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The Strategy for the Development of Low-carbon Animal Husbandry in Taiwan and the Lessons Drawn from It

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Abstract In this paper, we analyze the strategies for the development of low-carbon animal husbandry in Taiwan which mainly focuses on strengthening the livestock farm carbon reduction, promoting the livestock breeding energy conservation and emission reduction technology, and develop the environmental protection laws related to animal husbandry to combat animal husbandry pollution. Learning from the strategies and legislative management experience for the development of low-carbon animal husbandry in Taiwan, we set forth the following recommendations for improving the development of low-carbon animal husbandry in mainland China: increasing the financial investment in environmental protection; strengthening the scientific research of cleaner production; promoting sound pollution control legislation; moderately restricting the scale of livestock and poultry farm.

Key words Low carbon, Animal husbandry, Energy conservation and emission reduction, Taiwan

In recent years, with the development of mainland China's large-scale breeding industry, it has caused increasingly serious environmental pollution. Now the breeding industry has become a major source of pollution in China's rural non-point source pollution, and in many areas, the discharge amount of livestock and poultry pollutants has even exceeded the discharge amount of domestic pollutants and pollutants from township industry and catering industry, becoming an important reason for the pollution and eutrophication of important water sources, rivers and lakes. Prevention and treatment of livestock and poultry industry pollution has become an important issue in rural environmental protection at present. The development technologies and management strategies have been more mature for the low-carbon animal husbandry in Taiwan, which can provide a useful reference for the development of low-carbon animal husbandry in mainland China.

1 The main measures for developing the low-carbon animal husbandry in Taiwan

Taiwan's livestock industry has gradually caused some environmental pollution problems after large-scale production, including waste water, solid waste and air pollution. Swine wastewater is the main reason for river pollution, and the average daily volume of wastewater per pig is about 20L; the chicken pollution is generally from the henhouse stench, chicken manure and dead chicken waste; the pollution problem of cattle and sheep farm is mainly based on waste, coupled with waste water, and the odor does not constitute pollution. Since 1990, the Taiwan authorities have increased financial support for the livestock farm to set up the pollution control facilities; established "livestock pollution prevention

technology services group" to build regional counseling technique system for guiding the livestock farm to carry out the recovery and recycling of waste resources; organized the pollution prevention and control classes, built the livestock and poultry manure composting disposal field, and promoted the greening and beautification of pasture, in order to prevent animal husbandry pollution and promote the establishment of pollution-free animal husbandry.

1.1 Strengthening the carbon reduction and resource recycling of livestock farm

1.1.1 Pig pollution prevention. In 1992, Taiwan's Agricultural Committee began to implement the pig policy adjustment programs approved by Administrative Council to guide the pig farms to set up the waste water, solid waste and air pollution control facilities, and promote the three-stage waste water treatment. Currently, the waste water treatment facilities have been generally popularized in Taiwan's pig farms, and at the same time, the waste water reduction and waste water recycling are also guided, so the pig waste water pollution is no longer a major source of pollution to Taiwan's rivers. In terms of the solid waste treatment, it has set up animal manure compost disposal field to produce the compost.

1.1.2 Poultry pollution prevention. The main problem is the poultry house odor causing an impact on the environment. It guides the poultry farmers to carry out environmental sanitation control, strengthen the poultry house ventilation and deodorization; promotes the greening of poultry farms, and reduces the poultry house odor and mosquitoes to improve the environment; helps to set up the poultry waste incinerators to solve the problem of dead poultry processing. In terms of the poultry manure treatment, it guides the poultry farmers to set up composting facilities, to properly handle the poultry manure and make it into organic fertilizer.

1.1.3 Herbivore pollution prevention. It helps the herbivore farmers to set up waste water treatment equipments, and use three-stage method for waste water disposal. The waste is mainly made

Received: June 25, 2014 Accepted: August 21, 2014

Supported by Industrial Economic Research Project of National Sheep Industry Technology System (CARS-40-20).

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into compost to return farmland. In addition, it guides the livestock farms to widely plant trees to beautify the environment and absorb odor.

1.2 Promoting the energy conservation and emission reduction technology of animal husbandry

1.2.1 Livestock shed design. The livestock shed is surrounded by green plants, and the isolation greenbelt is established. Planting trees can provide oxygen, and the forest plants can directly absorb the ammonia and hydrogen sulfide in the odor. The trees can reduce wind speed, reduce the amount of dust, and prevent the odor spills. The livestock shed should be kept closed as much as possible, and regularly ventilated. In the fan mouth of the curtain-style pigsty, the air pollution control facilities are set, and around the open pig farm, the shading net is set coupled with spray facility. And the drains and septic tanks are transformed into a shell type^[1].

1.2.2 Feeding management. According to the nutritional needs of livestock and poultry, the digestible daily diet that can be absorbed easily is provided in order to reduce the excretion. The strip ground and other facilities are used to separate manure and urine as soon as possible. The sawdust, rice husks, shredded paper and other absorbent materials are used as the padding to absorb the manure and urine and retard the fermentation process. The frequency of collecting manure and urine is increased to reduce the manure fermentation opportunities. The protein content in the feed is moderately reduced, and the synthetic amino acids are added^[2]; the biological agents are added to the feed, which can improve feed use efficiency and suppress odor generation. The restricted feeding way is used to avoid the stench of residual feed, or the increased defecation arising from the excessive feeding of livestock and poultry^[1].

1.2.3 Waste disposal. Currently, the most economical and effective sewage and waste treatment of the ranch is the three-stage sewage treatment mode, and the daily management and maintenance are the simplest and easiest, that is, through solid-liquid separation at first, the effluent undergoes anaerobic fermentation treatment and anoxic aeration is used to further remove organics. For this treatment method under normal and well-managed operation, the removal efficiency of COD, BOD and SS is up to 98%, complying with effluent standard limit^[3]. After the solid waste is fermented and rotted, it is made into compost, and the routine sampling of compost and component analysis and testing are conducted twice a year. It is necessary to pay close attention to the compost quality and adjust the formula of raw materials, to produce the products in line with the quality standards of fertilizer registration items^[4].

1.3 Strengthening the animal husbandry pollution prevention and management

1.3.1 Establishing the technical guidance and maintenance services system for the livestock waste treatment. Taiwan Commission on Agriculture commissions Livestock Research Institute and affiliated branches, farms, Industrial Technology Research Institute,

Pig Research Institute, National Yunlin University of Science and Technology and National Pingtung University of Science and Technology, to establish the regional technical guidance and maintenance services system, and report the farmers who need technical assistance to the county government.

1.3.2 Strengthening the water quality and quantity monitoring. Firstly, it conducts the river pollution monitoring, and commissions Center for Environmental Studies of National Cheng Kung University, to set up six monitoring stations along the rivers to monitor the river water quality once a month, in order to control the regional pollution problem. For the river with serious water pollution, this center is responsible for notifying Kaohsiung and Pingtung county governments of this, so that they strengthen the wastewater inspection and counseling for the livestock farms along the river and remedy the river pollution.

Secondly, it establishes the livestock wastewater laboratory, and commissions the livestock disease prevention institute in Taipei County, Tainan County and Pingtung County, as well as Taiwan Farming and Livestock Development Foundation, to establish the livestock wastewater laboratory in order to coordinate the pig farm and monitor the effluent quality, including biological oxygen demand (BOD), suspended solids (SS) and chemical oxygen demand (COD).

1.3.3 Promoting the GPS work for the livestock farm. It commissions National Cheng Kung University to establish the geographic information systems, incorporates the basic data on the livestock farm pollution control into the geographic information system to build the database management system for the prevention and control of pollution, and converts the plane information of livestock farm pollution control into the space video data for the prevention work of livestock farm pollution. It has completed the GPS work for the livestock farm of pig, chicken, cow and sheep with a large raising scale.

2 The major environmental protection laws for the animal husbandry pollution prevention in Taiwan

Taiwan currently has many laws and regulations related to the animal husbandry environmental protection, which can be divided into four categories.

2.1 Water pollution control Since the pig industry is developed rapidly in Taiwan, the legislation has a early start. In May 1987, the Administrative Council promulgated *Effluent Standards in the Cause of Water Pollution Control*, which provided that the BOD limit of effluent when raising more than 1000 pigs was 20mg/L, and the SS limit was 300, and there were no restrictions when raising less than 200 pigs. The laws require the pig farm to solve the sewage problem before the deadline when it is not up to standard, otherwise it will be severely punished, and NT 60000 will be fined each time until the situation is improved.

In March 1990, it also issued *Pig-keeping Adjustment Bill*, which stated, "The number of pigs raised shall not be increased in the short term, and it is necessary to reduce and limit the large-

scale pig farms and increase the number of pigs raised in the long run; the future pig industry shall meet self-sale first, not for the purpose of export"^[6].

2.2 Air pollution control The existing environmental protection regulations for odor control are mainly focused on *Air Pollution Prevention Law*, and the key content of relevant laws and regulations is as follows:

(i) Article 2, Item 1: Air pollutants refer to the substances in the air directly or indirectly doing damage to residents' health or the living environment, such as particulate contaminants, sulfur oxides, nitrogen oxides, carbon monoxide and hydrogen sulfide. This section is a component of testing laws, and there is no case of livestock farm being punished by the environmental protection authorities due to breach of the provisions.

(ii) Article 20: The value of odor from the livestock farm shall comply with the provisions of *Fixed Pollution Source Air Pollutant Emission Standards*. The emission standard in the agricultural areas is 50, and the emission standard outside the agricultural and industrial areas is 10. The environmental protection inspectors collect and dilute the air samples around the livestock farms to be judged, and if exceeding the provisions of *Fixed Pollution Source Air Pollutant Emission Standards*, it will be adjudged as violation of regulations.

(iii) Article 56, Item 1 and 2: If the sampling results around the livestock farm exceed the provisions of *Fixed Pollution Source Air Pollutant Emission Standards*, the livestock farm will get a fine of NT 100000 to 1000000, and it shall be improved before a deadline, and where the violation is considered gross, it shall be closed down, and if necessary, the operating license shall be revoked^[7].

2.3 Waste disposal The solid substance generated during the disposal of daily manure and wastewater in the livestock farm and huge fixed losses such as carcass, broken eggs, as well as the egg-shell and afterbirth generated during the delivery or incubation of livestock and poultry, shall be legally cleared by oneself or properly cleaned and reused by the commissioned re-use agency.

The livestock farm with a breeding scale of more than 3000 pigs, 80000 chickens or 250 cows, shall first declare an industrial waste disposal plan to the local environmental protection bureau, and only after being examined and approved can it apply for livestock farm registration. For the livestock farm with a breeding scale of more than 4000 pigs, 100000 chickens or 300 cows, the generation, clean-up or reuse of waste shall be reported to the Industrial Waste Control Center using computer networks^[8].

2.4 Resource recycling For the reuse of waste, the livestock farm shall be in accordance with the bulletin of Council of Agriculture, to reuse the livestock and poultry manure, pollutants or animal carcasses to make them into compost or meat and bone meal. The type, date, quantity and purpose of reuse shall be recorded and stored for more than 3 years.

To properly handle the livestock and poultry manure, avoid environmental pollution and promote the use of livestock and poul-

try manure compost, Taiwan authorities developed *Setting Points for Livestock and Poultry Compost Site* in 1992, to regulate the application setting of livestock and poultry manure compost site, including the land changes. In 2002, Taiwan authorities developed *Operation Management Points for the Livestock and Poultry Manure Compost Site*, to guide and manage the operation of livestock and poultry manure compost site.

3 Financial support and counseling for the animal husbandry pollution prevention in Taiwan

3.1 Financial support To encourage farmers to build and improve the animal husbandry pollution control equipment, the Taiwan Council of Agriculture has amended the points of loans for pollution control equipment, relax the lending conditions and constraints on scale. Any livestock farm can apply for loans after obtaining the livestock farm registration certificate, and the credit quota has been raised.

The highest loan for each pig is NT 1500, and the highest loan for each sheep is NT 4000, while the highest loan for each livestock and poultry manure compost site is NT 10000000. The Taiwan Council of Agriculture says that the current annual interest rate of special loans for livestock pollution control equipment is 2%, and the longest loan period is eight years^[9].

3.2 Technical training and seminars In Taiwan, there are seminars to be held on the academic research, practical operation and published experimental research results every year, and they are mainly sponsored by financial groups commissioned by the Council of Agriculture.

For example, Housheng Foundation is commissioned to organize the training for grass-roots administrative personnel and hold seminars on pollution prevention for farmers, and the content includes environmental protection regulations and trends, pollution control facility operation and maintenance, livestock farm waste reduction and recycling, and the introduction of new ideas, new technologies. The Livestock Pollution Prevention Forum is regularly held and the experts and scholars at home and abroad are invited to deliver speech on special issues, in order to absorb the international livestock pollution prevention achievements and experience.

4 Recommendations for improving the development of low-carbon animal husbandry in mainland China

4.1 Increasing the financial support and enhancing the financial input to environmental protection The animal husbandry is in the period of low profit currently, but the pollution and control of livestock and poultry manure pollution requires considerable investment that the farmers and livestock operators can not bear. Therefore, it is necessary to encourage livestock and poultry breeding enterprises to carry out pollution control using both the legal means and financial assistance. The government should formulate and promulgate the supporting measures and preferential policies based on the protection of healthy development of

breeding industry, to encourage the livestock and poultry breeding enterprises to carry out the pollution prevention, give financial subsidies and preferential prices, and support the development of ecological animal husbandry. The government at all levels should establish the special fund for the livestock and poultry breeding pollution control, to solve the environmental protection funding.

4.2 Strengthening the scientific research and promoting the cleaner production The government should support the research and development of scientific pollution control technology, and implement the cleaner production in the livestock and poultry breeding industry. It is necessary to effectively control the pollution in the production process. The cleaner production includes capacity control, and the breeding scale is determined in accordance with the land environmental capacity, to ensure that there is enough land for dissolving the waste generated during the livestock and poultry breeding, to reduce environmental pollution and increase soil fertility.

In the process of livestock and poultry breeding, it is necessary to promote the automatic water drinking for the livestock and poultry, change the diluted feed to dry and wet feed, control the heavy metal salts, vitamins and other additives in the feed within the non-pollution range, and use the raw material control, rainwater and sewage separation and other ways to reduce the discharge of pollutants; make harmless treatment on the livestock and poultry manure and wastewater, to reduce and eliminate the threat and risks to the environment, human and animal health; promote ecology development, make full use of natural treatment systems, and use animal husbandry to promote agriculture, to achieve the ecological system balance.

4.3 Promoting sound pollution control legislation and refining the legal provisions After getting aware of the environmental pollution caused by the breeding industry, the Chinese government has introduced a number of management practices, such as *Management Measures for the Livestock and Poultry Breeding Pollution Control*, *Discharge Standards for the Livestock and Poultry Breeding Industry Pollutants*, and *Technical Specifications for the Livestock and Poultry Breeding Pollution Control*, and made a series of requirements on the construction of livestock and poultry breeding site, waste treatment and discharge. But relatively speaking, the livestock and poultry pollution prevention rules of mainland China are extensive, and the operability is not strong.

For example, Taiwan makes specific provisions on many links in the livestock and poultry manure pollution control while *Water Pollution Prevention Law in the Mainland* has not mentioned "livestock and poultry manure pollution", and the regulations should be more detailed. The level of relevant legislation in mainland

China is low, and the current management practices are only the administrative regulations and standards, so the deterrence is limited, and the farms rarely consciously abide by these regulations and standards.

4.4 Moderately restricting the number and scale of livestock and poultry farm In order to quickly eliminate the livestock and poultry manure pollution, it is necessary to take appropriate measures to limit the development of animal husbandry without affecting the food supply for local residents. For various reasons, many large-scale livestock and poultry farms of mainland China are in the residential areas. 8% to 10% of large-scale farms are less than 50m away from the water source for local residents, and 30% to 40% of large-scale farms are less than 150m away from the water source for local residents. Inappropriate siting of farms not only has inflicted enormous pressure on the surrounding environment, but also has caused environmental disputes between livestock farm owners and surrounding residents in many places. Therefore, it is necessary to establish a reasonable program on the livestock and poultry farm.

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