

Identification of Performance Indicators for Poultry Agribusiness Operations

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Abstract

Nowadays, the competitiveness of any organisations rests dominantly on how they can manage their performance. A host of performance variables such as quality, reliability, and efficiency are recognised as competitive priorities. This paper reviews the criteria and dimensions of performance measures, and discusses six core performance indicators in agribusiness operations with particular reference to the poultry/broiler farms. Besides, a holistic “Quality, Reliability and Efficiency” view of performance is proposed when developing measures for poultry agribusiness operations.

Key Words: Performance Indicators, Quality, Measures, Poultry Sector

1. Introduction

Progressive reductions in trade barriers and advances in technology have led to a rapidly expanding global marketplace in agriculture produces and products (AMI, 2006). The poultry industry has accounted for one of the largest segments in many agricultural economies and agriculture producing countries, like China, Thailand, Cambodia and Vietnam etc. The past decade has shown that great potential exists for the poultry products in the international trade arena. Nevertheless, poultry/broiler farms and operators are facing a lot of challenges such as market fluctuations, inefficient farm operations, poor farm infrastructure, strong competitors and insecure supply of food gains (Hosein and Pun, 2004; Manning *et al.*, 2007; Nijkamp and Vindigni, 2002).

Performance measurement (PM) is a process of quantifying the efficiency and effectiveness of actions that lead to performance in organisations. Traditionally, business organisations rely largely on financial measures and process outcomes using self-referenced objective data from internal sources (Kennerley and Neely, 2003; Welch and Mann, 2001). This has resulted in most measures focusing on return on investment, return on sales, price variances, sales per

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employee, productivity and profit per unit production. Although many PM frameworks and processes have been advocated (Hudson *et al.*, 2002; Kaplan and Norton, 2000; Neely *et al.*, 2002; Pun and White, 2005), there has been little research into identification of performance indicators for agribusiness operations particularly in small and medium-sized poultry/broiler farms and operators. In such context, this paper reviews the criteria and dimensions of performance measures, and relates them to the identification of performance indicators for poultry/broiler operations in agriculture producing countries. Besides, a holistic PM view of quality, reliability and efficiency is discussed.

2. Criteria and Dimensions of PM

Performance measurement is currently attracting a great deal of interest among both industry practitioners and academics alike (Bourne *et al.*, 2002). Neely *et al.* (2000) defined PM as a process of quantifying the efficiency and effectiveness of an action that leads to performance. This is the systematic assignment of a number of activities. Pun and White (2005) contend that PM is composed of various performance measures which are linked to performance management through the setting of goals, standards and targets for improving performance of an enterprise.

What gets measured will get attention, particularly when rewards are tied to the measures in organisations. In order to attain the measurement goals, White (1996) suggests that several basic questions must be answered, including 1) What will be measured; 2) How will it be measured? 3) Where will the data be obtained? 4) What type of data will be used? 5) How the data will be used in evaluating performance? and 6) Where and when does the measurement occur? Rolstadas (1998) contends that an organisation's performance would show a complex interrelationship among seven measurement criteria (see Figure 1). These are:

- *Effectiveness* involves doing the right things, at the right time, with the right quality. Defining the criteria as a ratio, effectiveness can be defined as actual output or expected output.
 - *Efficiency* is an input- and transformation process-question, defined as resource expected to be consumed/resources actually consumed.
 - *Productivity* is the traditional ratio of output/input.
 - *Profitability* represents the ultimate goal for an organisation.
 - *Quality* is an extremely wide concept, and could be measured at various checkpoints.
 - *Quality of work life* is an essential contribution to a well-performing system.
 - *Innovation* is a key element in sustaining and improving performance.
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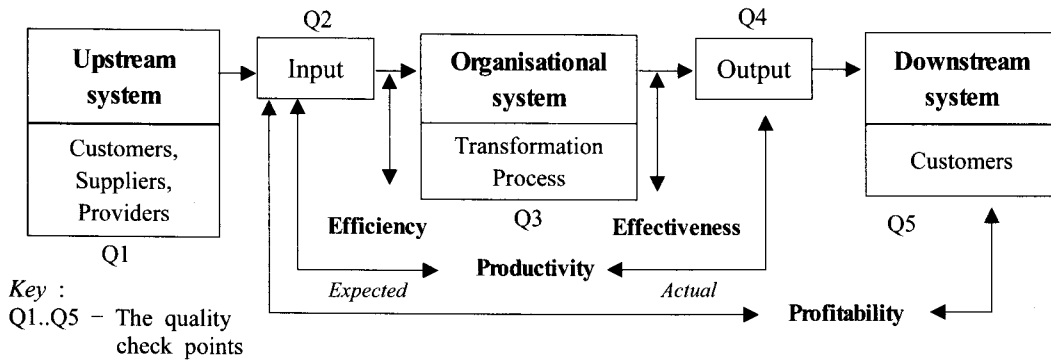


Figure 1. Operational definition of performance criteria

Source: Based on Rolstadas (1998, pp.991-992)

The dimensions of performance have caused a degree of replication in the literature (Hudson *et al.*, 2001). Time, quality and flexibility are commonly cited as the main operational dimensions that should be measured (Medori and Steeple, 2000). Neely *et al.* (2000) argued that quality, time, cost and flexibility are four main performance dimensions. Finance, in various different forms, is also considered to be a critical dimension of performance (Ghalayini and Noble, 1996). In addition, customer satisfaction and human resources are repeatedly cited as critical measurement areas (Kaplan and Norton, 2000). Hudson *et al.* (2001) argue that these dimensions should cover various aspects of business, such as financial results, operating performance (through the dimensions of time, quality and flexibility), the way a company is perceived externally (through its customers), and the cultural aspects of working environment

Table 1. Six dimensions of performance

Quality	Time	Flexibility	Finance	Customer Satisfaction	Human Resources
- Product performance	- Lead time	- Manufacturing effectiveness	- Cash flow	- Market share	- Employee relationships
- Delivery	- Delivery reliability	- Resource utilisation	- Market share	- Service	- Employee involvement
- Reliability	- Process throughput	- Volume flexibility	- Overhead cost reduction	- Integration with customers	- Workforce
- Waste	- Process time	- New product introduction	- Inventory performance	- Competitiveness	- Employee skills
- Dependability	- Process time	- Computer systems	- Cost control	- Innovation	- Learning
- Innovation	- Productivity	- Future growth	- Sales	- Delivery reliability	- Labour efficiency
	- Cycle time	- Product innovation	- Profitability		- Life
	- Delivery speed		- Efficiency		- Resource utilisation
	- Labour efficiency		- Product cost reduction		- Productivity
	- Resource utilisation				

Source: Abstracted from Hudson *et al.* (2001, pp.1102).

(through the human resource dimension). Table 1 shows the groupings of common performance dimensions as derived from the literature.

3. Determination of Performance Indicators

Performance indicators can be grouped under qualitative measures and quantitative measures. Quantitative measures (e.g. financial indicators and staff turnover) are easy to measure and manage on the one hand. They are primarily used in areas where inputs and outputs can be enumerated (Neely *et al.*, 2000). On the other hand, qualitative measures (e.g. quality, customer satisfaction, innovation, motivation, morale, leadership and customers' perception) are difficult to measure, and are often at different levels of aggregation (Bourne *et al.*, 2002).

Financial data have the advantage of being precise and objective, but they do not match entirely with the competencies and skills required by companies for the changing business environment (Najmi and Kehoe, 2001). However, many other indicators of business performance (such as quality, customer satisfaction, innovation and market share) that can always reflect an organisation's economic condition and growth prospects better than its reported earnings do (Kanji and Moura e Sá, 2002). Recent studies showed that financial indicators might not measure the performance of an organisation accurately and obscure the real problems (McAdam and Bailie, 2002). In order to counteract this problem, for instance, the activity-based costing procedure and throughput accounting were introduced to measure activity resource consumption (Welch and Mann, 2001).

The paradigm of non-financial measurement has spurred much interest (Neely, 1999). It is a need to split performance into two types of measurements with respect to business operations and business health, respectively. The first type is a function of quality, flexibility, resource utilisation, and innovation, whereas the second type is concerned with competitiveness and financial performance. Kaplan and Norton (2000) also introduced the balance scorecard addressing a balanced view of company's performance in four sets of variables, including financial, customer, internal business, and innovation and learning.

Moreover, the interest in business excellence has been fuelled with a range of national and regional awards such as the European Quality Award (EFQM, 2007) and the Malcolm Baldrige National Quality Award (NIST, 2007). These awards are being increasingly used by organisations as part of the business improvement process and strategic benchmarking. For instance, the European Quality Award employs two variable sets of enablers and results. The enabler variables are a function of leadership, people, policy and strategy, partnership and resources, and processes. The result variables are concerned with people, customer, society, and key performance (EFQM, 2007).

4. Measuring Performance in the Poultry Sector

The poultry industry typically consists of three main tiers with many complexities among 1) the supply of the raw materials, 2) the production and processing of poultry, and 3) the distribution and consumption of poultry (see Figure 2). The industry has two main products: firstly, meat from broiler chickens and secondly, eggs from layers. The poultry industry is not diverse in that the birds reared are mostly broilers at the commercial scale. The main source of income from the industry is derived through the growing and processing of broilers. The growing and the processing of broilers are usually the two main stages of production processes (Hosein and Pun, 2004; Manning *et al.* 2006). Figure 3 shows the operations flow of a typical poultry supply chain. At the intermediary level of the supply chain (i.e. the broiler farm level), quasi-market forces always exist where seasonal fluctuations in prices and demands occur in the industry (Manning *et al.* 2007).

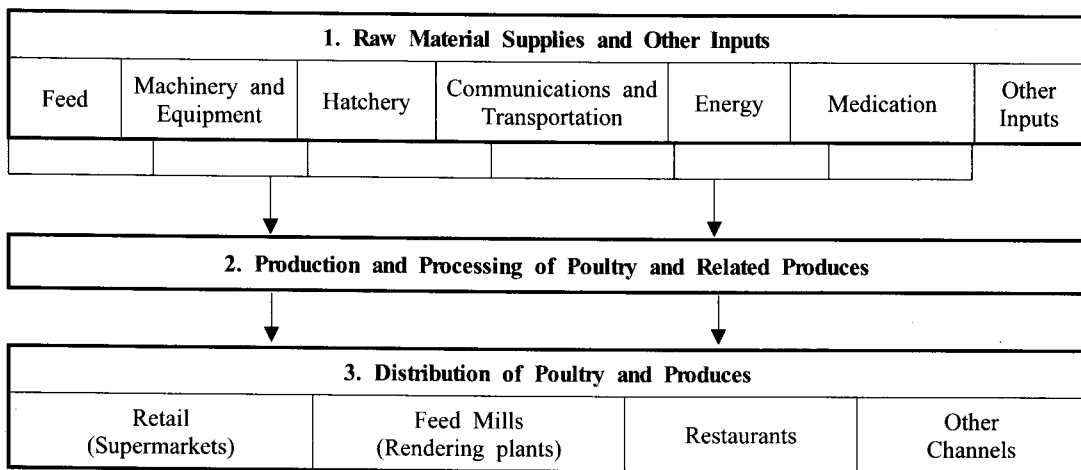


Figure 2. Three tiers of poultry/broiler operations

Source: Abstracted from Hosein and Pun (2004, pp.46)

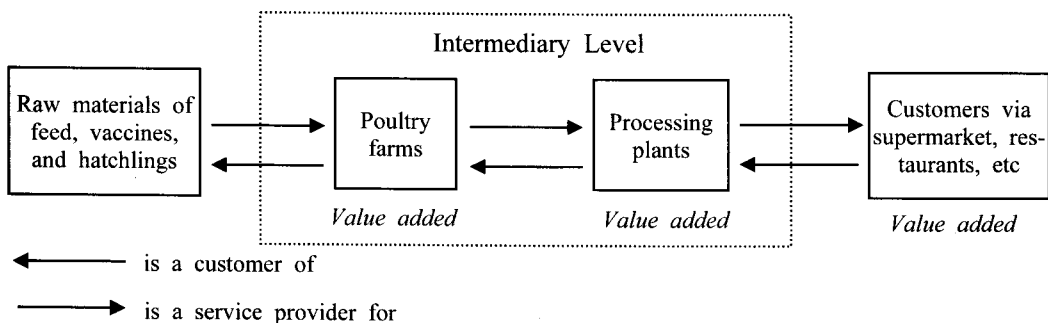


Figure 3. A typical poultry supply chain

Table 2. Performance indicators used for poultry/broiler farm operations

Measures	Focal Areas	Sources of Performance Data	Examples of Performance Variables
Finance <i>(Financial status)</i>	1. Quality	1. Auditing reports and Certification	1. Auditing reports; Certificates from accountants.
	2. Reliability	2. Annual and Monthly Financial Reports	2. Measurement of ROI, ROS, ROCE; Net profit percentage; Gross profit percentage; Sales revenue; Profit per cash flow; Gross and net operating profit; Debt to asset ratio; Surpluses.
	3. Efficiency (Profitability)	3. Business Reports	3. Profit per employee; Unit labour cost; Cost effectiveness index; Restoration costs; maintenance and replacement costs; Volume of sales; Cost in use; Stock/debtor days.
Production/ Operations	1. Production Efficiency	1a. Production Reports	1a. Measured variation in quality of broilers using sampling weights; Number of healthy broilers versus crippled broilers; Feed conversion of broilers; number of mortality; Hatchling plus feed costs; Percentage capacity of pen used; Overhead cost reduction; and Percentage broiler survival.
		1b. Quality Reports	1b. Recording diseases outbreaks; Vaccination times; Breeding lines; Temperature and humidity of pens.
	2. Inventory Efficiency	2. Production Reports	2. Demand percentage satisfied from stock; Inventory reordering times; Inventory turnover of equipment; Inventory levels; On-time delivery of products.
	3. Orders Efficiency	3. Production Reports	3. Meeting production schedules; Production schedule accuracy; Sales per period.
Customer Satisfaction <i>(from service providers to input suppliers)</i>	1. Feed Quality	1. Feed Nutrient Certificates	1. Labelling on feed bags; Company's certificates.
	2. Vaccines Quality	2. Vaccine certification	2. Labelling on vaccine; Observation of sealed packages.
	3. Hatchlings Quality	3. Hatchling Certification	3. Certificates of breeding lines; Certificates of vaccination.
Customer satisfaction <i>(from farms to customers)</i>	1. Processors Quality	1. Broiler Certification	1. Certificates of broiler health by providing list of vaccinations taken; Number of diseases incurred; Quantity of feed eaten; Life of broiler; Breeding lines.
	2. Service Quality/ Satisfaction	2a. Order Processing Reports 2b. Customer Satisfaction Reports	2a. Measurement of order processing time; and Time taken for response. 2b. Measurement of rate of repeat business; Increase in number of customers; Gap analysis of expected versus perceived service; Quality and appearance from business by the customers.
Human Resource	1. Daily-paid/ Semi-Skilled Labourers -Efficiency	1a. Production Reports	1a. Measurement of labour costs; Manpower utilisation during the day; Overtime; absenteeism; Number of multi-skilled daily labourers; Number of days work per month; number of daily paid labourers; Scheduling of labour.
		1b. Quality Reports	1b. Observation of level of effort; Teamwork; Entrepreneurship.

<p>Human Resources <i>(continued)</i></p>	<p>2. Monthly paid Labourers/ Supervisors - Efficiency</p>	<p>2a. Production Reports 2b. Production Reports</p>	<p>2a. Measurement of labour costs; Manpower utilisation during the day; Use of overtime; absenteeism; Number of multi-skilled monthly labourers; Number of days worked per month; Number of labourers supervised. 2b. Observation of level of effort; Teamwork; Entrepreneurship; Perceived employment satisfaction.</p>
<p>Building</p>	<p>1. Pen Structure Quality</p>	<p>1. Code Compliance Certificate</p>	<p>1. Measuring wire mesh size used; Ventilation; Number of misters; Number of waterers to chicks, Number of feeding trays/chicks; Feet of troughs to chickens; Numbers of fans, chicks, Lights per square feet.</p>
	<p>2. Pen Structure Reliability</p>	<p>2. Maintenance Reports</p>	<p>2. Measurement of frequency of repairs to structure; Age at which repairs occur; Number of chicks lost due to openings in building; Frequency of complete replacements; Manpower hours and cost required for structure maintenance; Structure maintenance cost/profit ratio.</p>
	<p>3. Pen Structure Efficiency</p>	<p>3. Production Reports</p>	<p>3. Measuring space utility by equipment and chickens; Electrical energy usage efficiency per pen; Water usage per pen.</p>
<p>Equipment and Maintenance</p>	<p>1a. Feed Silos Quality</p>	<p>1a. Certification</p>	<p>1a. Manufacturer specifications of silos, time bought, used or new equipment, and capacity; Expected silo dispensing rate; Expected lifetime; Electricity usage; and Cost of equipment.</p>
	<p>1b. Feed Silos Reliability</p>	<p>1b. Maintenance Reports</p>	<p>1b. Frequency of checkups; Actual silo dispensing rate; Frequency of repairs; Cost per repair; Manpower hours required for repair; Number of repairs done.</p>
	<p>2a. Feed Bins Dispensers Quality</p>	<p>2a. Certification</p>	<p>2a. Manufacturers specification of feed bins, time bought, used or new equipment, and capacity; Expected feed dispensing rate; Expected lifetime; Electricity usage; Cost of equipment.</p>
	<p>2b. Feed Bins Dispensers Reliability</p>	<p>2b. Maintenance Reports</p>	<p>2b. Frequency of checkups; Actual feed bin dispensing rate; Frequency of repairs; Cost per repair; Manpower hours required for repair; Number of repairs done; Number of chickens lost due to equipment maintenance security.</p>
<p>Equipment and Maintenance <i>(continued)</i></p>	<p>3a. Feed Troughs Quality 3b. Feed Troughs Reliability</p>	<p>3a. Certification 3b. Maintenance Reports</p>	<p>3a. Manufacturers specifications of troughs, width and depth of troughs; and Cost of equipment. 3b. Time taken for troughs to be filled; Frequency of checkups; Frequency of repairs; Cost per repair; manpower hours required for repair; Number of repairs done; Number of chickens injured or lost due to equipment maintenance security; Number of feet length replaced; Frequency of trough replacement.</p>

	4a. Feed Trays Quality 4b. Feed Trays Reliability	4a. Certification 4b. Maintenance Reports	4a. Manufacturer labelling, capacity, strength, and expected life time; Cost of equipment. 4b. Time taken for troughs to be filled; Manpower required for filling trays; Frequency of checkups; Frequency of repairs; Cost per repair; Manpower hours required for repair; Number of repairs done; Number of chickens injured due to equipment maintenance security; Number of trays replaced; Frequency of trays replacement.
	5a. Waterers Quality 5b. Waterers Reliability	5a. Certification 5b. Maintenance Reports	5a. Manufacturer labelling, capacity, strength, and expected lifetime; Cost of equipment. 5b. Time taken for waterers to be filled; Manpower required; Frequency of checkups; Frequency of repairs; Cost per repair; Manpower hours required for repair; Number of repairs done; number of chickens injured due to equipment maintenance security; Number and frequency of waterers replacement; Electricity usage; Water used by waterers.
Equipment and Maintenance <i>(continued)</i>	6a. Fans Quality 6b. Fans Reliability	6a. Certification 6b. Maintenance Reports	6a. Manufacturers specification of fans, time bought, used or new equipment, and fan speed; Expected square feet usage; Expected lifetime; Electricity usage; Cost of fans. 6b. Frequency of checkups; Actual fan speed; Frequency of repairs; Cost per repair; Manpower hours required for repair; Number of repairs done; Number of chickens lost due to equipment maintenance security.
	7a. Misters Quality 7b. Misters Reliability	7a. Certification 7b. Maintenance Reports	7a. Manufacturer labeling; Capacity per square feet; expected lifetime; and Cost of equipment. 7b. Frequency of checkups; Frequency of repairs; Cost per repair; Manpower hours required for repair, Number of repairs done; Number of chickens injured due to equipment maintenance security; Number of misters replaced; Frequency of misters replacement; Electricity usage used by misters; Water used by misters.

According to White (1996), performance measures can be classified with respect to the competitive capability being measured, data source (i.e. internal and external), data type (i.e. objective and subjective), reference (i.e. benchmark and self-referenced), and process orientation (i.e. input and outcome). The performance indicators can be grouped into quantitative means (e.g. use of indices, by frequency, average and/or totals) and qualitative (e.g. use of Likert scale, charting, and/or by means of subjective observation). There are six common performance indicators identi-

fied for the poultry/boiler farm operations, namely 1) finance, 2) production and operations, 3) customer satisfaction, 4) human resources, 5) innovation, and 6) building and equipment. Table 2 shows the focal areas of these indicators, the sources of performance data and the examples of performance variables that are incorporated into the poultry/broiler farm operations.

First of all, *finance* is the largest group of quantitative measures, and ratios are the common measure of the financial performance status of poultry/boiler farms (Manning *et al.*, 2007). Secondly, *production/operations* indicators are derived mainly from enterprise resource planning systems that cover the areas of production, inventory and shipping in the poultry sector. Thirdly, *customer satisfaction* rests largely on a qualitative set of indicators that address the achievements of productivity, service quality, and levels (Manning *et al.*, 2006). The fourth indicator is concerned with *Human resources*. Many poultry/boiler farms use quantitative measures in overall employee productivity. Besides, qualitative indicators are used to measure employee satisfaction and work performance in the areas of leadership, teamwork and communication (Dufficy, 1998).

Innovation performance is the fifth indicator. For instance, innovation in marketing, research and development would rely largely on a number of financial measures. Customer requirements, culture and organisational environment would also affect the innovation performance of poultry/boiler farms (Manning *et al.*, 2007; Prajogo and Sohal, 2003). The sixth performance indicator is concerned with *building and equipments*. Productivity and satisfaction are the two main performance measures for this indicator. The building productivity would be measured using various performance indices whilst the measures for building satisfaction are of subjective observation. The determination of equipment productivity and maintenance performance would rely significantly on quantitative measures (Chan *et al.*, 2001).

5. Discussion

There are a host of performance variables that determine the competitive priorities of poultry/ boiler farms. Among these variables, *quality* is the attainment of the excellence state of the product/system. *Reliability* refers to meeting or exceeding the expected benchmark or level, while *efficiency* examines how well inputs are converted into outputs. In other words, performance could be holistically expressed as a function of quality, reliability, and efficiency.

Both financial and non-financial indicators (such as operations, customer satisfaction, productivity, and innovation, etc.) are of equal importance to obtain an objective measure of organisational performance. However, many performance measures presently in the sector focus on process outcomes using self-referenced objective data from internal sources. Organisations would have both subjective and objective measures from external data sources. They would also consider looking at the process input measures and/or focus on the use of benchmark

measures (White, 1996). Poultry/boiler farms and operators (including farmers, farm operators, contracting firms, and processor firms) should stress a holistic measurement in the focal areas rather than solely on financial indicators (Bourne *et al.*, 2002; Rolstadas, 1998).

The source of performance data would be derived from reports of the individual sub-systems, and each variable set evaluates performance. Both financial and non-financial indicators would be used to determine the quality, reliability and efficiency of the business. Customer satisfaction would be split into two categories; one from service providers and another from farm customers. The performance indicators should be validated for their contributions to the performance value. These would be coalesced to determine the effectiveness of the measures and ensure that various perspectives are to be investigated.

6. Conclusion

Like other business organisations, poultry/boiler farms would measure their performance systematically and thoroughly, or on an *ad hoc* basis. This attracts much cynicism over why, how and when performance measures are used (Kennerley and Neely, 2002). Performance measures must concentrate on the indicators that are meaningful, that is, on the key areas that determine organisational success or failure. They must go beyond the presentation of financial figures, and stress the competencies and core processes of poultry operations. Quality, reliability and efficiency are not prescriptive. Instead, adopting these performance variables would encourage a holistic view when developing measures to support organisational strategy and operations.

Poultry/boiler farms and operators need to assess performance from a wider stakeholders' perspective (such as customers, suppliers, employees, the government, and the public). They should select, develop and use various performance indicators according to their relevancy to operational needs. A major question for management is how these indicators support the key functions and processes of the agribusiness operations. These indicators must offer insight into how organisations are performing the tasks and to what extent their objectives are realised. By measuring the right quantities and attributes, poultry/boiler farms and operators could identify where to improve and how the limited resources could be used for performance improvement.

This paper reviews the criteria and dimensions of performance measures, and determines the six performance indicators and three performance variables (such as quality, reliability, and efficiency) for poultry/boiler farm operations. Further research could test empirically the holistic measurement of performance in various focal areas, and to verify these indicators and variables as viable performance drivers for poultry/boiler farms. Comparative evaluations of PM practices could be performed across various tiers of poultry operations and the supply chain.

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