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A Study on Environmental Pollution of Agriculture and Countermeasures under the Double Failure

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Abstract

Double failure is a common failure of government regulations and the market, at this time we have to rely on other forces or re-design new market rules and government controls. From pesticides, fertilizer, plastic film and aquaculture industry, the article analyzes the impact of agricultural pollution and concludes that pollution is due to the existence of a common failure in government regulations and the market. Agricultural resources are public goods which led to government's intervention failure. If agricultural production patterns don't change, the environmental pollution will gradually accumulate. Contamination of agricultural products can not be reflected through the price system. Producers of pollution-free products can't compensate for losses of reduced production by raising prices. At last the paper proposes solutions such as control of pesticide dose, relying on ethics and establishing pollution-free agricultural market.

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The double failure is a common failure of government regulation and the market. In many cases, market failure can be effectively curbed by government regulation, and similarly government failure can be corrected through the market. But there are exceptions, though the joint efforts of government and market, it is difficult to achieve good results in the situation. At this time we have to rely on other power which outside markets and government, or re-design new market rules and government controls.

1. Agricultural pollution and impact

Agricultural pollution is irrational behaviour which agricultural producers in the pursuit of agricultural production abuse chemical fertilizers, pesticides, plastic film and other damages so as to destroy the

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ecological environment. China's agriculture models are mainly individual family farming, because the farmers' awareness of environmental protection is weak, they do not recognize the potential hazards in abuse of pesticides, fertilizers and others. Crop production will be affected if farmers don't use pesticides or chemical, so there are common drug use in crops, fruits, vegetables and aquaculture industry.

1.1 Pesticide contamination

Farmers use pesticides in planting crops and different growth stages in order to effectively control crop pests. Excessive use or frequency use of pesticides not only kill pests, but have a direct impact on the soil. Crop itself can carry pesticides, and transfer to humans, animals and beneficial insects through food chain. According to market research, almost all vegetables and fruits are sprayed pesticides in the training process or mixed with pesticides. The following table lists some common pesticides in vegetables (see Table 1). According to China's Rural Yearbook, Chinese pesticide dosage is 1.386 million tons in 2004^[1], more than 95% of toxic pesticides use in crops, fruit trees and flowers.

Table 1 Pesticides Implementation of Some Common Vegetables

Name	spinach	cabbage	cucumber	tomato	peanut	potatoes
Spraying stage	Growing stage	Growing stage	Growing stage	Growing stage	Sowing Stage	Sowing Stage
Spraying Methods	Directly spray in proportion with water	Directly spray in proportion with water	Directly spray in proportion with water. Growth agents are added to promote growth.	Directly spray in proportion with water. Drugs are applied for premature ripening.	Mix pesticides with peanut seeds	Mix pesticides with potato pieces which will be planted.

1.2 Fertilizer Pollution

Fertilizer pollution means that water, soil and air pollution caused by large amounts of fertilizer application. In China, agricultural production has become increasingly dependent on chemical fertilizers. The use of fertilizers has reached the national average of 301 • 9kg/hm², while the world average is only 93 • 5kg /hm² ^[2]. In 2005 fertilizer production of China was 48,975,000 tons, and China imported 13.97 million tons, excluding the number of domestic exports, compared with 43,395,000 tons in 2003, fertilizer use increased about 1,500 tons. Fertilizer demand increased 1.04 million tons in 2009 than that in 2009. The total demand of fertilizer was about 51.21 million in 2009^[3]. These data proves that China's fertilizer usage is increasing year by year.

Any kind of fertilizers used in farmland can not all be absorbed by plants. General fertilizer efficiency is that nitrogen is 30-60%, phosphorus is 2-25%, and potassium is 30-60%. Too much fertilizer will make nitrate content of vegetables and soil increase. If increased nitrite content in food and feed is too high, it can cause poisoning in children and livestock. Long-term application of fertilizers can cause rivers, lakes and coastal pollution, water resources' nutrition and soil structure's destruction.

1.3 Plastic Film Pollution

Plastic film pollution is that wasted plastic film causes damage to the environment. Film technology was introduced from Japan in 1978, since the application and development are very rapid. Plastic film leads to production increasing in reality. Now 31 provinces in China have used film technology in production of grain, cotton, oil, vegetables, fruits, tobacco, sugar, drugs, hemp, tea, forestry and other 40 kinds of crops. Today the covering area of film and amount of film production are both number one in the world.

Film pollution is mainly the residual film cause adverse effects on soil and crop. Residual film will damage the soil structure, seriously affect the permeability of the soil and transporting water from top to bottom, reduce soil moisture, reduce farmland's drought resistance, and prevent seed germination and growth. At the same time, it also contributes to the activities of bacteria and other harmful organisms, leads to crop failures. Research indicates the land with plastic film of 3.9 kg per acre can cut 11% -23% of corn production, 9% -16% wheat production, 14.6% -59.2% vegetables production, cut 4.6% -8.1% cotton production^[4].

1.4 Poultry Industry Pollution

Poultry industry pollution refers to the untreated manure, sewage and residual feed easily discharged into water bodies or seep into groundwater, soil and air, then damage these resources. 90% of the scale of farms has not an environmental assessment, and 60% of farms lack of separation of wet and dry. 80% of large-scale farms lack the necessary investments of pollution control. Because of lots of poultry points, largely pollutant emissions, low levels of pollution treatment, pollution of the surrounding environment increasingly becomes a trouble problem. We can see poultry pollution in the table below (Table 2).

Table 2 The Main Poultry Pollution

Contaminating objects		Water resources	soil	Atmospheric environment
Sources of pollution	stool	The leakage of feces into water. The ammonia and nitrogen content in groundwater near farms beyond the normal 2-3 times.	Livestock manure contains large amounts of organic matter, N, P, K, SS and pathogens and other pollutants. They are easy to leak out of the soil and beyond the purification capacity of soil.	Decay and fermentation of animal wastes will create HS, NH ₃ , amines, phenols, volatile organic acid, ethanol, acetaldehyde and other hundreds of hazardous substances. They cause the surrounding atmospheric pollution.
	poultry industry emissions	Washing appliances and site disinfection's sewage without any treatments are discharged into the ground, the shallow water or the surrounding rivers.	Dead livestock, hatched residues (shells, dead embryos, hair, meconium) and slaughterhouse waste, sewage, etc. are thrown away to the surrounding soil.	Surrounding odour of the farms becomes the breeding of mosquitoes and a large number of harmful diseases. The air quality will decline.
	Residues in vivo	Vaccines, growth hormones, antibiotics, moldy food, pesticide residues in food and water can be delivered to the body through meat, eggs, milk, then be excreted by the body to re-enter the soil, water and atmosphere.		

2. Why the Pollution Can Not Be Cured Effectively

China began implementing the "emission standards for livestock and poultry's breeding industry" on January 1, 2003. It becomes the reference for local departments. To some extent, it controls the pollution of breeding industry, but not completely regulates the breeding industry to achieve compliance. Country is vigorously promoting environmental protection, but the pollution of pesticide, fertilizers, plastic film is still difficult to effectively control. The reason can be attributed to two aspects, namely, government failure and market failure.

2.1 Government Failure

For agricultural producers, soil, air and water are public goods. Public goods lead to failure of government intervention. Producers concerns about their product output in the production process, and environmental pollution will not cause any economic loss. Agricultural products with pesticide residues are generally sold on the markets. Producers do not eat or eat very little. Pesticides, fertilizer and plastic film can really bring about the increase in production, so farmers will not voluntarily reduce or eliminate the use of pesticides, fertilizer and plastic film.

Agricultural producers are in the pursuit of personal interests. They pursuit increased production. As long as increased input costs of fertilizers, pesticides, plastic film are less than productive gains, they will continue to use or incrementally use these things. Government is concerned about the public interest, concerns for environmental pollution control. As long as there are effective measures, government will be sure to take to implement. Government and agricultural producers have inconsistent goals. Regardless of the environment agricultural producers are certainly make the best choice for A or C (see Table 3). Whether the Government controls, they will continue to pollute. If the Government finds its measures do not work after a period of control, or have little effect, it will be gradually inclined to exit control before the new and more effective controls appear. Finally, the equilibrium situation will be agricultural producers increase production and the government does not control, that is C.

Table 3 Government, Agricultural Producers Game Equilibrium

Government Agricultural producers	Control	Do not control
Continue to pollute	A Production increases, To pay administrative costs	C Production increases, 0
Do not pollute	B Production reduces, To pay administrative costs	D Production reduces, 0

In addition, the soil pollution of pesticides, fertilizer or plastic film is difficult to quantify in practice. It requires the help of advanced equipment, depends professionals to complete. China's vastly rural areas do not have such conditions. Meanwhile, family-run model makes government regulation inconvenience. The environmental pollution will gradually accumulate, if agricultural production mode doesn't change.

2.2 The market failure

Meat products, aquaculture, aquatic products, the price system can not reflect their degree of contamination. Agricultural products used pesticides and fertilizers often look full and beautiful and more attractive to the consumers whose information is not complete. In many cases, it is difficult for consumers to judge whether the product is contaminated only from the appearance of the products. So it is almost impossible to rely on market forces to control agricultural pollution in the present situation.

Consumers with completing information will choose pollution-free products when they face the same price of the two kinds of products (pollution-free products and polluted products). Agricultural products of contamination had to withdraw from the market because of its unpopular or reduced sales (see Figure 1, Q2 is demand of non-pollution products). In the case of incomplete information, facing the same prices, consumers will choose products with more attractive appearance which may be polluted (see Figure 2, Q1 is demand of residual products). Agricultural products market is perfectly competitive market. Agricultural producers are price takers. In the case of consumers' incomplete information, producers of agricultural pollution-free products can't be compensated by raising prices. In fact they think reducing pesticides or fertilizer, without pesticides or fertilizer will cause production losses and the losses can't be compensated. Based on agricultural characteristics, in many cases consumers can not determine whether the product is contamination one, so people who wish to engage in pollution-free production have to be out of the market in facing fierce competition.

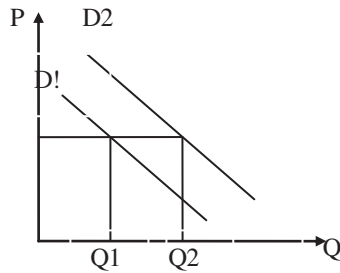


Figure 1 Consumer Demand in Completing Information

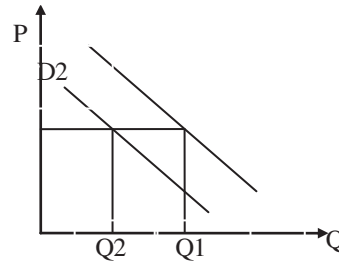


Figure 2 Consumer Demand without Completing Information

3. The Measures

Agricultural pollution control is in the face of the government failure and market failure. Government should re-design a new and effective control measures, enhance publicity of agricultural pollution in rural. Let ethics make agricultural producers to engage in pollution-free production voluntarily.

3.1 Quantity control

Quantity control must rely on government forces, The Government may issues regulations to require the used amount of pesticides in each acre of land, thus the total amount of pesticides can be controlled. The government should implement a registration system for pesticides and farmers. Each family must register when it purchases pesticides. Families purchase pesticides according to the number of land cultivated. Pesticides over the limit will be banned to purchase. Pollution control of Plastic film and chemical fertilizer can be applied to this program.

3.2 Ethics

Government departments should make use of various media, and widely publicize agricultural pollution to the environment and human life, so that people can recognize the side effects which are caused by chemical fertilizers, plastic film, pesticides, growth hormones and others. Many farmers use too much fertilizer and pesticides, because they only know the increasing effect in production, they do not know its long-term harm. To allow people to engage in pollution-free production by relying on ethics, it can not only save costs of government control, but also be the most thorough curing method.

3.3 Establishment agricultural markets of pollution-free

Government should promote pollution-free products and build pollution-free markets of agriculture. Government should raise the price of pollution-free agricultural products, so as to make up for reduced production losses cause by pollution-free production. To guide agricultural producers to post pollution-free logo on pollution-free products, so that consumers can know that it is pollution-free products.

References

- [1] ZHu Liya, QI Yanyan, BI Qidong Economic Analysis of environmental pollution of Agriculture. Environmental Science and Management 2007, 06. 140-144.
- [2] China Rural Yearbook.2003 [M]. 2003
- [3] <http://info.china.alibaba.com/news/detail/v0-d1004349135.html> 2009-02-27.
- [4] <http://www.farmer.com.cn/wlb/nmr/nb8/200902250069.htm> 2009-02-25.