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## *Review*

# Farmers' Recognition and Coping Strategies to Environment Health Risk of Livestock Farming in China

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By interviewing pig farmers and related institutes in Enshi, China, the paper investigates breeding behavior of farmers, compares different subjects' recognition and their coping strategies to prevent the environment health risk. The results show related subjects' recognition on environment health risk is not comprehensive enough. Addressing to environment health risk of livestock breeding, related subjects adopt some prevent and control measures. But these measures are not regular and short of perfect prevent and control system. The research suggests improving related subjects' recognition on environment health risk and promoting prevention and control behavior fitting the risk recognition. And it is essential to build the system of pig farmers as subject and related institutes inducing farmer healthy breeding by regular cooperation.

**Keywords:** environment health; pig breeding; subject recognition; risk coping

## INTRODUCTION

With the global economic development and industrialization, the ecological environment around the world has changed dramatically in recent decades. People's health and welfare are affected by the even complicated dynamic social-ecological system and issues on environment and health are gradually paid attention to by researchers and related policy makers. Considering the complexity of the problems, analyzing health issue from the view of cross-disciplinary are being advocated by more and more researchers (Holdaway et al. 2010; Lebel 2003; Anon 2009).

In recent three decades, during the course of rapid socioeconomic development and transition, China is also facing extensive environment health risk, i.e., Three Representative Industrial Wastes and Heavy Metal Pollution. In poor rural areas illnesses prevent people out of poverty. Some researches have confirmed that the emergence of disease is closely related with environmental change (Holdaway et al., 2010). In rural areas, people's health is seriously threatened by indoor air pollution, agricultural ecosystem pollution, drinking water, polluted rural environment, endemic and infectious disease. The explosion of SARS, bird flu, H1N1 have arose people's acutely awareness that disease originated by animal has threatened people's health seriously since the 21<sup>st</sup> century. The previous studies also show that 62% of infectious diseases are caused by animal among a thousand kinds of human infectious diseases, which is called zoonosis. Among most updated human infectious diseases, 80% are originated by animals. Thus, analyzing the impact of animal disease on human health and how to decrease the threat to human health brought by animal disease are important issues which need to be concerned by current researches. There are many studies related to above issues, such as King (2004), Blacket (2009), Peng Li and Ying Liu (2009) etc. What is more, with the expanded scale of livestock breeding and the transition of breeding mode, livestock breeding has brought more uncertainty and risk.

China is the biggest livestock breeding country in the world. The statistics from FAO show that in 2007, China produced 540 million tones of pork and 290 million tones of poultry accounting for 54% and 50% of the world total respectively and the livestock production is increasing 4.7% annually. While the scale of livestock breeding is expanding, the livestock breeding mode in rural China is transforming from traditional dispersion breeding mode to the combination of dispersion breeding, specialized breeding and commercialized breeding mode. During this process, as the ecosystem changes, pattern of livestock and poultry disease is also undergoing transformation, of which presents an increasing trend. Most of China's livestock and poultry production is concentrated in the rural areas, among which 60% pork and 30% poultry are produced by dispersion farmers, as a result, rural areas are suffering more environmental health risks from livestock and poultry disease. However, subjects' recognition on environment health risk and treatment strategies are rarely being studied deeply from the perspective of sociology.

This paper aims at describing farmers breeding mode and its change trends, investigating related subjects' recognition on environment health risk of pig breeding, comparing farmers' cognition of different breeding modes of environment health risks and their cognitive difference of environment health risks in the process of pig breeding, understanding the pig disease control and environmental health risks control behavior of livestock and poultry by different breeding scale farmers and different breeding mode farmers, examining the environmental health risk measures of relevant government agencies (including Animal Husbandry Bureau, Health Bureau, Animal Husbandry and Quarantine institutions, etc.) in the control of livestock and poultry breeding, analyzing behavior of livestock farmers and problems existed in related measures in dealing with the livestock farming's environmental health risks, coping with effective prevention and treatment of behavior when facing environment health risks by interviewing pig farmers and related institutes deeply in Enshi, and then rethinking the existing livestock farming's environmental health risk defense system, promoting to

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build integrated defense system of environmental health risks from farmers to government.

## Pig Breeding Mode of Investigated Farmers

### Data Source and Site Situation

Data in this article comes from the interview with pig farmers and related institutes in Enshi city, Hubei Province, China. Three villages are investigated in the city. In every village, 3 to 5 farmers are chosen by numbers of pig their reared (below10, 10-30, above 30), and 48 farmers are interviewed. Interviewed institutes included Centers for Disease Control of Enshi City, Health Supervision Bureau of Enshi City, Animal Husbandry Bureau of Enshi City, Environment Protection Agency of Enshi City, Jiu Zhou Mu Ye co., LTD.

Enshi City is located in the southwest of Hubei Province, central China. The total popularity of Enshi City is 0.76 million and 75% is rural popularity. Enshi City is a typical agricultural city, agricultural production in 2011 of which was amounted to 2.143 billion RMB, accounting for 48% of the city's GDP. The terrain of Enshi City is undulating and the mountains of it is rolling, which is not conducive to the development of crop farming. Therefore, Enshi City is focused on the development of livestock and poultry industry and it is the most important livestock city in Hubei province. The city's comprehensive livestock industry output value reached 1.99 billion RMB, accounting for more than 39% of agricultural output. In livestock farming, pig farmers is the most common among local farmers. In 2011, the amount of pig slaughter was 1.05 million and there were 0.71 million live pigs in inventory.

### Pig Farmers Breeding Modes and Trends

Pig farming in Enshi has experienced free-ranging breeding mode, traditional backyard breeding mode, manure digesters processing breeding mode, and development stage of

biological fermentation bed breeding mode. Free-ranging breeding means put pigs out of door directly and this mode was relatively common before 1990s. Around in 1995, backyard breeding began to rise and was accepted by farmers quickly. Currently, free-ranging breeding has almost disappeared.

Traditional backyard breeding is to put pigs in pigpen. Fecal sewage directly discharged outdoor or into cesspool without treatment. Around in 2002, the local government began to implement the "Five Change and Three Build" policy, manure digesters processing breeding mode was gradually adopted in local area. This backyard breeding mode is the most common pig breeding mode currently. Biological fermentation bed breeding mode is a healthy breeding mode introduced by a migrant farmer in 2010 and because of its labor-saving and environmentally friendly, this mode has get the attention and implement of the local livestock sector. Since initial expense is large, there are not very many farmers using this mode, the number of which is around 15 in the whole city.

To sum up current pig breeding mode in Enshi is the combination of traditional backyard breeding mode, manure digesters processing breeding mode, and biological fermentation bed breeding mode, among which the first two are main breeding modes now. The overall development of pig breeding patterns tend to be normative, standardized and healthy.

During recent twenty years, farmers breeding modes are developing constantly, so does the scale of farming. The local traditional breeding habits for every farmers is to rear 7 to 8 pigs. In past several years, farming scale has polarized, most farmers have reduced the scale of farming. Generally, a farmer would rear 1 to 3 pigs. On the basis of pigs "Four Modernizations" "Three Excellent" and the other projects, the local government also implemented "150" Standard of the pig production. Some farmers increase the scale of farming and large-scale farmers began to appear. At present, the number of this kind of farmers has reached 200 to 300. Besides, the number of larger-scale farmers is also increasing, among which 20 to 30 farmers have more

**Table 1. Different Breeding Behavior of Different Breeding Mode**

	Traditional Backyard Breeding Mode	Manure Digesters Processing Breeding Mode	Biological Fermentation Bed Breeding Mode
Pigpen location	In the place of residence, Adjacent to the kitchen	Near the residence, Far from residence if the large scale	Near the residence
Baby pigs source	In the market or in the village or own breeding	In the market or in the village or own breeding	In the market or in the village or own breeding
Cleaning pigpen	1-2 times per week, centralized sewage treatment	1 times 1days, regular disinfection	Regular disinfection, without cleaning
Handling pig manure	Concentrated discharge	Dealt with by manure digesters	Dealt with by biological fermentation bed
Fodder source	Self-product, Formula feed	Formula feed, Make feed by purchasing raw materials	Make feed by purchasing raw materials
Dealing with immunity and disease	Performed by veterinarians	Performed by veterinarians, Performed by themselves	Performed by veterinarians, Performed by themselves
Slaughter processing	Not need to be quarantined if the pigs are eaten by farmers their own, Quarantined by livestock sector if sale in the market	Quarantined by livestock sector	Quarantined by livestock sector

than a thousand pigs, 7 to 8 farmers have more than three thousand pigs and the largest two scale farmers have more than ten thousand pigs. Typically, the scale is usually smaller if farmers use traditional backyard breeding mode and larger if farmers adopt manure digesters processing breeding mode and biological fermentation bed breeding mode.

### **Breeding Behavior of Different Breeding Mode**

In the process of pig breeding, farmers' behavior include confirming pigpen location, baby pigs source, and fodder source, cleaning pigpen and pig manure, dealing with immunity and disease, slaughter processing. No matter what kind of farming model is adopted, farmers' behavior may differ in all respects. This article summarizes farmers' breeding mode based on their characteristics in Table 1.

When choosing pigpen location, since the breeding scale of farmers who adopt traditional backyard breeding mode is relatively small, those farmers usually feed and breed in their own residence and it is manageable to build pigpen next to kitchen. Manure digesters processing breeding and biological fermentation bed breeding need larger breeding scale while their own residences are not big enough. What is more, considering the effect they would bring to life, farmers usually choose to breed near their residences instead of in their residences. However, Large-scale farmers need to follow environmental regulations, that is, away from the living area.

The baby pigs of above three breeding modes are from three ways. First, people buy from the market. Second, buy from farmers in village and breeding themselves. Third, large scale farmers tend to let pigs breed their own to save cost of buying baby pigs.

Farmers who adopt traditional backyard breeding usually do cleaning once or twice per week, including cleaning pigpen and excrement. Sewage flows into cesspool, coming together with excrement. After being deposited for a while, they can be used as fertilizer. Basically, this mode does not do disinfection treatment to pigpens. Farmers who adopt manure digesters processing breeding are used to cleaning everyday and disinfecting pigpens regularly. After being processed, excrement would turn to biogas slurry, biogas residue and biogas. Biogas slurry and biogas residue can be used as fertilizer; biogas can be used as fuel. Biological fermentation bed breeding means excrement would break down through biological fermentation bacteria, so it does not need to do cleaning. Biological fermentation bed can be used for many years and residue can be used as fertilizer.

With the respect to feed source, traditional backyard breeding farmers feed what they produce (Corn, soybean meal, rice, vegetables) or buy formula feed. Manure digesters processing breeding farmers usually have relatively large breeding scale and feed they produce is not much enough, so they prefer to purchase formula feed or raw materials to make feed themselves. Pigs of biological fermentation bed breeding mode eat dry food, thus farmers

used to purchase raw materials to make feed themselves.




The pig immune is unified by the livestock sector organizations so all pig immune is performed by veterinarians. However, large-scale farmers usually choose to do immunization for pigs themselves in order to ensure the quality of immunization. With the respect to disease treatment, traditional backyard breeding farmers generally ask for veterinarians' help. While large-scale manure digesters processing breeding farmers and biological fermentation bed breeding farmers would study pig disease prevention and treatment technologies and in consequence, they would treat pig diseases themselves. When selling pigs, if the pigs are eaten by farmers their own, they would not need to be quarantined. On another hand, the pigs for sale in the market need to be quarantined by livestock sector and then stamped with the quarantine official seal before sale.

### Related Subjects' Recognition on Environment Health Risk

Environmental health is an ecosystem which consists of human beings, animals and external natural environment and has the ability to self-sustaining and self-updating. External natural environment mainly includes vegetation, soil, water and air. With the increasing human's intervention to the ecosystem, environmental health is facing various impact of risks. In the process of livestock breeding, , livestock diseases, parasites, manure, sewage, vaccines, veterinary drugs, odor, noise and feed additives are likely to cause harm to the external environment. Different subjects have different recognition on pig breeding environmental health risk. To compare the difference, we interviewed related professional disciplines (Animal Disease Prevention and Environmental Science experts), the relevant agency staff (local Animal Husbandry Bureau, EPA staff, CDC staff) and livestock farmers to get different subjects' recognition on soil, water, air, vegetation, human, and animals from different sources of risks (See figure 1).

Regarding to diseases and parasites on the

Subjects	Risk source	Soil and water	Air	Vegetation	Human	Animal
Professional	Disease and parasite	Weak risk	No risk	No risk	Weak risk	Weak risk
	Manure and sewage	Weak risk	No risk	Weak risk	Weak risk	Weak risk
	Vaccine and veterinary drug	Weak risk	No risk	Weak risk	Weak risk	Weak risk
	Odor	No risk	Weak risk	No risk	No risk	No risk
	Noise	No risk	No risk	No risk	No risk	No risk
	Feed additive	Weak risk	No risk	Weak risk	Weak risk	Weak risk
Staff of related institutes	Disease and parasite	Weak risk	No risk	No risk	Weak risk	Weak risk
	Manure and sewage	Weak risk	No risk	Weak risk	Weak risk	Weak risk
	Vaccine and veterinary drug	Weak risk	No risk	Weak risk	Weak risk	Weak risk
	Odor	No risk	No risk	No risk	No risk	No risk
	Noise	No risk	No risk	No risk	No risk	No risk
	Feed additive	Weak risk	No risk	No risk	Weak risk	Weak risk
Farmer	Disease and parasite	No risk	No risk	No risk	No risk	Weak risk
	Manure and sewage	Weak risk	No risk	No risk	Weak risk	No risk
	Vaccine and veterinary drug	No risk	No risk	No risk	No risk	Weak risk
	Odor	No risk	No risk	No risk	No risk	No risk
	Noise	No risk	No risk	No risk	No risk	No risk
	Feed additive	No risk	No risk	No risk	No risk	Weak risk

Note: Strong risk  Weak risk  No risk 

**Figure 1.** Related subjects' recognition on environment health risk of pig breeding

environmental risks, the following three kinds of subjects all think they has a great risk on humans and animals. Professionals and agency working staff believe that they

have a great risk on soil and water while farmers does not think so. Professionals hold the opinion that they has some threat to vegetation, and agency working staff and farmers

consider there is no impact on vegetation. Regarding to feces and sewage on the environmental risks, professionals and agency working staff believe that they have a great risk on soil, water, vegetation, humans and animals while farmers they have little risk on soil, water and humans and have no risk on vegetation. Regarding to the effect of odor which generate from the livestock breeding process, professionals think the odor has very bad effect on air, little on humans and animals and no effect on soil, water and vegetation. However, agency working staff and farmers both think the odor just has little bad effect on humans and on impact on the other respects. Regarding to the noise influence, professionals think the noise brought by breeding pigs has weak influence on humans and animals, while agency working staff and farmers think just humans are at weak risk under the influence of noise. In terms of risk of feed additives, professionals consider that they have relatively bad effect on soil, water, vegetation, humans and animals. Agency working staff think they have relatively bad effect on soil, water, humans and animals and no effect on vegetation. Farmers think they just have relatively bad effect on animals, little effect on soil, water and humans and no effect on vegetation.

To sum up, farmers' awareness of environment health risks is poor. Even though they have a certain sense of risk, it is only retained in the perceived level of sensory, such as the awareness of odor and noise, etc. However, they do not know how odor and noise affect humans very much. Animal husbandry and veterinary staff's awareness of environment health risks is similar to farmers' and is poor as well. Environmental staff and CDC (Centers for Disease Control) staff's awareness of environment health risks is stronger but they have different emphases. Environmental staff emphasis on natural environmental risks while CDC staff emphasis on human health risks. Therefore, whether farmers or animal husbandry and veterinary staff, or CDC staff, they all do not have strong or comprehensive awareness of environment health risks enough, which is only limited to their own cultural background and professional knowledge. They all think Enshi can be described a mountainous area and farmers' living places are

relatively scattered, which reduce the spread of disease and pollution in the process of breeding on the environment risk is less than the plain or hilly areas.

Farmers think different breeding modes have different environment health risks. It is generally thought that traditional backyard breeding have relatively strong impact on environment because of manure and sewage discharge. But if the manure is after a long-time fermentation, it is not a big issue. As for manure digesters processing breeding mode, fecal and sewage both have flowed into septic tank, and then flowed into digesters. Digesters are cleaned every three or four years and slurry residue is used in field, so this breeding mode does not have much effect on environment. Biological fermentation bed breeding can be called "zero emissions" healthy breeding. After a certain number of years, slurry residue is moved, being used in field or burned and basically there is no environment issue. In a word, farmers think biological fermentation bed breeding mode is the healthiest way, the second is manure digesters processing breeding mode and traditional backyard breeding mode have greatest impact on environment. This view has been supported by the related agency working staff.

### **Farmers' Coping Strategies to Environment Health Risk of Pig Breeding**

According to World Bank's Management Framework, risk management includes risk prevention, risk management and risk mitigation strategies afterwards (Holzmann et al., 2000). Also according to this framework, we investigated all the processing strategies including before, during and after breeding, of farmers and different institutes (Environment Sector, Health Sector and Livestock Sector) corresponding to pig breeding disease risk and environment pollution. The results are showed in table 2. The coping strategies of farmers and different agencies to environment health risk of pigs breeding have great difference. Each subject adopts

**Table 2.** Related subjects' coping strategies to environment health risk of pig breeding

		Farmer	Livestock sector	Health sector	Environment protection sector
Coping with disease risk	Before event	Choosing pup, disinfecting epidemic prevention	Propaganda, organizing epidemic prevention, casual inspection, training	Epidemic disease control and prevention, training	Environmental assessment for large farms
	During event	Curing	Checking, culling, Propaganda	Checking and prevention	
	After event	Culling, burying, disinfecting	Checking, supervision, Propaganda	Prevention and control	
Coping with environment risk	Before event	Selecting pigpen location, changing breeding pattern, disinfection treatment	Propaganda, Extending health breeding		Environmental assessment for large farms
	During event	Regular cleaning pigsty, disinfection treatment, fermentation by concentrated manure			Irregular checking
	after				

certain risk responses based on the pursuit of their own interests.

Farmers' awareness of environment health risks is poor and its environment health risks control measures focus on pigpen location confirmation, fecal sewage treatment and immunotherapy, etc. However, no matter in which aspects, the coping strategies of medium and large-scale farmers to environment health risks are more than small-scale farmers.

For example, large-scale pig farmers would do ultraviolet light treatment before people go into the pigpens to avoid germs spread while there is few small-scale farmers would do so. In response to pig disease risks, healthy baby pigs and timely immunization will be chosen based on farmers' experience in breeding. And pigpens will be cleaned or disinfected to prevention diseases. When the diseases occurs, farmers will promptly seek treatment. Once the



disease can not be cured or cured cost is large, pigs will be will be culled, buried and pigpens will be disinfected. In response to pig breeding on the environment pollution, large-scale farmers will try to choose the barn away from residential areas or valley, and disinfect the pigpens. At the same time, they will select healthy breeding mode to decrease the impact on environment and humans. During the breeding, farmers would clean and disinfect pigpens regularly and do manure concentrated fermentation but they can not afford to take any post-processing for environment pollution has already occurred.

For Animal Husbandry Bureau, the control measures beforehand of pig diseases are mainly teach farmers to farm in low pollution or promote technologies through advertisement or training. And they make relevant policies and measures to guide and give incentives to farmers who adopt low pollution farming or new technologies. For example, some farmers introduce biological fermentation bed healthy breeding technologies from Fujian. After Animal Husbandry Bureau learned these technologies they began to promote healthy breeding technologies in the whole city and experts were hired to provide technical advice. Pig breeding propaganda usually include three ways. First, "Pig Disease Prevention Notice", "A Letter To The Farmers in Town" and other related materials were issued by township livestock sector. Second, gathering village officials together and illustrating healthy breeding to them so that they can then inform and guide farmers. Third, every year the livestock sector organizes 1 to 2 times meetings or trainings for farmer representatives. At the same time, veterinarians are organized to do unified immunization for baby pigs and report immune farmers information to veterinary stations in town. And working staff in veterinary stations will check regularly on immune effect of immune farmers. Usually 3 to 4 farmers are chosen as samples and the sampling rate is around 10%. But whether it is propaganda, training, or spot check, livestock sector would focus on large or medium-sized farmers. Since the impact of small-scale farmers is small, they are not focused. Besides, large or medium-sized farmers can perform demonstration effects. Newly-built farms and farming communities are

registered and large-scale farms are conducted environmental assessment by Environmental Protection Bureau. Such environmental assessments are generally easy and they usually just include some farm sitting suggestions and occasionally sewage discharge checking.

Coping strategies of CDC focus on the prevention of zoonosis and there is no other tactics to deal with other pig breeding risks.

Relevant agencies in controlling livestock environment health risks have different responsibilities and agencies for environment health risks are still some cooperation mechanisms. The main characteristics of this cooperation mechanism are: no prior contact, joint together at the moment and separate afterwards. When large-scale environmental pollution problems occur, Animal Husbandry Bureau and Environmental Protection Bureau are responsible to control them jointly: Animal Husbandry Bureau requires farmers to rectify as what Environmental Protection Bureau demands; farmers would rectify as what Environmental Protection Bureau requires, and get the breeding permit after being evaluated by Environmental

Protection Bureau hat they comply with all standards. Then farmers would contact with Animal Husbandry Bureau and Animal Husbandry Bureau would manage farmers according to the comments of Environmental Protection Bureau. When zoo noses occurs during breeding, Animal Husbandry Bureau and CDC (Center for Disease Control and Prevention) will control it together. These two departments mainly rely on reciprocal notification mechanism for cooperation and their main job is to send relevant staff to the countryside for farmers to deal with spreading large-scale infectious diseases. In a word, although every agency already has some preliminary health risk prevention and control measures, there is still no perfect and regular prevention system.

### **Improvement to Environment Health Risks of Livestock Breeding Defense System**

Perfecting environment health risks of livestock breeding

defense system is not only to depend on improving breeding technologies, sewage discharge technologies and other technical indicators, but also should be propelled from the view of social management and multi-level.

First, strengthening every subject's cognitive level of environment health risks in livestock breeding. Starting from the situation that breeding farmers' awareness of environment health risks is poor, the publicity and education to breeding farmers of environment health risks should also be enhanced. Thereby turning their unconscious or passive risk control behavior to autonomic behaviour. At the same time, considering the relevant working staff's weak sense and one-sidedness of environment health risks in all agencies, we should actively guide agency working staff to analysis and understand environment health risks from multiple perspectives.

Second, promoting the unity of environment health risk perception and prevention actions which has involved every subject's behaviors. Raising the level of perception is beneficial to the prevention of environment health risk. However, currently the environment health risk perception of every subject performs risk internalization and it is out of line with prevention actions and not conducive to improving defense system.

Third, agencies should give full play to the functional roles from the dynamic system level of humans, people and the environment. For example, Animal Husbandry Bureau should strengthen the prevention and control of livestock diseases further and improve complement links to avoid leaving out certain steps; it also should strengthen the diagnosis and treatment of sick livestock and the registration to ensure that sick and dead livestock can be disposed properly. What is more, Environmental Protection Bureau also should strengthen the conduction of environmental assessment and build environmental assessment standards to guide farmers to do breeding actions according to standards. After operation, the livestock farms are supposed to be spot-checked occasionally in order to ensure that the environment pollution is in a controlled breeding range. CDC should further inform and educate the livestock farmers so that

their environment health risk awareness of infectious diseases can be strengthened.

Fourth, building close cooperation between every agency and routine notification mechanisms established. Current cooperation between every agency is mainly reflected after great environmental health danger. There is little contact before and after the danger because of lack mutual notification mechanism. Thus it is necessary for relevant experts from different agencies to exchange information and ideas regularly and change the current situation that they do their own business.

Fifth, farmers are the basis for prevention and control system and all the control measures cannot work until through farmers. All agencies must be clear about the dominant position of environment health risks, putting forward feasible control strategies from the farmers' point of view. Guidance should be put in the first place by every agency and farmers should play dominant position.

Sixth, establishing an ongoing incentives for farmers, such as giving proper continuing encouragement and corresponding subsidies to breeding farmers in their emissions abatement process or who adopt newly breeding technologies to arouse the enthusiasm of farmers to do prevention and control of environment health risks better.

Last but not least, actively promote bio-fermentation bed technology to reduce the cost of bio-fermentation bed. It is also very important to encourage farmers to actively use bio-fermentation bed technology to perfect environment health risk prevention and control system.

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