ensure the safety of the ecological environment, which means that ecological agriculture has a strong positive environmental externality. From the perspective of economic development, ecological agriculture can integrate and configure the agricultural resources effectively to increase the agricultural output and to ensure the safety of agricultural products' quantity and quality, which means that ecological agriculture has greater economic benefit compared to the traditional agricultural.

As China is a large agricultural country, to promote the development of ecological agriculture is the general trend of policy development. But nowadays, it is known to all that China's ecological environment is getting worse and worse. In the traditional agricultural activities, on one hand pesticides and the large quantity of chemical products are used. On the other the self-purification of soil is limited which leads to soil alienation and pesticides resistance seriously. So it needs to spray more pesticides on the next season and the season after and so on, which involves into a vicious circle. Meanwhile, over-used pesticides can result in great water pollution and cause tremendous pollution of agricultural products, which will threaten the food safety and human's health.

Therefore, this paper tries to make it clear that how the pesticide polluted the ecological environment firstly. Then

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discusses the problems of China's pesticide industry and analyzes the ways of how the Chinese pesticide enterprise upgrades and transforms the developing path under the background of the eco-agriculture.

The mechanism of ecological environment pollution caused by agricultural pesticide

Excessively using pesticides has not only brought serious environmental damage and the decline in quality of crops, but also directly affected the food security, which would be bad for human health. Seeing from the fig. 1, which illustrates the mechanism of ecological environment pollution caused by the pesticide use, it is obviously that pesticides can bring different degrees of damage to the soil, air, water and other environmental elements in different ways. Specifically discussions are as follows.

Effects on the soil environment

The pesticides falling into the soil would make the abilities of reproduction, purification and fertility of soil decline, which would have a significance influence on crop yields. Especially some of the crops grown in greenhouses, in order to maintain their growth, they would have extremely relied on pesticides result in reducing the value of planting soil. Meanwhile, the pollution of soil produced by pesticides can usually lag a long time. Contaminants in the soil are quite different from the ones in the atmosphere, which the former are not so easy to diffuse and dilute into the water. And it won't be detected until it has been accumulated excessively in the soil. According to a research conducted by the China's National Academy of Agricultural Sciences, it was known to all that the BHC and DDT which have been forbidden for long are currently found in the soil. And they have exceeded rates of 28% and 24% respectively, suggesting that low residual toxic pollutants can affect chronically and long-term in nature, for decades or even longer.

Effects on the water environment

There is a low rate of pesticide use in China. Most of pesticides adhere to the crop leaf surfaces and pesticides which are not absorbed into can access to the water by raining or irrigating to contaminate the groundwater. LI Baogui etc. (2003) showed that pesticide contamination on water bodies were mainly from the following paths: directly going into the water by spraying; migrating into water bodies through rain or irrigation water; wastewater discharging from pesticide production or processing enterprises; atmospheric residues of pesticides via the rain into the water and during the pesticide using process, some droplets or dust particles drifting into the water or useless water after cleaning relevant tools and instruments. Different levels of pesticide contamination of water bodies can be ranged as follows: Farmland Water > ditch water > runoff > pond > shallow groundwater > river water > deep groundwater > sea. As there are thousands of rivers distributed widely in China, which makes the chances of pesticides go into the water greatly easily. In addition, pesticide contamination, such as coastal estuaries and coastal areas, also should not be underestimated (ZHANG Luoping etc., 1999; SHAN Zhengjun etc. 2007; SUN Xiaoyu etc. 2009).

Effects on the air environment

Pesticide pollutions in the atmosphere are mainly from the pesticide plant emissions, the proliferation coming from

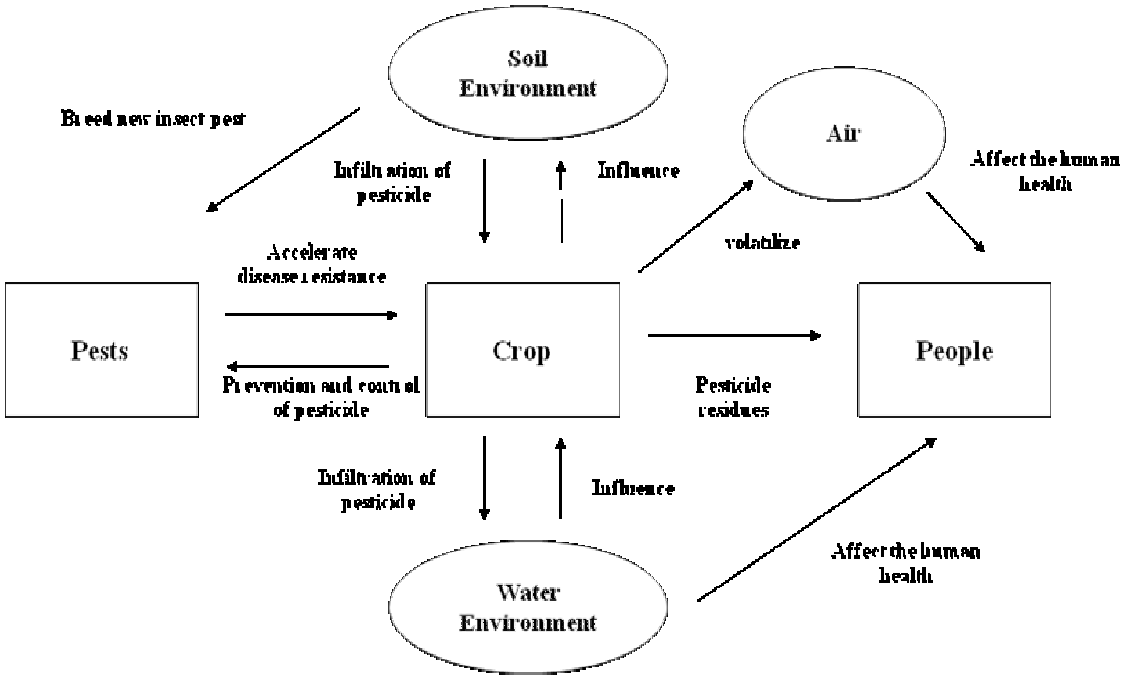

Fig. 1: Pesticide use on the ecological environment pollution.

pesticide spraying and the volatilization of pesticide residues, among which the pesticide plant emissions are in the most serious. To prevent pesticide air pollution, some countries have developed a maximum allowable concentration of pesticides in residential air. But China has not yet. Pesticide residues can be diffused along with the movement of atmosphere, which will expand the pollution the scope. Take organochlorine pesticide as example, although it has been prohibited in the early 1980s, Organochlorine pesticide can persist in the environment for a long time due to durable and steady attribute. And it is not easy to degrade but easy to be calculated in organisms. When going into the atmosphere it can spread to faraway places causing harm to human health, crops in other areas.(Jones K C, de Voogt P, 1999; Iwata H, Tanabe S, Sakai N, *et al*., 1993) . Researches of organochlorine pesticide, one is conducted by WANG Jun etc. (2007) which is about the Pearl River Delta Region, and another is by YANG Dan etc. (2010) which is about Hong Lake, all their results suggest that the settlements of organochlorine pesticide of DHC and DDT are in the largest quantity.

Effects on Pest resistance

If farmers use certain pesticides for a long term to control certain pests within the same piece of land, then after a time, the efficacy of the pesticides will significantly decrease or even become invalid. In agricultural production, there are two ways to maintain the effectiveness of the agent, one is to increase the amounts of drug administered and the other is to increase the frequency of administration, which will in turn prompt the development of pest resistance inevitably. This is a serious problem in the current agricultural production process of chemical control of pests and diseases arising. Resistance is formed in the selective procedure of the drug, during which the drug resistance gene in an individual can be saved down, then gradually developing into a large resistant population. Almost all types of pests can develop some kind of pest resistant. As most of Chinese pesticides production and consumption are imitations which validity period are not more than 20 years. And considering the low level of domestic pesticide use, it is easily to prompt the rapid development of pest resistance.

Effects on human health

Pesticide residues in the crop stems and leaves, it is difficult to clean, it will enter the body through diet. Therefore, excessive use of pesticides can obviously low the quality of crops and directly affect human health. A research of SHEN Xiang-hong etc. (2007) said that Zhe Jiang province, a big province of vegetables and rice production, had a high rate of pesticide poisoning in the past, especially during the 1980s. At that time there was a large number of poisoning populations which fatality rate is more than 15%. The high detection rate of pesticide was the main reason of pesticide poisoning. Currently, it is important of the quality and safety problem of fruit and vegetable caused by serious pesticide residues. Among the process of implementation of the national "vegetable basket" project, it is reported continuously about the serious quality problems of vegetables because of the excessive pesticide spraying. For example, In February 2010, Guangzhou agricultural standards and monitoring center tested five samples of cowpeas from Hainan in Jiangnan fruit and vegetable wholesale market, whose report shows that cowpeas samples from WanNing city Liji county in Hainan were detected illegal pesticide Carbofuran 0.223 mg/kg; samples from city Sanya city Yacheng county in Hainan were detected illegal pesticide Omethoate 0.10mg/kg, Isocarbophos 0.11mg/kg and Carbofuran 0.321mg/kg.

Problems of pesticide industry in china

Excessive use of pesticides

The amount of using pesticide in China ranks first in the world. fig. 2 illustrates the pesticide using quantity (per 1000 Ha) in some main countries around the world. It shows that, from 2001 to 2010, there was a rapid increase in pesticide using amount in China. In 2007, the quantity went to 14.48 tons, in the first place of the world. After that, the number ran quickly to 17.81 tons in 2010 and followed by South Korea and Japan, which were 13.12 tons and 12.1 tons individually. The scale of plantation in Italy was very large, but the level of its modernization is still low compared with other developed countries, such as America, France and Germany. The amount of pesticide using in Italy ranged from 6tons to 8tons per thousand hectares. The highest level of agricultural modernization and the thorough mechanism of policy supervision in the U.S.A contributed to the lowest pesticide using amount in the world for the last ten years. Too executive use of pesticide may largely damage to ecological environment, which goes against the development of ecological agriculture.

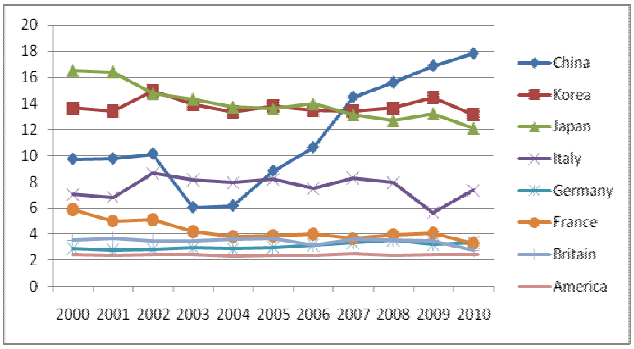

Fig. 2: Pesticides of several countries in the world, year 2000-2010 (U. Tonnes per 1000 Ha).

The unreasonable pesticide production structure

The immature agricultural technology makes the spraying of pesticides the main method of pest-controlling. Highly

toxic pesticides and herbicides accounting for too much in pesticides production structure is still a big problem in ecological agriculture construction. fig. 3 shows the proportion of insecticides, herbicides and fungicides in main pesticides types in China from 2001 to 2011. We can tell that insecticides accounted for 59.15% in total amount of pesticides output and then dropped to 35.45% in 2009; the herbicides made up for 19.87%, while, it rose up to 35.5% in 2009. Overall, the percent of highly toxic organophosphate insecticides showed a downward trend, herbicides rose up and fungicides stayed in a same level. On average, the percentage of three sections above is 41.3%, 31.26% and 9.19% individually. These three parts, insecticides, fungicides and herbicides, have a ratio which is 4.5:1:3.4 (the ratio in developed countries is 2:1:2 usually). The biomass pesticide production accounted for too little is the key to excessive pesticide residues in crops, which is hard to solve.

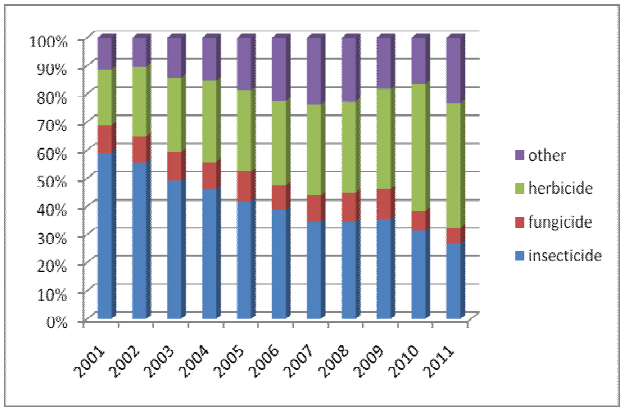

Fig. 3: The production ratio of main pesticides types in China, year 2001- 2011.

Small scale and low degree of industrial concentration

By the end of 2010, China has had 1,819 pesticide companies, among them there were only about 1,400 enterprises which were designated by the National Development and Reform Commission (NDRC) and only about 400 ones were issued by Administration of Quality Supervision. Inspection and Quarantine (AQSIQ). However, the number of enterprises, which was showed in the Pesticide Registration Report issued by Institute for Drug Control of Ministry of Agriculture (MOA), reached more than 4100. It is so tremendous a discrimination between the two statics. Large number but small scale of pesticide enterprises is the serious problem. Up to now the amount of listed pesticide related company was only above 30 and most of them are concentrated around the eastern of China. In other areas, there was few or no large pesticide company that could promote the development of pesticides industry. The output quantity of top ten pesticide enterprises only accounts for 19.5% of the total output of the nation; The company with the highest market share can only make up less than 4% of the entire market; And top twenty pesticide enterprises' output only accounts for 19.5% of the whole output, which all shows there is a low degree of industrial concentration.

Low entry barriers and disorder market order

At present, there are lots of problems of Chinese pesticide industry, such as low barriers to entry, low-level redundant construction and the disorder market. It is bound to induce unfair competition and disorder market for there is so large a number of illegal production enterprises. According to two years (2011, 2012) notification of supervising and spot checking to pesticide issued by the Ministry Of Agriculture, China (MOA), adding hidden ingredients in the process of pesticide production and selling fake products is still a normal phenomenon. According to Notification of MOA General Office on 2nd Pesticide Supervision & Random Inspection 2012 issued by office of MOA, in the product quality checks, among the 3,348 samples tested were 2,922 samples qualified and the pass rate was 87.3%; in the product label checks, among 3,376 samples tested were only 2,776 samples qualified and the pass rate was 82.2%. In the 600 substandard labels, reasons can be seen in fig. 4. The counterfeit, fake, no pesticide registration number or expired registration certificate and unqualified trademark label are the main reasons which reflects the chaos of Chinese pesticide market.

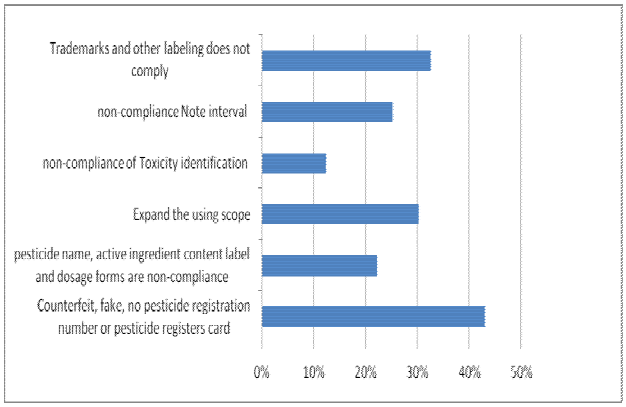

Fig. 4: the reasons to substandard labels and the accounting condition

Low investments in environmental protection

Because the technical, financial and institutional and other problems are not solved, Chinese agricultural pharmaceutical companies always pay their attention to the production and ignore of the environment protection. Many of the companies lack the effective measures to deal with the "Three industrial wastes". In China, the technologies of comprehensive utilization of by-product recovery are still not widely applied. Some of the small companies do not have the ability to control pollution and complete the clean production target or meet environmental standard. The National Environmental Protection Bureau's statistics show that only 4.86% of the total investment was used in environmental protection in

the Chinese pesticide production enterprise. But the number of foreign pesticide enterprises was about 40%. The pesticide enterprises are facing enormous pressure on environmental protection because of the low level of investment in environmental protection.

Backward production technology, low level of R&D inputs and lack of competitiveness

Firstly, Chinese pesticide production enterprises' investment in R&D is inadequate. Those companies' innovation capability is weak as well. Up to now, according to the Ministry of agriculture China incomplete statistics, there were only 44 kinds of pesticides, which had registered. This is mainly because the large initial investment and the long cycle of the pesticide R&D which many Chinese companies cannot afford it. On the contrary, foreign pesticide multi-national companies paid a great attention to their research and development. For example, the Basf Inc in 2011, pesticide R&D investment was about 0.417 billion Euros ($558000000), accounted for 10.01% of sales. And in 2012, the pesticide R&D investment was about 0.436 billion Euros ($584000000), accounted for 9.32% of sales. But Chinese most pesticide enterprise R&D investment accounted for 1% of sales to 2%.

Secondly, intellectual-property protections in China are not efficiency. The policy of Chinese pesticide patent protection is not perfect. Many large enterprises newly developed products can be easily imitated by small companies. Those can not only make the market disorder, but also make that the large enterprises cannot concentrate on doing research and development.

Thirdly, the Chinese agricultural industry has low competitiveness in international pesticide industry. And it positions at tail end in the international pesticide industry chain. At present, the multi-national companies' sales accounted for 80% of the world. While Chinese thousands of pesticide enterprises sales accounted for only about 10% of the world. This is mainly because many Chinese pesticide enterprises always keep cooperation with foreign companies in a way that China Company offers low-cost raw materials and primary products for foreign enterprises to make the deep produce and then they raised prices and sold around the world. What cannot be ignored is that Chinese pesticide enterprises spend Chinese cheap labors, non renewable resources and the environment resources to the multi-national companies and leave the pollution behind in own nation. It is vital for Chinese pesticide industry to change the way.

Imperfect government regulatory system

Firstly, the pesticide industry regulatory body is not clear. Pesticide industry is rather special. Multiple aspects of pesticides, such as research and development, production, transportation, operation, and management involves many departments, such as the Ministry of Transport, the Ministry of Agriculture, Ministry of Public Security, the Ministry of Industry, safety supervision department, and the Ministry of Environmental Protection. Industry regulation between the provincial, city and county as well as differences, easily lead the phenomenon of multiple management. If there are problems, it is prone to, no management or people management, a phenomenon. Obviously, the lead role of the agricultural sector in the pesticide market regulation is not obvious.

Secondly, the legal regulations are imperfect. China issued the first national regulations on pesticide management "pesticide regulations." in 1997. This marks the production, operation, use and management of Chinese pesticide into the standardized and legalized track. Although the legislation has been amended several times in subsequent years, there are still many unclear provisions setting does not apply to the current status of the pesticide industry. And, so far, there is only one national regulations of the pesticide. There are no laws on a national pesticide management.

Finally, the protection of intellectual property mechanisms of pesticides is inadequate. In the pesticide management regulations and management practices, China lacks the relevant provisions of the intellectual property rights of pesticides. Especially in the core areas of pesticide management - pesticide registration management and pesticide production management, China lacks a clear, workable mandatory system of intellectual property. Currently the law of intellectual property protection, pesticide companies rely on, including the "Patent Law," "Trademark Law" and "Pesticide Registration Data" Management Regulations. This is far less than an effective level of protection of pesticide regulation and patents. In addition, in recent years, e-commerce development is very rapid, online peddling without a license infringement pesticide or pesticide incidents often occur. Online features are hidden and strong offense, span, hard evidence, and this lead Internet pesticide intellectual investigated more difficult. Therefore, we urgently establish a new era of pesticide meets a new era of intellectual property mechanisms required.

Development paths of china's pesticide industry

Develop the green agriculture to serve construction of ecological agriculture

In the context of the construction of ecological agriculture, pesticide enterprise transformation and upgrading is imperative. We must vigorously develop the pesticides of small side effects in favor of green environmental protection and ecological diversity of development. On the one hand, it should be the top design from the national level, to prepare ecological agriculture development plan. On the other hand, from the fiscal

policy, the government should implement subsidies and incentives for low-toxicity pesticides, green pesticides.

Strengthen research and development to support the leading enterprises innovation

At the national level, the national response to the pesticide to be strong support for innovation. Our country should focus on protecting the environment and conserving natural resources. We should control and reduce industrial emissions of major pollutants and improve the recovery rate of pesticide products and byproducts resource utilization. For the enterprise level, pesticide companies should increase investment in research, selected pesticides and develop new pesticides, to improve the overall level of technology. Large enterprises should take the lead in the concept of pesticide reform and technology updates to continue to lead the industry green development. For smaller pesticide companies, we can take the form of government subsidies and incentives to encourage research and development. We should strengthen the sense of innovative production for the small-scale enterprises.

Regulate the market to improve pesticide industry access threshold

Firstly, we should raise the standards for approval of new pesticide companies, promulgation and implementation of new regulations. Government should help establish the order of competition pesticide industry, and promote the standards and integration of the pesticide industry, promote non-standard, substandard small businesses out of the market, and to support the rapid development of large-scale enterprises. Secondly, we should increase the new minimum standards registered capital of the approved for pesticide companies. At the outset we should prohibit small enterprises, which lack the financial strength. This helps to control the amount of pesticide companies within a short time, to ensure the quality development of the industry. Finally, to further improve the approved work for pesticide companies. By coordinating pesticide licenses and registration certificates with pesticides, we can strictly control the number of enterprises. So that companies may fail to pass the continuation of the approval and gradually solve Chinese pesticide companies scattered, small-scale phenomenon.

Improve the level of intellectual property management in the pesticide industry

Firstly, our government should improve the legal system, to develop specific regulations or rules of protection of intellectual property of pesticide. Pesticide intellectual property management should be raised to the level of national law. Intellectual property protection, in all aspects of registration, production, operation and use, should be in the form of a clear legal. Implement veto system of intellectual property rights, so as to prevent unnecessary pesticide intellectual property disputes.

Secondly, we should guide enterprises to improve IPR protection awareness and ability, thus to promote industry self-regulation. Enterprises should establish a special department of intellectual property protection. These departments can introduce and train a group of professionals. They have both the expertise of pesticides, and master of laws and regulations, and also know the intellectual property protection tips. These people should continue to learn about pesticide intellectual property protection abroad, and to improve the ability to respond to violations. While improving their quality, they should not malicious occupied intellectual property of others, to ensure the normal competitive market environment.

Finally, we should establish the pesticide intellectual property protection mechanisms in the Internet era. We can create online marketing licensing mechanisms. Websites selling should be prohibited, if there is no corporate authorization. Relevant departments should regularly organize specialized staff to do some of the relevant training to help them distinguish information between true and false. Asked these people, these people publish information, to provide detailed content, such as pesticide registration certificate, proof of professional posts, to prevent the sale of counterfeit infringing products. For illegal sellers, should be in heavy fines or even cancel the sale qualifications.

CONCLUSIONS

In summary, the excessive use of pesticides and the irrational pesticide production in China have caused serious environmental pollution of ecological agriculture. Excessive use of pesticides not only causes pollution in soil and water, but also increased pest resistance. Meanwhile, pesticide residues threat the crops and food security and also harm people's health. Meanwhile, China's pesticide industry has many problems, such as multiple numbers of enterprises, small-scale enterprises, market competition confusion, uneven product quality. What is more, the Chinese pesticide enterprises are small and weak in R&D capabilities, which makes China cannot be dominant in the market of the world pesticide. Finally, the Chinese market is not standardized, with imperfect laws and regulations, and intellectual property protection is not in place pesticide products. Therefore, we need to accelerate the construction of innovative enterprises, to regulate pesticide market environment. We should improve the access threshold for the pesticide industry, to improve laws and regulations of the pesticide industry. We should particularly pay attention to the protection of intellectual property online pesticides in the Internet age. In the agro-ecological environment construction background, we should accelerate industrial upgrading and restructuring of the pesticide industry. We should vigorously develop green pesticide companies to build large-scale, high-efficiency pesticide companies. We should improve the efficiency of technological innovation

and drug development. We should produce such kinds of pesticide which are "efficient use, low drug side effects" and they are also conducive to environmental protection and the development of ecological diversity. And this is the direction of the development of green pesticide industry.

ACKNOWLEDGEMENT

This work is partially supported by the Scientific Research Common Program of the Major Public Bidding Project of National Soft Science (2012GXS1D003) , the National Natural Science Foundation of China (71173006), New Century Excellent Talents in University (NCET-2012-0691), the National Fund of Social Science of China (08AJY039), the Science & Technology Innovation Talent in University of Henan Province:(201008), Humanity and Social Science Foundation from Henan Educational Committee (2011-JD-018). The Major Project from HNUEL (2012-001).

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