

Sustaining Performance Improvement in the Poultry Industry in Trinidad and Tobago: A Decision Support Paradigm

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The poultry industry is presently one of the largest contributors to the agribusiness incomes in Trinidad and Tobago. Facing a lot of challenges within the country and from outside, there is a pressing need for industry practitioners and operators to attain performance goals and competitiveness. After a brief digest of current operations and challenges in the poultry sector of the country, this paper presents a decision support paradigm for aiding practitioners and operators in decision-making and managing their operations and performance. A prototype decision support system in broiler management is introduced, and a module in farm operations is described to illustrate how the paradigm helps practitioners and operators to manage their operations and attain sustainable performance improvement.

1. Introduction

The Republic of Trinidad and Tobago is a small developing state in the Caribbean and is currently facing a food security predicament [1]. Since the 1980s, the standard of living has been improving and need for food has been increasing. Despite having no substantial increase in world food prices, Trinidad and Tobago's import food bill increased greatly since the signing of Uruguay Round Agreement on Agriculture in 1994. Recent statistics showed that the country imports over 70% of its staple foods including wheat, maize, potatoes, rice and barley. In addition, rice and pork imports have increased because of a 20% drop in local production [1]. A secure staple, animal and plant protein source is thus critical for Trinidad and Tobago to guarantee its population security in nutrition and health.

Poultry meat is now able to meet the local market demands and becomes one of the main sources of animal protein in the country [2,3]. Although the poultry production is more efficient than other livestock production in terms of feed conversion [4], the poultry

sector has been encountering a lot of difficulties within the country and from outside (e.g., market fluctuations, inefficient farm operations, poor farm infrastructure, strong competitors and insecure supply of feed grains). In order to seek ways to strengthen industry competitiveness, this paper presents a decision support paradigm deriving for sustaining performance improvement in the poultry sector in Trinidad and Tobago.

2. The Poultry Industry and Its Operations in Trinidad and Tobago

In Trinidad and Tobago, the poultry industry has made important contributions to the agricultural Gross Domestic Product (GDP) from about 17% in 1996 to 20% in 2000 [5]. This steady increase is reflected in a substantial growth of the number of broiler farmers in the country, from 169 in 1995 to 285 in 2001, with a 100% increase in small farms operations, 56% in medium farms operations and 80% in large farms operations. According to the classifications of the Central Statistical Office (CSO) in Trinidad and

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Tobago, small farms are those with size less than 10,000 ft², medium farms with size between 10,000 and 50,000 ft². Large farms are those greater than 50,000 ft². The breeding capacity of farms is approximately 1 ft per broiler irrespective of their size [6].

In 2000, the poultry industry employed some 15,000 workers in Trinidad and Tobago [7]. The industry 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 1**).

2.1 Supply of Raw Materials

The raw materials required for the industry are of three (3) basic types, namely:-

- a) Feed
- b) Hatchlings or chicks, and
- c) Veterinary supplies.

Feed is made from imported staples, such as soybeans and maize, at feed mills within the country. The feed mixture or nutrient values vary depending on the age of chick and are termed as starter, grower and finisher. Hatchlings or chicks are obtained via two channels. Broiler eggs may be imported or obtained from local breeder farms from whence they are transported to the local hatcheries. Veterinary supplies and equipment are supplied from foreign markets.

2.2 Production of Poultry Products

The poultry 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, with a few backyard operations which rear ducks, turkeys and geese. The main source of income from the poultry industry is derived through the growing and processing of broilers. Each farmer usually has three 'grow-out' seasons in a year, lasting usually for a period of 6 - 10 weeks.

The growing and the processing of broilers are the two main stages of production processes in Trinidad and Tobago. During the period of 1997 - 2000, contractual farming accounted for almost 91% of the production of broilers. Under contractual farming, there is a pre-order of chickens by poultry-contracting firms, usually at a pre-determined price. Through contractual

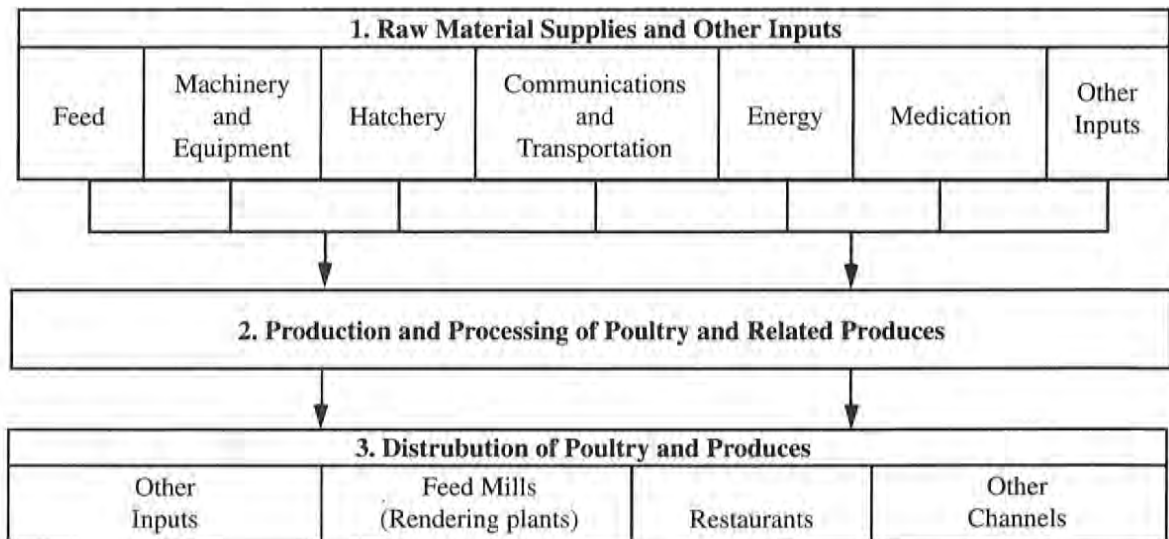


FIGURE 1: Three Tiers of Poultry Broiler Operations

farming, it is the duty of the poultry-contracting firms to provide hatchlings for the farms, feed and medication as well as technical advice [3]. These expenses are automatically taken out before the contracted farm operators get their pays. On the other hand, non-contractual farmers (i.e., some 9%) will sell their product on the open market.

In both contractual and non-contractual farming, day-old vaccinated and debeaked chicks are transported from the hatcheries and placed on the farms. The farms consist of a series of pens usually made from galvanized wire that allows natural ventilation. The floor is littered with bagasse or sawdust. Farm operators would provide regular feedings, adequate water and appropriate vaccinations and medicines for chicks on an average period of 7.5 - 8 weeks. During the grow-out period, public officers and ones hired by the contractor will visit the farms to inspect, provide advice and collect data. At the end of the grow-out period, the chicks usually weigh on average about 2.0 kilograms (kg) live weight with approximately 90% of the chickens surviving [3]. At the end of sales, pens will be cleaned and the poultry litter manure is either dumped or sold to local vegetable farmers.

2.3 Distribution of Poultry Products

After the grow-out period, contractual farmers are obligated to sell their chickens to the poultry-contracting firms who then resell to large processing firms. The processing firms account for some 43% of the processed chicken (including chilled or frozen whole chicken or parts) [3]. The whole chicken and parts reach the consumer mainly via the processor firms to large supermarkets, restaurants and fast-food chains and some may be via pluck shops and pluck-processor shops to localised groceries and small restaurants.

The remains from the large processing plants are normally sold to rendering plants and converted into feed and dog food. The majority of the remains from the processing plants and pluck shops are dumped. The non-contractual farmers and a small portion of the contractual farms channel their products through pluck shops and pluck-processing shops in which chicken may be plucked, eviscerated and chopped into parts and packaged. These shops cater specifically for consumers who prefer freshly killed whole chicken.

3. Challenges in the Poultry Industry

Harry [4] argues that industry practitioners (including farmers, farm operators, contracting firms and processor firms) in the poultry industry have been facing several challenges. These are:-

- 1) Fluctuations in the market demand with sometimes gluts and shortages,
- 2) The inefficiency of broiler breeder farms,
- 3) Poor record-keeping of farmers that hampers effective decision-making,
- 4) Mistrust between poultry-contracting firms and contract farmers,
- 5) Lack of adequate extension and advisory services, and
- 6) Poor infrastructure of farms.

Besides, there are also logistic problems associated with the distribution of feed, chicks to and from farms and processed meat to supermarkets. It is thus essential for the internal operations of the industry to be efficient and be able to place marketing data to the planners, with proper accounting procedures that facilitate the certification and establishment of standards.

In a recent Caribbean Community (CARICOM) meeting, a motion was moved to classify the poultry industry as a sensitive industry as it faces fierce competition from imported meats of USA, particularly chicken parts [2]. Presently, US chicken can land in the Trinidad and Tobago's local markets at about US\$0.61 per kg, while processed prices of local chicken may vary from US\$1.50 to US\$2.00 per kg. Trinidad and Tobago has applied 40% tariff rates on all imported whole chicken in 2001 [2]. Nevertheless, evidence shows that the poultry industry is far from being a secure food source since the raw materials needed for the production are mainly from foreign sources. The USA has targeted the Caribbean poultry feed markets for increasing soybean exportation by 2004 [8].

In order to secure poultry as one of the main meat sources, Trinidad and Tobago has to lower costs of production at all tiers of the poultry industry before

the markets are opened up with no more applied tariffs. The country should seek to:

- (a) Locate alternative sources for cheaper raw materials feed, and
- (b) Establish alternative reliable sources, for instance, to explore the option of converting the abandoned sugar lands for producing feed grains. These lands can possibly intercrop grains such as maize, soybean and upland rice. Alternatively, the government may consider:
 - a) Paying for partial feed costs to poultry farms which are willing to plant grain for feed purposes, and
 - b) Investing into intensive grain programmes for feed by cooperating with other larger CARICOM neighbours (e.g., Guyana).

When the markets open up, an industry can survive by using a high standard with which other competitors cannot meet. In the food industry, the sanitary and phytosanitary standards (SPS) and hazard analysis critical control points (HACCP) are essentially technical barriers to trade. Therefore, the government and policy personnel should take the initiative to introduce (or draft up) these standards and specifications and promote them to the industry. Besides, information regarding industry and market needs, quality assurance checks, customer preferentiality and proper labelling and traceability of the products should be included. High standards of food quality and hygiene should be assured with implementing proper SPS, HACCP and equivalent requirements. This could offer an opportunity for Trinidad and Tobago's practitioners to enter the CARICOM's poultry markets and to export the poultry products that meet the needs in the USA.

4. A Proposed Decision Support Paradigm

Facing the recent challenges and problems on poultry production and distribution, industry practitioners and operators in Trinidad and Tobago have to ensure integrity in their operations and acquire reliable

information for forecast demands to attain sustainable performance. It is envisioned that using decision support systems (DSS) can help industry practitioners with access to processed information for making production decisions and thus conquering many industry-wide challenges.

4.1 DSS in Poultry Applications

A decision support system (DSS) is a computer-based information system that combines models and data in an attempt to solve non-structured problems with extensive user involvement through a friendly interface [9,10]. It is composed of four (4) main components, namely:

- 1) A database management system,
- 2) A model management subsystem,
- 3) A knowledge-based management subsystem, and
- 4) A user interface subsystem.

These components can be standalone modules integrated by users to make better decisions (see **Figure 2**). The DSS tool has been widely used in market-planning and research, operations and strategic planning and sales support [9]. In particular, many DSS have been developed and used in the livestock and agriculture applications such as, AUSPIG in Australia [11], Stockpol in New Zealand [12] and the Poultry Management Tool Series in USA [13].

The decision-making process normally involves three (3) phases – intelligence, design and choice. In the intelligence phase, decision-makers would acquire knowledge to determine which opportunities to exploit and which problems to solve. They would decide the approach by considering a set of alternatives in the design phase, whereas they would choose the best feasible alternative(s) that best meet some predetermined requirements in the choice phase [9]. A DSS provides information needed to solve particular problems in a specific managerial context [9,10]. It does not make the decision but helps users to decide throughout the decision-making process.

Derived from literature review ([11-14]), a list of decision variables, uncontrollable variables or

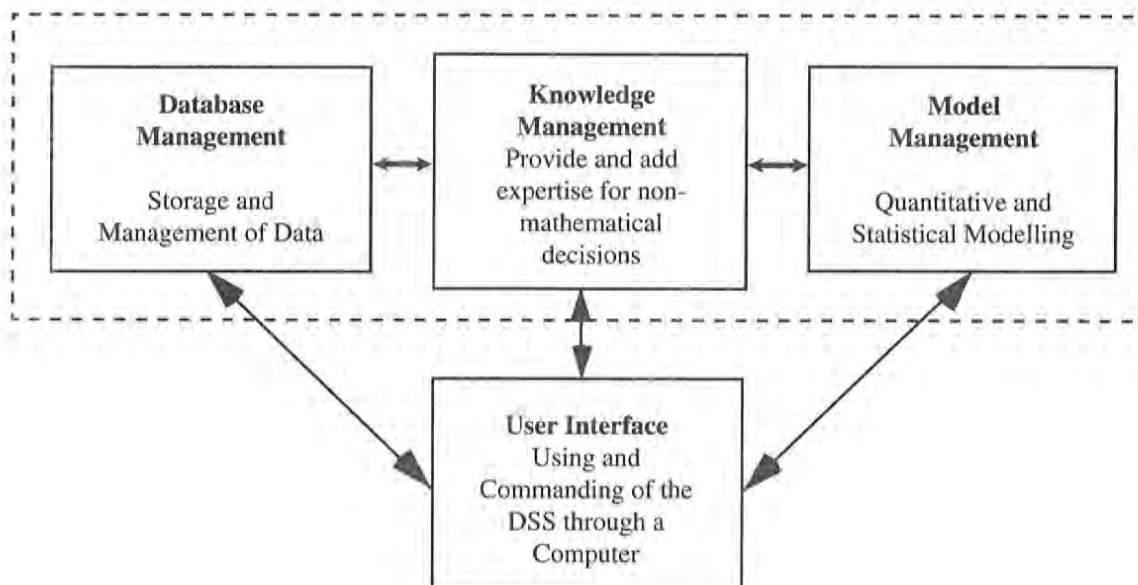


FIGURE 2: Four DSS Sub-Systems

parameters and result variables of the development of a DSS is given in **Figure 3**. A DSS in poultry applications would be made up of several modules with respect to the user requirements on system development. Practitioners and operators could use these modules individually and collectively for strategic planning and operational decision-making. In the case of poultry operations and production, typical DSS modules and their data requirement include, for instance:

▶ **Farm Operations**

Data collected by farmers (e.g., deaths per day on each pen, vaccination times, inventory of feed and vaccines for each pen) could be stored in a computerised system. Farm operators could monitor any disparities found in their pens on the farms and track flock data from various sources and nature (e.g., mortality rates, schedule activities, resources, budget and account for activities).

▶ **Distribution/Logistics**

Data regarding farm locations and their distances from feed mills, hatcheries and processing plants could facilitate the distribution of materials on time at a lower feasible cost. These are dependent on ordering data provided by farmers and processors. In the case of the feed mills, hatcheries and processing plants, the number

and capacity of distribution vehicles for each stage should be known.

▶ **Market Intelligence**

Data collected from farm operators have to be disseminated as rapidly as possible to get maximum benefits from them. To strengthen the capabilities of market intelligence, data should be collected online and allow practitioners and farmers to update their daily records and exchange information from processors.

4.2 Development of the Paradigm

The development and adoption of DSS could aid practitioners, operators and other users on making decisions for poultry operations. These systems could provide users an environment for decision-making and suggest an option or a mixture of options in the decision-making process using such aiding tools and techniques as decision tree, linear programming and analytical hierarchy process. These tools are employed depending on the user's approach to make decisions.

A diagrammatic representation of a decision support paradigm is given in **Figure 4**. The paradigm allows industry practitioners and operators to plan their management strategies and provides a mechanism to help them check periodically the integrity of their data systems [15]. This strengthens the market intelligence capabilities by acquiring updated information, for

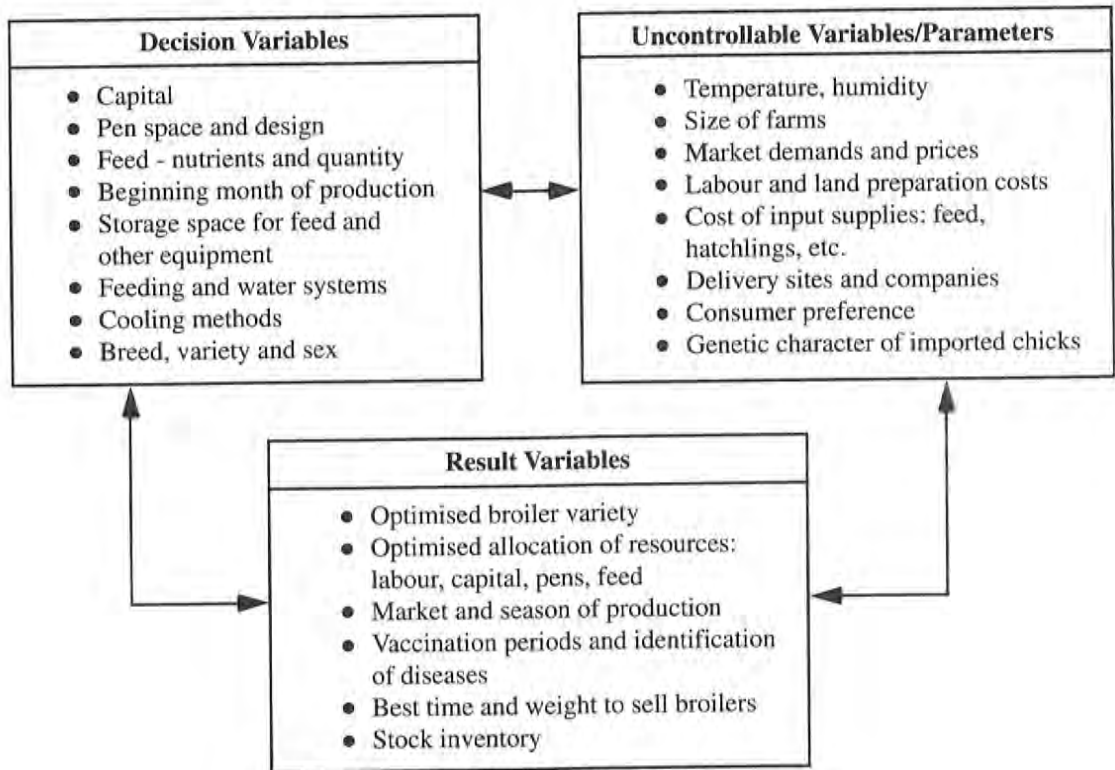


FIGURE 3: Variables and Parameters for DSS Development

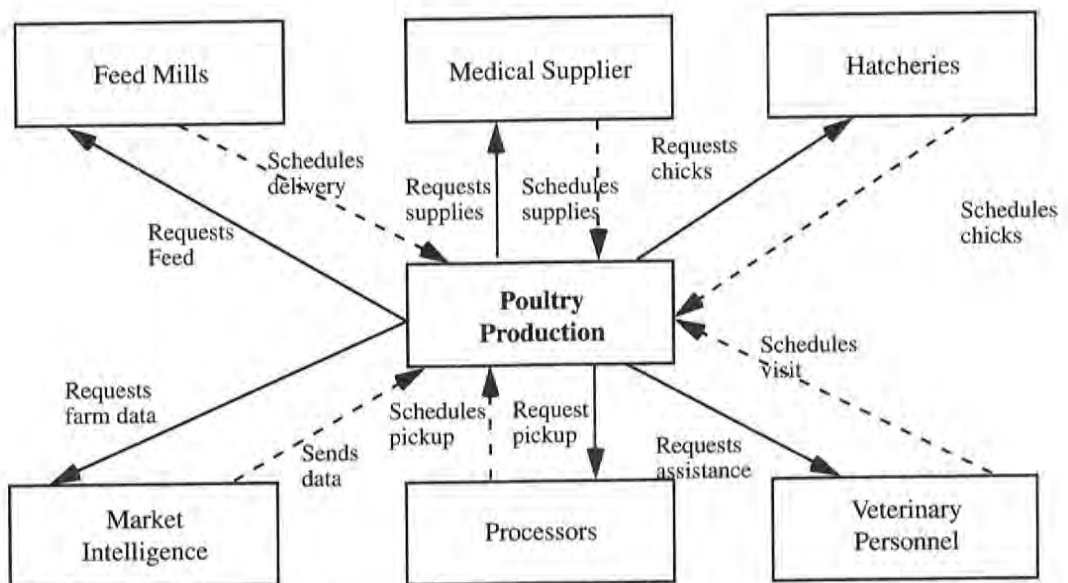


FIGURE 4: A Decision Support Paradigm for Poultry Production

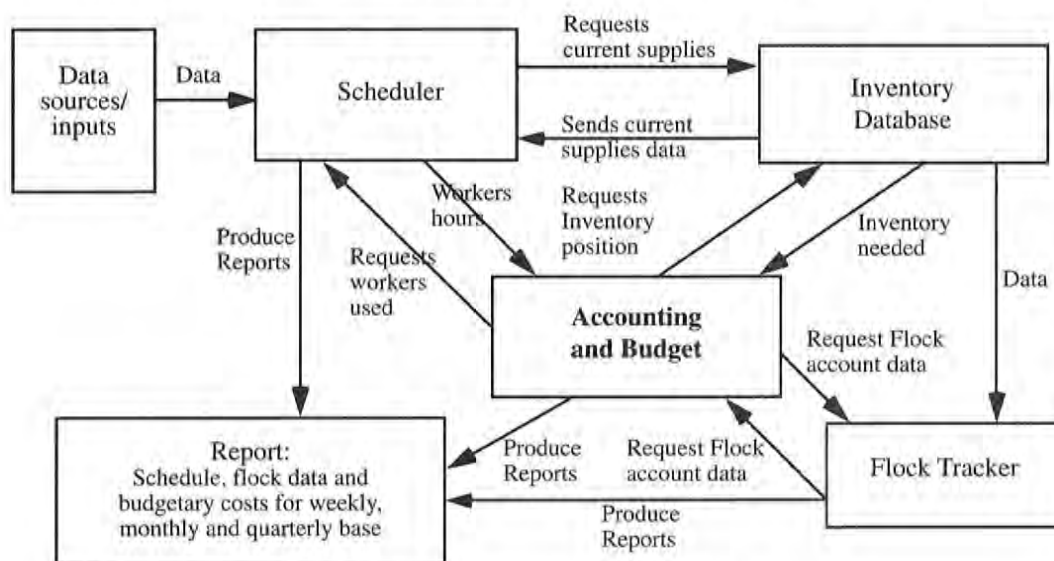


FIGURE 5: A Broiler Farm Operations Module

example, on the mortality rates in pens or breeds and the number of farm-growing chickens at any point of time. Practitioners and operators could compare the weights of chickens in a pen from previous years or between pens in a same season. They could decide the appropriate time to take their new batch of chickens and help prevent any gluts or shortages in the markets. Similarly, the decision support could assist local hatcheries to plan for any intended grow-out periods and determine the amount of hatchlings needed, thus avoiding inefficiencies or shortages. The paradigm could also help secure the supply of the chicken throughout the year and prevent unusual fluctuations in the market prices. Besides, a workable logistics operation could be set up to assess possible cost-effective distribution routes for practitioners and operators [15].

Managers or delegated personnel in farms, feed mills, hatcheries and processing firms, etc. would be responsible for collecting and updating their own data to the national poultry database on a frequent basis (say, every week). To facilitate the process and disseminate the data, the contracting firms would collect and store own data of their farms, mills and hatcheries, etc. before supplying to the national database. Besides, independent farmers and suppliers for feeds and machineries, etc. could supply their data directly to the national or central database.

With the decision support paradigm, the poultry-contracting firms could share their operation

information and decide on providing incentives to farm operators who meet the food quality and hygiene standards in line with the SPS and HACCP requirements. On the other hand, farm operators could obtain timely medical supplies needed from the poultry-contracting firms. Further, through consultation with the national poultry database, veterinary officers could schedule their visits at critical times and monitor farms through farm operator's data such as mortality rates, vaccination period and disease outbreaks [15].

5. A Prototype DSS in Broiler Management

Based on the support decision paradigm, a prototype DSS in broiler management was developed to help demonstrate the DSS capability [15]. To illustrate how the paradigm could help the users to manage their operations, a broiler farm operations module is selected. The module aids farm operators in decision-making and planning of their production (see Figure 5). To optimise the need of capital, labour and time, the scheduler (i.e., resource allocation function) is designed to produce a list of farm activities, including the vaccinations, feedings and watering of the chicks.

Using the established inventory database, farm operators could keep track of current inventory (including vaccines and feed) to determine reordering times. The flock tracker would house the pen records for each individual batch and give reports on mortality

rates, the feed conversion rates, vaccination dates and affected diseases. Therefore, farm operators could compare each pen to see if there are any differences in pen growth and to determine any abnormalities. Substantial improvement of their production (e.g., food quality and hygiene standards and feed-to-weight conversion) could be achieved. Besides, farm operators could use the module's accounting and budgeting facility to access costing records and monitor costing performance. Needed pertinent data could be automatically generated for use.

6. Discussions

The usefulness of the DSS described depends significantly on the number of users. Users are required to have a computer with Internet access and pay if necessary for the software module they need and membership a subscription fee for the use of the national database and services from the market intelligence unit. On the other hand, using the DSS could bring several tangible and intangible benefits to users. For instance, they could access industry and production information on a timely basis and enhance decision-making and planning abilities. Several costs and benefits generated from using DSS are give in **Table 1**.

Considering the stored data could be sensitive to the poultry practitioners and operators, the Government should assure the upkeep of the system and the national database in the country. For developing

the decision support paradigm, a list of registered suppliers, processors and farmers based on the available sources (e.g., the Central Statistical Office (CSO) and the Caribbean Poultry Association (CPA)) would be used.

At present, there has been a mandatory requirement that poultry practitioners and operators should submit their production and operations data as requested by the Government [16]. The CSO is responsible for collecting and storing data from the industry at the national level. Therefore, the hosting of the system with central database at CSO would be of competitive advantage that safeguard the provision of services and benefit a large number of users (including feed mills, hatcheries, processors, distributors, contracting firms, suppliers, veterinary personnel, and so forth). Local universities (e.g., The University of the West Indies) and other institutes (e.g., CPA) could also provide technical advice and assistance in monitoring the system and maintaining the database for the industry.

7. Conclusions

The world is plagued with uncertain conditions which affect the production and availability of foods. Trinidad and Tobago's poultry industry has been identified as a potential food security in animal protein. The industry is however dependent on external input supplies and is susceptible to US imported meat. Faced with various internal and external challenges, industry practitioners

TABLE 1: *Costs versus Benefits of Using DSS*

Costs	<ul style="list-style-type: none"> * Invest in hardware and facilities of the system * Pay for system installation, operations (e.g., Internet access), maintenance and software upgrade * Subscribe to the use of the national database services * Compensate productive time to data inputs and processing * Compensate productive time to train personnel to use the system * Create conflicts in managing changes in workplace * Bear the risks for disclosing strategic data and information to competitors
Benefits	<ul style="list-style-type: none"> * Increase accessibility to up-to-date industry information * Access information that could not exist in the past * Save time and resources in accomplishing jobs, thus reducing operating costs * Enhance decision-making and planning abilities * Improve operational efficiency and customer satisfaction * Promote industry links among users * Safeguard the offer of quality products or services

and operators have to disseminate data and establish a sound market intelligence system for ensuring integrity and enhancing sustainable performance improvement in their operations.

This paper presents a decision support paradigm using DSS that assist practitioners and operators in managing these challenges in the poultry sector. The proposed DSS could help them to improve their operational efficiency and attain benefits from the dissemination of reliable data. Nevertheless, more research is needed to develop, implement and test the DSS. Post-implementation evaluations are needed to validate the applicability of DSS to different scales of operation and determine the level of user acceptance in industry. The findings would help industry practitioners and operators manage their performance and the experience gained could also benefit other agribusiness operations and related industry sectors in Trinidad and Tobago.

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References

- [1] United Nations Conference on Trade and Development (2000). *Report of the Expert Meeting on the Impact of the Reform Process in Agriculture on LDCs and Net-Food Importing Developing Countries and Ways to Address Their Concerns in Multilateral Trade Negotiations*, United Nations, Palais des Nations, Geneva, July.
- [2] Caribben Poultry Association (2001). *The Study of the Caribbean Broiler Industry*. Paper presented at the CARICOM Heads of Government Meeting, Trinidad and Tobago, October.
- [3] Harry, E. (1997). *Situation Analysis of the Poultry Industry in Trinidad and Tobago*. Situation Analyses of Agricultural Sub-Sectors for the Priority Setting Process in Trinidad and Tobago, NIHERST, Trinidad and Tobago.
- [4] Campbell, J.R. and Lasley, J.F. (1975). *The Science of Animals that serve Mankind*. 2nd Edition, Mc Graw Hill Book, London.
- [5] International Monetary Fund (2001). *Trinidad and Tobago: Statistical Appendix*. IMF Country Report No. 01/108.
- [6] Central Statistical Office (2001). *Poultry Bulletin*. Vol. 13, No. 284, Trinidad and Tobago.
- [7] Fournillier, N. (2000). *Challenges for the Poultry Industry in Export Thrust*. Internet Express, 16th March.
- [8] United Soybean Board (1999). *US Soy Exports are making a Big Splash in the Caribbean*. SoyLine, May, pp. 1-2.
- [9] Turban, E. and Aronson, J.E. (2001). *Decision Support Systems and Intelligent Systems*. Prentice Hall, Upper Saddle River, N.J.
- [10] Sauter, V.L. (1997). *Decision Support Systems: An Applied Managerial Approach*. John Wiley & Sons, New York.
- [11] CSIRO Animal Production (2002). *AUSPIG A Computer Decision Support System*. Available at: <http://www.anprod.csiro.au/research/auspig/auspig.html>
- [12] Ministry of Agriculture and Forestry, New Zealand (2002). *Decision Support Systems: A New Element in Farm Management*. Available at: <http://www.maf.govt.nz/MAFnet/publications/decision-support-systems/dss.htm>
- [13] M-Tech Systems (2002). *The Poultry Management Tool Series (PMTS)*. Available at: <http://www.mtech-systems.com/web/products.htm>
- [14] Hutton, P. (1994). *Environmental and Nutritional Requirements of Broilers in 2001*, World Poultry, Vol. 13, No. 8, pp. 33-35.

- [15] Pun, K.F. and Hosein, A. (2003). *Improving Performance of Agribusiness Operations and Production in Trinidad and Tobago: A Research Agenda for Poultry Industry*. Proceedings of the 16th Annual Technical Conference on Manufacturing for the 21st Century, Association of Professional Engineers of Trinidad and Tobago, St. Augustine, Trinidad and Tobago, March, pp. 132-141.
- [16] The Statistics Act Chapter 19:02, The Trinidad and Tobago Laws, May 1982.■