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Research Article

Animal Data Transmission and Product Traceability System Model for Goat in the Philippines

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Abstract

The ability to trace and track food producing animals and their products from production and distribution is considered as an indispensable instrument to improve consumer confidence. In the Philippines, traceability on food production and manufacturing is covered under Republic Act 10611 or the Philippine Food Safety Law of 2013. Thus, the present initiative was implemented to develop a model on animal and product traceability using goat as commodity. The goal of system development is to transform and innovate traditional monitoring of goat farms and recording of animal performance and introduce a traceability system for chevon. The traceability model utilized existing technologies on SMS-based for data transmission and QR code for product traceability. A central processing unit was established and served as depository of production performance. Using mobile data transmission, the real time production status of the farm can be monitored, thus, appropriate interventions can be sent to the farm via feedback mechanism embedded in the system. Likewise, using the stored data, estimates on volume of meat can be forecasted which is then used as input in product processing. Movement of products in the market can also be evaluated, which can be used as basis in determining consumers' product preference. Overall, the developed system can lead to improvement of goat production management while food safety is also addressed. It can also be a useful tool to continuously provide technical assistance to the raisers amid the community restrictions due to the current pandemic.

Keywords: Animal Data Transmission; Product Traceability; Goat; Philippines

Introduction

Food traceability has emerged as one important component of food chain. The application of the traceability system guarantees the consumers that the food is safe and fit for consumption. Important features such as rapid identification, location and withdrawal of food when problems arise are needed to maintain products' wholesomeness.

Traceability in animal-based products is well established. Historically, animal ID was used to indicate ownership and to prevent theft, but at present, the reasons for identifying and tracking animals have evolved to include rapid response to animal health and food safety concerns [1]. Aside from food safety concerns, the establishment of animal traceability system is important in enhancing animal health surveillance, disease control and eradication

[2,3]. At present, the application of appropriate technology enhances the ability to track animals throughout the marketing chain [4].

Among the developed animal traceability are 2D barcode and radio frequency identification (RFID) technology China [5], Hipertext Preprocessor technology MySQL for database management and traceability system for goat and sheep meat in Brazil [6] and Beef Traceability System (BTS) in South Korea [7]. In Japan, in response to beef crisis brought by bovine spongiform encephalopathy a law was create to established bovine animal traceability for domestically produced beef from farms to slaughterhouses [8]. In support to cattle and beef trade in China, a conceptual model of traceability system was applied in the supply chain [9,10]. In the Philippines, Republic Act 10611 was created and implemented to help boost the country's food industry by making it more competitive both in domestic and international market and to provide investment opportunities [11]. However, food traceability from farm to market is not properly established. The present study was undertaken to develop a model for animal and product traceability using goat as model.

Materials and Methods

The existing technologies on data transmission were evaluated for fitness in the proposed traceability system. For instance, the use of short messaging system (SMS) was tapped due to the popular use of cellular phones and the capability to send data without the use of internet connectivity and presence of network that provide affordable services. Likewise, the use of quick response (QR) code was considered because of machine-readable optical system, capability to contain information and presence of application that can read code.

Development of animal data transmission and product traceability

Technology adopted and system development for animal data transmission

Capitalizing on the stability, access, and cost of widely used SMS system, an SMS-capable data transmission system from farm to the central database unit was developed in 2018. This was created and established for easy monitoring of stocks within the farms. Important data on performance were identified, coded and transmitted via SMS from each participating farm to CVSRRC Central Data Processing Unit (CCDPU). The data center is capable of accepting SMS in all network providers of the country was established.

To facilitate data exchange, each farm monitored by the center will enroll into the system using their personal mobile phone number. Once enrolled, a unique identification will be assigned to the farm. In the system, farm owner, farm location and all identification numbers of the stocks in the herd using ear tag number were encoded in the database system. The animals were also identified accordingly to include breed, sex, age or age bracket if possible. From here, the animal traceability begins by documenting all activities that the animal has been trough in the production.

Codes for each production stages and farm activities were developed and served as basis for data transmission. Among the data transmitted are the following:

- Breeding information- date of breeding, buck ID, buck breed, doe ID, doe breed
- Kid information- date of birth, sex, birth weight, parent ID (Buck and Doe)
- Grower information- weaning weight, slaughter weight (weight at 12months)
- Health management- biologics and drugs such as dewormer, vitamin-mineral supplement and antibiotic administered and the dosage given
- Transfer of animals
- Record of death
- Record of sales

Each production activity has unique set of codes to be transmitted. The set of SMS transmitted is a combined information of production activity and the animal involved. After each data is transmitted, the database center will acknowledge it to ensure that the data was successfully entered into the system (Table a).

Technology adopted and system development for product traceability

Product traceability started once the animal is brought to the slaughterhouse. The production information from farm is carried to post- production record to trace the animal's information once it is used for product production. Inside the slaughterhouse, the following information were added to the animal's data to complete the record

- Slaughter weight
- Carcass recovery percentage
- Weight of offals

There are two products from goat meat that were commercialized, to include vacuum-packed choice cuts and canned chevon. For vacuum-packed choice cuts, once the carcass is fabricated, the weight of each prime cut was recorded and a of a QR Code was generated containing information of the animal and attached to the product's label. Information such as animal origin and date of slaughtering can be accessed by the consumer. In the case for canned products, the products were recorded per lot. A lot number was designated in each batch and all animals used in the production were identified and recorded. The lot number represents the date of slaughtering, while date of manufacturing is a mandatory information among products.

Information to be sent	What to type
Breeding thru natural mating	Area code + Farm Code + Buck Stock No. + Breed of buck + Doe Stock No + Breed of doe + Date of breeding + Production activity In case the following data will come from a farm in Echague, Isabela, this code can be used: 3309-1-2B-B-3F-N-01132018-BrN
Kidding	Area Code + Farm Code + Doe Stock No+ Breed+ Production Code Code + Date of Kidding + Number of Kidding + Litter size + Sex In case the following data will come from a farm in Baggao Cagayan, this code can be used: 3506-2-4F-UB-Ki-01132018-2-1-M
Sold	Area Code + Farm Code + Animal Code + Date Sold + Production activity In case that the animal sold is from Diffun, Quirino, the code to be send is as follows: 3401-3-2M-01132018-So
Transferred to another farm	Area Code + Farm Code + Animal Code + Date Transferred + Area Code + Farm Code + Production activity In case the following data will come from a farm in Echague, Isabela, this code can be used: 3309-4-5M-B-01132018- 3325-3-Tr
Slaughter	Area Code + Farm Code + Animal Code + Date of slaughtering + Production activity In case the following data will come from a farm in Echague, Isabela, this code can be used: 3325-5-6UB-01132018-Sl

Table a

The developed system is composed of three different tiers, all linked together for the product traceability system to include:

- Presentation tier is the component of the project where user must have an android mobile device and an app installed to access the traceability.
- Application layer is where the user must connect to a wireless modem or mobile data to access the traceability.
- Data layer is where the data or information from the inputs of the administrator are stored and retrieved upon the request of the application user. Also, all queries of the user are transmitted to the web server.

Results and Discussion

Developed model for animal data transmission and product traceability

The developed model for data transmission and product traceability utilized combination of several available technologies. The adoption of SMS-based data transmission and QR code ready application are important interventions to ensure that the model for goat is low-cost and functional even in the farthest communities. Moreover, the data transmission and traceability system developed was the first complete model for goat in the country. The model is used for tracing the animals and products, and in evaluating the effect of technologies adopted in each farm.

The primary use and application of the system are diverse from farm monitoring, production management application effect, real-time inventory assessment, product sales and distribution, among others. It also served as tool in the process of evaluating the technologies applied the performance of the farm as well.

The model developed is composed of four different layers to include (1) farm, wherein data are transmitted by the farmers or raisers, (2) ISU-CVSRRC, where the central data processing unit is housed, (3) ISU-CVSRRC Integrated Slaughterhouse and Meat Processing Center, where post-production like slaughtering and product development are conducted and (4) consumers. In each layer, data management differs from one another, as the use or application of data sets are different. There are data sets that are used for evaluation, while other data are utilized as input or supporting data for the evaluation. The model is presented in the illustration below.

The existence of an integrated traceability system covering both animals and animal products is essential to perform effective risk assessment along the production chain. This is applicable both for animal health and food safety relating to foods or animal origin.

Figure 1: The data transmission and product traceability model developed for goat.

Figure 2: Designed feedback mechanism feature from central database center to farm and vice-versa for kid produced.

Applications of the traceability system developed

The data transmission system can perform as a traceability system for animal. With the data transmitted, the inventory in the farms can be monitored. Thus, the growth in the farms can be determined. The projected number of pregnant des can be monitored, hence, projected number of kids born in the succeeding kidding period can be projected, thus increase in the population inventory can be predicted.

Using the same data, the farms can prepare for the needs as the production-level increases just like housing, forages, feed supplement among others. Likewise, using the data transmitted, improvement on the production performance can be measured through the data on different physiological stages that are being transmitted in the central processing unit. Using the information on breeding system used and data on the production performance, the overall improvement on the herd can be established on particular generation. On the other hand, health status of the animals can also be pictured. Using the data on health, the predominant diseases and health-related problems occurred in the farm can be mapped-out throughout the year. The information can be used in planning for disease prevention strategies to lower mortality rates.

Other than the production performance, the traceability system can also provide insights on the effect of the technologies and production practices adopted in the farm. For example, the effect of upgrading and using exotic breeder bucks can be measured by the production performance which can be related to improvement of growth indices in the population. Using the same set of data from the farms, top sires can be identified which can later be used in the assessing breeder lines used in upgrading. Aside from this, the effect of the supplementation can be evaluated on weight at different physiological stages as well as in the percentage of mortality.

With the application of the system, the central database can have an outlook on the number of animals for slaughtering at a given period of time. The data can also provide information on projected volume of meat for market which can be correlated to the improvement of the production management employed can be assessed using the products derived, such as slaughter and carcass weights.

In case of product processing, the actual volume of meat can be forecasted using the production record. With this intervention, the manufacturers can project the supply of chevon meat at a given period, which is important to determine what percentage of the supply-demand chain is being address and can promote the developed standards for goat post-production [12,13].

Conclusion

The developed data transmission and traceability systems served as tool to improve data gathering, recording and farm production management evaluation. The traditional way of farm monitoring is time consuming and sometimes not accurate as it is time bound. With the application of the model on mobile data transmission and traceability for goat, it is observed that the monitoring becomes more effective and efficient; while reducing cost of usual monitoring and evaluation activity.

The real-time situation of farms as well as animals can be generated which will lead to improved feed-back mechanism from the central database system. The system can be used to further improve farm management by utilizing the real time data transmitted and thru feedback mechanism, raisers can be guided accordingly based on the current situation of farm and the animals. With the adaption and utilization of the system, the following positive implications to include (a) improvement on animal production performance thru application of relevant intervention according to farm situation and need, (b) significant increase in production as increase in the population of animal and volume of meat can be attained, (c) improvement on product marketing by application of efficient evaluation of product movement in the market and (d) address transparency in product information as food safety measurement established. All these increment on improvement of production management can be translated to positive profits gained. The model developed is applicable to any commodity, thus, its usability coverage is not limited to goat production only.

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