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Application Of Iso 14001:2015 International Standards In Determination Of Environmental Aspects At Market Pig Farm With Semiautomatic Technology Farm Size 12,000 Pigs Per Year In Phu Giao District, Binh Duong Province

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ABSTRACT

Recognized as a smart city, Binh Duong's smart city development strategy also includes the development of automated agriculture, typically large-scale livestock farming. Sustainable urban development will not be able to ignore the factor of providing food for urban and regional people. Phu Giao district - Binh Duong province is one of the leading districts in livestock farming, especially concentrated pig farming. The agricultural industry, pigs breeding, is one of the strengths of the district, besides the cultivation of short and long-term industrial crops such as rubber, cashew, Ho Tieu... Livestock is a very old profession of the Vietnamese people in Phu Giao district as well as in Binh Duong province. The contribution of livestock production to the socio-economic face of the district cannot be denied. However, animal husbandry activities, besides the economic values, also cause some consequences to the natural environment such as soil and water pollution, noise, odors in the air, etc. Hence, we decided to research the "Application of ISO 14001:2015 international standards in the determination of environmental aspects at market pig farm with semiautomatic technology farm size 12,000 pigs per year in Phu Giao district, Binh Duong province" (TCVN ISO, 2015). This is a large-scale pig farm with modern semi-automatic technology equipment. We expect to find out environmental issues in the most detailed and specific way so that the owner can overcome the above environmental problems, rest assured to raise livestock and develop more expansion later. We conducted a review of the areas on the farm and evaluated the activities in each area, from which

we found the environmental problems through the material flow diagram (Phạm Thị Hồng Cẩm, 2020). Next, through the multi-criteria method (Phạm Thị Hồng Cẩm, 2020) we calculated the score and found the most significant environmental aspects (most environmental risk). The research results will be a general picture to provide farm owners with an intuitive and easy-to-understand view of suitable solutions. Developing farm economy along with environmental protection towards sustainable development of livestock agriculture.

Keywords: *agriculture, environment; environmental aspects, livestock, semi-automatic technology*

1. Introduction

Binh Duong province is the only locality in Vietnam that has been honored 4 times by the World Smart Community Forum (ICF) in a row as an area with the world's typical smart city development strategy. Joining the group of 7 smart communities in the world in 2022 is an opportunity for organizations in Binh Duong province to access new knowledge and visions, and learn new trends, advanced technologies, and innovative innovations for constructing and developing socio-economic. The smart city development strategy of Binh Duong province also includes the development of agricultural automation, typically large-scale livestock farming. A sustainable development urban will not be able to ignore the factor of providing food for urban and regional people. Therefore, in the coastal areas of Binh Duong province, there are many large-scale cattle and poultry farms that are being encouraged to apply automatic technology to all processes to increase output, control quality, reduce costs, and satisfy food supply in terms of quantity and quality for people inside and outside the province.

Ms. Cam Pham Thi Hong's pig farm is located in Dong Tam Hamlet, Tam Lap Commune, Phu Giao District, Binh Duong Province. With an area of nearly 13,000 square meters, established in 2011 with the scale of feeding 12,000 pigs per year. This is a large-scale livestock farm applying semi-automatic technology in the stages of mixing feed and bathing pigs. In the process of breeding, the farm partly affects the surrounding environment (InterConformity Assessment and Cefitication, 2016). In this study, we approach the farm as a place to research and learn about breeding processes, activities in different areas, and input and output material sources to initially find out the meaning of environmental aspects based on ISO 14001:2015 standard. Finding out the environmental aspects arising through activities in areas in the region contributes to helping farm owners have the most intuitive view of the impact on the environment from their farms. to raise actions to contribute to compliance with the Law on Environmental Protection of Vietnam and to build relationships with the communities around the farm. This study serves as a premise to help farm owners approach building an environmental system according to

international standards. The building of an environmental management system according to ISO 14001:2015 will contribute to helping farm owners improve their reputation, expand the domestic consumption market, and then export their products to foreign countries. The study also provides recommendations related to the application of modern technologies to effectively solve environmental related problems.

2. Methods

2.1. Data collection

Collecting general information about the farm such as: learning an overview of the history of the establishment of the farm, the farm arrangments, the activities in areas, the processes of activities, input materials, waste streams, and output products, etc., thereby having an overview of environmental aspects affecting water, soil, air, landscape, occupational accidents, and diseases, etc. of the farm.

2.1. Flow diagram (Phạm Thị Hồng Cẩm, 2020)

The research team selected the following 5 areas because these are the areas where the main activities of the pig farm take place. These areas will be the areas that generate the most environmental aspects on the farm. The selection of these sites is somewhat representative of the entire farm during the assessment and scoring process for important environmental aspects. Most of the important environmental aspects will appear here.

The study selected 5 areas on the farm Piglet import area; feed mixing area; pig farming area; warehouse area; wastewater storage area. We identify the input and output material sources in the selected areas above. All environmental aspects arising from activities or processes will be recorded and analyzed in depth.

- Piglet import area: This area has few activities, mainly importing pigs when they are young (the farm has no sows), and this area is also for exporting mature pigs. The area is connected to the parking lot, so it is convenient for large trucks to get in and out. Part of the area is forever covered with corrugated iron, a part is left open. The floor of the area is covered with cement for easy access and cleaning.

- Feed mixing area: This area contains mechanical equipment, the feed mixing is done semi-automatically. This is a covered area divided into 2 parts: the part for the equipment and machinery, the part for the staff to move the feed bags, cut the feed bags, and pour them into the machine hopper.

- Pig farming area: This area is covered with a roof, and equipped with lighting, heating, and cooling devices... Pigs are put into each cage in this area, 10-20 pigs each depending on the age and weight of the pigs. In this area, there is a feed trough system with an automatic feed pumping device, automatic pig bathing equipment, etc. This area is built half-closed, and half-open, but in the future, the farm will likely be fully enclosed and installed with refrigeration equipment.

- Warehouse area: This is a closed area, the warehouse is divided into areas for feed, nutritional medicine, medicine... This area is dry, clean, and managed according to the principle of first in, first out.

- Waste water storage area: This area is located at the end of the barn system, wastewater from the barn system will flow into this area, through septic tanks built according to regulations. This area has no roof and is at a lower elevation than the barn area.

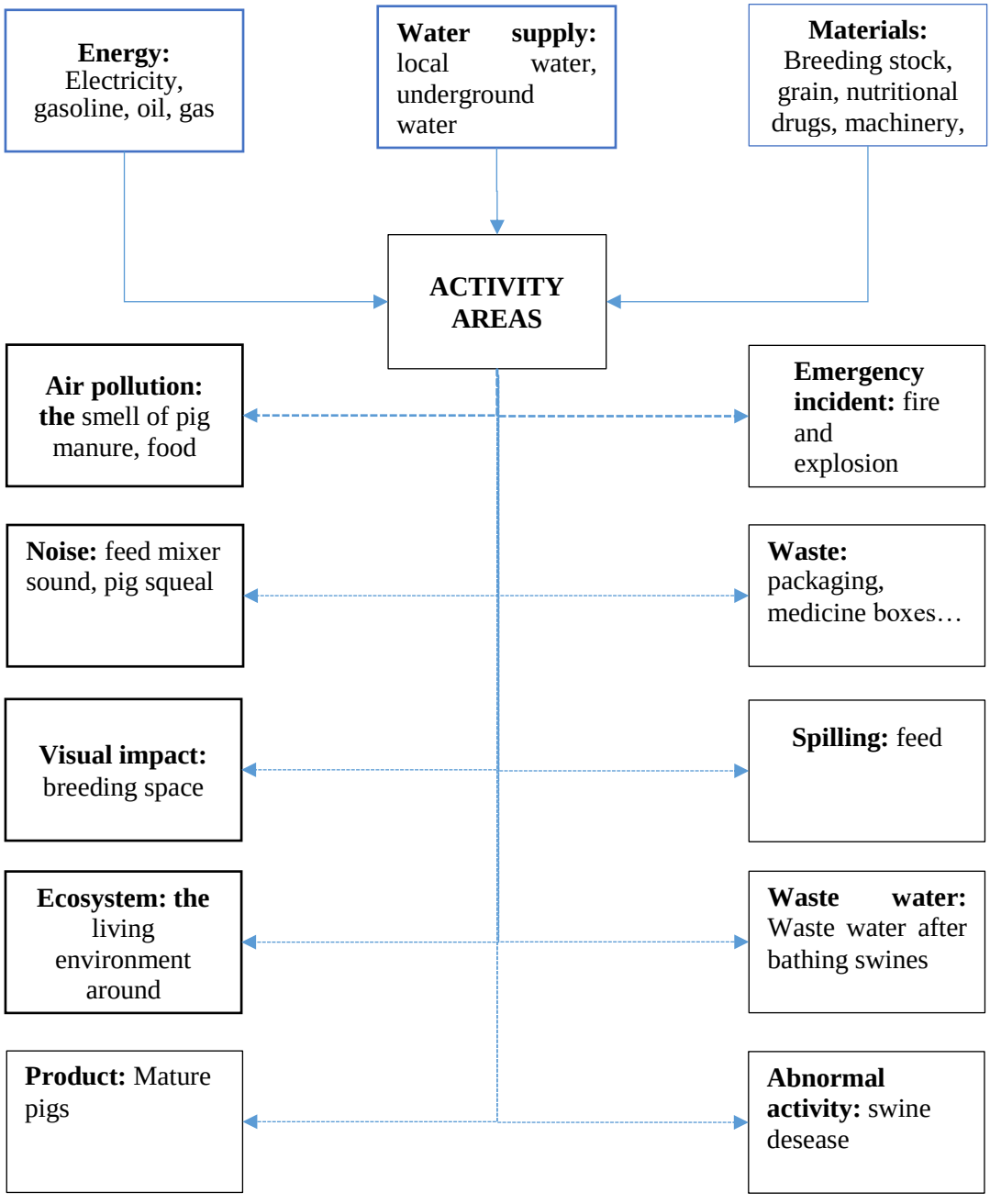

Figure 1. Flow diagram of input and output criteria of activity areas
Source: InterConformity Assessment and Certification, 2016

2.3. Multi-criteria **(**InterConformity Assessment and Cefitication, 2016)

- The multi-criteria method is a method used to determine the significant environmental aspects through the assessment and scoring of the environmental aspects. To determine the significant environmental aspects based on 2 criteria set forth by the assessment organization (see table 1), namely the frequency of occurrence and the severity of the incident. The basis for choosing these two criteria is based on scientific research on risk assessment standards (Lê Thị Hồng Trân, 2008) used by Assessment and Certification Organization InterConformity.

- Each criterion will have a scoring method depending on the level of environmental impact with a score from 10 to 30. From the total of the above 2 criteria, the average score will be taken, if the average score >= 60 is the environmental aspect. The significant field needs to be prioritized for remediation first, if the average score < 60 is the environmental aspect, the environmental aspect that has not been prioritized for immediate remediation will be remedied next time. The assigned mean score is not fixed but will shift with the number of significant environmental dimensions the study finds. According to the document of the InterConformity Assessment and Certification Organization (2016), a company that initially builds an environmental management system, if the number of environmental aspects is less than 10 meaningful aspects, the organization can meet the improvement of the environment. Such several meaningful aspects will not put too much pressure on the organization, encouraging the organization to take improving steps.

- Convention: Environmental aspects such as fire and explosion, occupational accidents, and food poisoning ... will be the significant environmental aspects that are prioritized to be limited and improved first and eliminated if possible. Therefore, as long as they get 30 points of the hazard level, they will also be listed as significant environmental aspects.

Formula = Frequency of occurrence X Severity of incident

TABLE 1. Scoring for 2 criteria

Criteria	**Score**
Frequency of occurrence: The number of times the environmental aspect occurs, the occurrence more or less will determine if the aspect is meaningful.	Low (10 points): May not appear or appear once per year or severals in several years. Medium (20 points): Occurs a few times in a month or a year. High (30 points): Appears weekly or daily.
The severity of the incident: How serious is the aspect of the surrounding objects?	Low (10 point): Only aesthetic impact, comfort. Average (20 points): Impact on water, air, soil quality… High (30 points): Unfavorable and harmful to humans, animal and plant populations...

Source: InterConformity Assessment and Certification, 2016

3. Results and discussion

3.1. Flow diagram of each area

The material flow diagram is determined in 5 areas as follows:

TABLE 2. Activities in the region

No	Area	Activity
1	Piglet import area	- Taking the piglets to the assembly yard - Taking the pigs down, weigh and numbered - Taking the pigs to the barn - Cleaning activities
2	Feed mixing area	- Putting the feed pakages in - Counting numbers and balance each type - Opening the pakages, pour into the machine - Starting the machine - mix the food - Feeding is pumped into the pipe system to each barn - Washing
3	Pig farming area	- Checking pig health - Injection - Weight pigs - Feeding (automatic) - Bathing pigs (automatic)
4	Warehouse area	- Importing goods (feed, medicine, necessary equipment) - Exporting - Inventory - Arranging & cleaning Warehouse
5	Waste water storage area	- Washing - Smell test - Periodic mud suction

(Source: Authors)

The material flow diagram in selected areas. The output of the flow diagram includes products and environmental aspects that have an impact on the environment.

TABLE 3. Environmental aspects of activities in 5 region

Area	Activity	Environmental aspects	Environmental impact
Piglet import area	Taking the piglets to the assembly yard Taking the pigs down, weigh and numbered Taking the pigs to the barn Cleaning activities	Consumption of electricity, water Leaking fuel oil Exhaust gas (dust) Noise Vibration Solid waste (Pig manure)	Resource Consumption Environmental pollution in water, soil, air Impact on employee health

Feed mixing area	Putting the feed pakages in Counting numbers and balance each type Opening the pakages, pour into the machine Starting the machine, mix the food Feeding is pumped into the pipe system to each barn Washing Cleaning	Consumption of electricity, water Engine oil consumption Solid waste Water shortage incident Power outage incident Flowing water Food spilled Food smell Food dust	Resource Consumption Pollution of soil, water, and air Impact on employee health
Pig farming area	Checking pig health Injection Weight pigs Feeding (automatic) Bathing pig (automatic) Washing barn (automatic)	Consumption of electricity, oil Noise (Pig call) Electric shock, fire and explosion Solid waste (scattered feed, pig manure)	Resource Consumption Pollution of soil, water and air Occupational accident (slip, pig bite)
Warehouse area	Importing goods (feed, medicine, necessary equipment) Exporting Inventory Arranging & cleaning Warehouse	Power consumption Paper consumption, stationery… Noise caused by porters, pulling feed Fire incidents Solid waste (perforated bags, scattered)	Resource Consumption Pollution of soil, water and air Occupational accident
Waste water storage area	Washing Smell test Periodic mud suction	Power consumption Consumption of water Lime pepper, deodorant chemicals... Water spill… Losing the beauty of the landscape	Resource Consumption Pollution of soil, water and air Occupational accident (slipping ...)

(Source: Authors)

Comment: According to the above list, the environmental aspects of each of the above areas will have a positive or negative impact on the environment. If the impacts are negative, they will deplete natural resources; cause environmental pollution of water, air, and soil; affect the health of workers. This environmental aspect will be further calculated to filter out the meaningful environmental aspects prioritized for remediation.

3.2. Evaluation of meaningful environmental aspects

Through activities in 5 areas, the study identified the environmental aspects of the Pig farm. The research team will conduct an assessment of each environmental aspect, to find the meaningful environmental aspects for concentrating on management, better control, mitigation of negative impacts, or avoiding causing negative impacts on the environment and people. To determine the environmental aspects, we used the multi-criteria method, the results obtained are as follows:

TABLE 4. The synthesis of significant environmental aspec

No	Significant environmental	Frequenc	Severity	Total	Related Areas
1	Hazardous waste	30	30	90	Piglet import area Feed mixing area Swine farming area Warehouse area Waste water storage area
2	Ordinary solid waste	30	20	60	Piglet import area Feed mixing area Swine farming area Warehouse area Waste water storage area
3	Noise	30	20	60	Piglet import area Feed mixing area Swine farming area Warehouse area Waste water storage area
4	Odor	30	30	90	Piglet import area Feed mixing area Pig farming area Warehouse area Waste water storage area
5	Dust	30	20	60	Piglet import area Feed mixing area Pig farming area Warehouse area Waste water storage area
6	Occupational accident	10	30	30	Piglet import area Feed mixing area Pig farming area Warehouse area Waste water storage area
7	Fire, explosion, short circuit	10	30	30	Piglet import area Feed mixing area Pig farming area Warehouse area Waste water storage area
8	Leaks, spills (water, food)	30	20	60	Piglet import area Feed mixing area Pig farming area Warehouse area Waste water storage area
9	Consumption of resources (electricity, water, food)	30	30	90	Piglet import area Feed mixing area Pig farming area Warehouse area Waste water storage area

(Source: Authors)

In the above table, there are 2 separate convention cases: For the environmental aspect of fire, explosion, short-circuit, or occupational accident, although the frequency with a score of 10 (not appearing, or rarely appearing), when it occurs, the level of risk is very high and dangerous. Therefore, with a score of 30, the aspect is classified as a significant environmental aspect that must be prioritized to be eliminated.

Through the summary table of significant environmental aspects, we see that there are 9 significant environmental aspects of the Pig farm including ordinary solid waste; noise; hazardous waste; odor; dust; occupational accidents, electrical short-circuit incidents, fire, and explosion; leak, spill; resource consumption. If there are no control and management measures, they will negatively affect the environment, and people and affect the stable operation of the farm.

4. Conclusion

The study found environmental aspects according to ISO 14001:2015 standard at the Pig Farm with 9 significant environmental aspects including ordinary solid waste; hazardous solid waste; food dust; noise; the smell of food, the smell of pigs, and the smell of feces; occupational accident; incidents of touching, short-circuiting, fire and explosion; spills, leaks of food, water, etc., consumption of electricity, water, and food resources. The study listed 9 significant environmental aspects and causes for the appearance of these aspects which help the pig farm monitor, track, and then come up with the most effective solutions based on the farm's resources.

Due to time constraints, there are several areas in the pig farm that have not been considered and calculated to create uniformity for the whole farm system such as the staff kitchen area, staff parking area, car disinfection spray area; employee accommodation, operator's quarters, burial pit, etc.

Although there are some limitations, the results obtained from our study could help the pig farm get the most comprehensive and detailed overview of environmental issues according to the ISO 14001:2015 standard. From there, they could have prepared for the implementation of corrective and preventive solutions. In the future, it is possible to completely build an environmental management system according to ISO 14001 standards, improve its reputation, and export finished products to other countries.

Recommendations on information technology application:

To improve the factors related to the environment as analyzed, one of the effective solutions is to use "Environmental monitoring and control devices when applying IoT and AI technology" installed on the farm to monitor the air environment in the barn to promptly detect abnormal signs; automatic temperature and humidity control; automatic water pump for cleaning cages; motion surveillance camera system to detect and warn of all farm intrusions and incidents to ensure security. The application of IoT and AI

technology helps control the temperature, humidity, and ventilation of the barn to remain stable within the allowable threshold, and to set the appropriate temperature and humidity to help the animals grow best. This control system also helps to display information on the website, from real-time values of temperature, humidity, NH3, H2S, and CO2 gas to help centralized management, and allows control of many houses at the same time. The system also sends out warnings about the failure of the fan and pump system when the equipment is broken, the engine has a problem, the engine is overloaded, etc. by lights, whistles, or via SMS, or email.

It can be said that a smart farm management system that applies IoT and AI technology helps to best control the environment of the barn based on accurate parameters measured from 24/7 online sensors. Thereby, minimizing risks from the impact of the environment: high temperature, low humidity, high concentration of NH3, H2S, and CO2. At the same time, integrating automatic control systems, remote controls, fans, lights, and sprinkler irrigation systems, saves operating labor costs and improves production efficiency. In addition, the product also integrates with AI cameras to monitor activities and security, and detect abnormal behavior. Moreover, the IoT device system with data obtained from various sources and external services provides actionable recommendations - warnings, including risk analysis, and safe environment protection for customers, people, and pets. The control system has a remote monitoring interface on the phone or computer, which is very convenient for users. Currently, this farm still has some limitations in terms of geographical location deep in the rubber forest, so the problem of voltage and power grid is not guaranteed, making it difficult to apply a fully automated system. However, this problem will be overcome in the future according to the infrastructure development of Binh Duong province in particular and Vietnam in general.

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