

PRECISION AGRICULTURE TRENDS IN 2025 AND PIG FARMING

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Abstract: *The year 2025 will bring about eight precision agriculture trends: Agricultural Robotics, Artificial Intelligence, Big Data & Analytics, Drones, Emission Reduction Technology, Internet of Things, Satellite Technology, and Variable Rate Technology. The authors have investigated the contents of these trends and identified those precision agriculture trends that could have a positive impact on pig farming provided strategic decision-making is improve due to innovation intelligence supported by data-driven research. This approach will allow farmers to meet the demands using cost-effective and efficient methods and gather real-time data on crop fields, thereby improving product quality and overall farm management.*

Key words: *precision agriculture, trends, 2025, pig farming.*

INTRODUCTION

Here are some key trends in precision agriculture for 2025 that are driving the future of agriculture towards greater efficiency, sustainability, and productivity [5,9,13,14]:

- Agricultural robotics: Deployment of robots for tasks like planting, weeding, and harvesting.
- Artificial Intelligence: AI-driven predictive analytics for crop management and decision-making.
- Big Data & Analytics: Leveraging big data to optimize farming practices and improve yields.
- Drones: Advanced drone technology for crop monitoring, spraying, and field analysis.
- Emission reduction technology: Innovations aimed at reducing the environmental impact of farming.
- Internet of Things: Increased use of IoT devices and sensors to monitor and manage farm conditions.
- Satellite technology: Enhanced satellite imagery and GPS tracking for real-time data collection and field mapping.
- Variable rate technology: Precision application of inputs like fertilizers and pesticides based on real-time data. [2,15,16]

MATERIALS AND METHODS

The material used in this paper consists in a corpus of articles (published between 2017 and 2023) on precision agriculture trends in 2025 and pig farming. The research method used is corpus analysis.

RESEARCH RESULTS

Here are some trends in precision pig farming for 2025, trends set to make pig farming more efficient, sustainable, and profitable:

Artificial intelligence (AI) impacts precision pig farming in several ways [2,6,15]: automated feeding optimizes feeding schedules and quantities based on individual pigs' nutritional needs, improving feed efficiency and reducing waste; behavioural analysis allows AI algorithms to analyse pigs' behaviour patterns to identify any anomalies that

could indicate health issues or environmental stressors; environmental control through AI systems that monitor and adjust environmental conditions (e.g., temperature and humidity) to ensure optimal living conditions for pigs; gait analysis through AI tools to detect lameness or other mobility issues, which can be addressed promptly to prevent further health complications; health monitoring through AI-driven systems that use cameras and sensors to monitor pigs' biometric data (e.g., behaviour, sounds) in real-time and detect early signs of illness or stress, allowing for timely intervention; predictive analytics through AI models that predict potential health problems by analysing historical data and current conditions, enabling proactive management of pig health.

Big Data & Analytics revolutionise precision pig farming by providing detailed insights and enabling data-driven decision-making [2,3,5,7]: disease management through identifying patterns in data, which allows farmers to detect and respond to disease outbreaks more effectively; efficiency improvements through data analytics, which optimise feed consumption, growth rates, and resource use, reducing waste and increasing profitability; individualized care through big data, which helps tailor care to each pig's specific needs, improving overall welfare and productivity; predictive analytics through machine learning algorithms, which analyse historical and real-time data to predict potential health issues, enabling proactive management; real-time monitoring through sensors and IoT devices, which collect continuous data on pigs' health, behaviour, and environmental conditions, allowing for immediate adjustments; sustainability through analytics, which help minimize environmental impact by optimizing resource use and reducing emissions;

Environmental monitoring involves using advanced technologies to continuously track and manage the farm environment, ensuring optimal conditions for pigs [2, 4]: air quality monitoring through sensors that detect levels of ammonia, dust, and other harmful gases, ensuring a healthy environment for pigs and workers; energy efficiency through tracking energy usage and identifying areas for improvement, reducing the farm's carbon footprint; temperature and humidity control through sensors that monitor and regulate temperature and humidity levels to keep pigs comfortable and reduce heat stress; waste management through monitoring waste levels and composition, helping to manage manure effectively and reduce environmental impact; water quality monitoring through regularly checking water quality to ensure pigs have access to clean drinking water, which is crucial for their health.

Health monitoring systems utilize advanced technologies to ensure the well-being of pigs [2]: acoustic sensors monitor the sounds made by pigs, helping to identify respiratory issues or other health problems based on changes in vocalizations; cameras and vision systems through high-resolution cameras that track pigs' activities and body conditions, using AI to analyse behaviour and detect abnormalities like lameness or changes in feeding patterns; data analytics through the collected data that are processed and analysed to provide actionable insights for farm management, helping to make informed decisions about health interventions and care practices; environmental sensors that track parameters like temperature, humidity, and air quality to ensure that the pigs' living conditions remain optimal; wearable devices that include sensors attached to pigs that monitor their vital signs, movement, and behaviour, providing real-time data to detect early signs of illness or stress.

Internet of Things transforms precision pig farming by enabling real-time monitoring and management of various farm parameters [6,7,8]: behavioural analysis through tracking pigs' behaviour that identify patterns that may indicate health issues or environmental stressors; biosecurity through tracking devices for farm staff and animals, which help manage movements within the farm, reducing the risk of disease spread;

environmental monitoring through sensors that continuously track temperature, humidity, and air quality, ensuring optimal living conditions for pigs; feed management through smart feeders that adjust feeding schedules and quantities based on individual pigs' needs, reducing waste and improving growth rates; health monitoring through wearable devices and sensors that monitor pigs' vital signs, such as heart rate and respiration, detecting early signs of illness or stress; resource optimization through data collected from IoT devices that help optimize the use of resources like water and energy, reducing costs and environmental impact.

Precision feeding tailors the nutritional needs of each pig to improve growth rates and minimize waste [3,10,11]: cost savings through minimizing waste and improving feed efficiency, which is one of the most significant expenses in pig farming; environmental benefits through reducing excess nutrient excretion, which helps lower the environmental impact of pig farming, including greenhouse gas emissions and nutrient runoff; health monitoring through continuous data collection, allowing for early detection of issues and adjustment of feeding regimes to address any problems; individualized diets through using data from sensors, allowing farmers to create customized feeding plans based on the specific needs of each pig, which ensures that each pig gets the right amount of nutrients at the right time; nutrient efficiency optimises the feed composition, thus reducing feed waste and improving feed conversion ratios, leading to better growth and weight gain; smart feeders dispense precise quantities of feed to each pig, adjusting in real-time based on the pig's growth and health data.

Robotics transform the industry by automating various tasks and improving efficiency [1]: automated feeding through robots that can dispense feed at precise times and quantities, ensuring each pig receives the right amount of nutrition; cleaning and sanitation through robotic systems that can clean pens and remove waste, maintaining a hygienic environment and reducing the risk of disease; data collection through robots that can collect data on pigs' growth, feed intake, and health, providing valuable insights for farm management; environmental control through automated systems that can adjust temperature, humidity, and ventilation to create optimal living conditions for pigs; health monitoring through robots equipped with sensors that can monitor pigs' vital signs and behaviour, detecting early signs of illness or stress.

Sustainability practices focus on reducing environmental impact while maintaining productivity and animal welfare [11,12,15]: environmental monitoring through continuous tracking of air and water quality that ensures a healthy environment for pigs and farm workers; health monitoring detects health issues through AI and sensors, which reduces the need for antibiotics and promotes overall animal welfare; manure management through advanced systems manage manure to minimize odours, reduce greenhouse gas emissions, and recycle nutrients as fertilizers; precision feeding tailors feed to individual pigs' needs, which reduces waste and nutrient excretion, lowering environmental impact; resource optimization through IoT devices and sensors to monitor and optimize water and energy use, reducing waste and costs; sustainable feed sources reduce reliance on traditional crops and improve sustainability through incorporating alternative feed ingredients like insects, algae, and by-products.

A comparison between the trends in precision agriculture for 2025 and the trends in precision pig farming for 2025 shows that:

They share only three trends: Artificial Intelligence, Big Data & Analytics, and Internet of Things;

Environmental monitoring, Health monitoring systems, Precision feeding, Robotics, and Sustainability practices are trends specific to the trends in precision pig farming for 2025;

Artificial Intelligence, Big Data & Analytics, and Precision feeding can make pig farming more efficient, sustainable, and humane;

Environmental monitoring can help create a healthier environment for pigs, improve their welfare, and enhance overall farm efficiency.

Health monitoring systems can help farmers catch health issues early, reduce the need for antibiotics, and improve overall pig welfare.

Internet of Things can collectively enhance the efficiency, sustainability, and welfare of pig farming.

Robotics can help improve animal welfare, reduce labour costs, and increase overall farm productivity.

Sustainability practices can help create a more sustainable and efficient pig farming system. [5]

CONCLUSIONS

Precision pig farming trends in 2025 are set to revolutionize the industry by integrating advanced technologies to enhance efficiency, sustainability, and animal welfare. Key trends include the use of IoT devices, AI-driven analytics, robotics, and big data to optimize every aspect of pig farming, from feeding and health monitoring to environmental control and resource management. These innovations promise to make pig farming more productive, cost-effective, and environmentally friendly, ensuring a sustainable future for the industry.

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