

Technological Model for Tracking & Monitoring Brazilian Beef Supply Chain

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Abstract: - This paper addresses the issue of tracing the chain of Brazilian beef sector, which contributes largely to the contents of Brazilian exports. In order to, scrutinize the issue of tracking applied to the sector, were briefly raised the demands of domestic and foreign markets, highlighting the heterogeneity of the international market. After, they were raised and briefly explained the main technological solutions currently available. Armed with such data, solutions were proposed. The full adoption of the solutions indicated would reduce the need for paper during the processes contained in the supply chain, streamline the exchange of information securely, allowing the real-time tracking of the product during his trip to the importer, increasing, in addition, the reliability the quality of Brazilian products.

Key-Words: - Tracking, monitoring, Brazilian Beef Supply Chain, electronic seal, RFID.

1 Introduction

In the year 2010, according to Brazilian government officials [1], the Brazilian beef producers allocated 80% of its total production ("in natura", industrialized and guts) for the internal market and the remaining 20% for the market external. Of these 20% exported, 8% were guts, 17% were

industrialized beef and 75% were beef "in natura." The meat "in natura" was destined to 107 countries, mainly Russia (30%), Middle Eastern countries (43%), particularly Iran and Egypt, and the Union Européia/EU27 (5%) [1 and 6]. Thus, the export of beef "in natura" fresh, chilled or frozen, in 2010, totaled \$ Mil 3.861.061US Fob. This amount, which

represented 1.9% over the total exports that year, secured the 11th place in the ranking of the main products exported by Brazil [2].

Still, according to official figures released by the Brazilian government, Brazil is the largest exporter of beef in the world [3]. Add to that the sales of over \$ 50 billion / year and the supply of 7.5 million jobs by cattle meat supply chain and it is clear the importance of the Brazilian agribusiness. According to the Association of Brazilian Beef Exporters (Associação Brasileira das Indústrias Exportadoras de Carne Bovina – Abiec), the cattle meat supply chain represents the biggest slice of the Brazilian agribusiness [1].

The development of Brazilian bovine cutting for export is closely linked to infrastructure, animal health, trade and tariff barriers, sanitary and socio-environmental management and production system [4]. In terms of public policies to promote the development of beef for export, the Brazilian government launched the Meat Program of the Productive Development Policy (Programa Carnes da Política de Desenvolvimento Produtivo – PDP), through the Ministry of Development, Industry and Foreign Trade (Ministério do Desenvolvimento, Indústria e Comércio Exterior – MDIC), and the Sectorial Chamber of Beef Production Chain, through the Ministry of Agriculture, Livestock and Supply (Ministério da Agricultura, Pecuária e Abastecimento – MAPA).

The Meat Program aims to promote exports, improve product quality, thicken the production chain, and establish a tax and credit policy to promote the sector. Among the measures provided for such purposes are: to include meat products in the negotiating guidelines to increase access to foreign markets and eliminate trade barriers and subsidies for export markets; to enable equivalence health agreements; deploy Health and Quality National Committees; to create technical cooperation term for control and improvement of meat quality, to establish and implement a logistics with differentiated competitiveness, developing a socio-environmental program for the sector and to structure a national program for traceability of supply chains [4].

The Brazilian Chamber of Beef Production Chain is a collegiate body external of MAPA, which, under the lines of its president Antenor Nogueira Amorim, has as the big challenge to increase in markets by 2015 the national cattle meat and "turn ideological discussions and unfounded in a dialogue grounded in scientifically proven data and to justify the requests made nowadays by some entities" [5].

The expansion of importing countries diversify export markets, thereby strengthening the position of Brazil in the international market, since the market concentration, among other things, can leave the country weakened in the face of an embargo. "It's the situation that beef exporters are living today, for almost half of our output goes only to Russia and Iran" in the words of Senator and chairman of the Agriculture and Livestock Confederation of Brazil (CNA) Kátia Abreu, spoken on June 2010 [6].

The management of the productive system of beef cattle for export, however, depends not only on the determinations of public power, but also the imposition of export markets and coordination between the links of its supply chain, both physical, and informational, financial and knowledge to meet the requirements of the final consumer. The supply chain of Brazilian beef, therefore, must connect products and services from multiple vendors in order to meet the needs of the consumer [7].

So there must be an intense interaction between the actors in the sector (employers, employees, government, academia and the national congress), so the management of the supply chain, as happens to modern management production systems, reduces costs, increases profit, gains quality and differentiates itself positively from the competition. The realization of these goals not only gives the product competitiveness in domestic market and overseas market, as also adds value to the product.

2 Tracking and Monitoring Brazilian Beef Supply Chain

The Brazilian beef industry is opening new markets, thanks to the mobility in the production system and the ability to meet the requirements of buyers [6]. The biggest Brazilian meat industries, for example, are certified to perform the Halal slaughter (according to Islamic precepts) and Kosher slaughter (according to Jewish precepts), as the need for some importers [8].

The Brazilian government, through the MAPA, established the System of Identification and Certification of Cattle and Buffaloes (Sistema de Identificação e Certificação de Bovinos e Bubalinos – SISBOV) to be implemented and maintained electronically in the single database, called the National Data Bank (Banco Nacional de Dados – BND), by the Secretariat of Agricultural Protection (Secretaria de Defesa Agropecuária – SDA) of MAPA [9]. The SISBOV allows individual identification of each animal through the numbers

contained in an earring and tied to the animal. In addition to identify individuals ox, it is possible to track each ox based on information in the system, as required, for example, by the European Union – EU. The requirements of each country for the final product imported are determined by the questions required to issue an International Health Certificate (Certificado Sanitário Internacional – CSI) for a given destination country, including the invoice, the Report of Traceability and other health reports according to specific Circulars. In the case of products destined for Finland or Sweden, for example, it is necessary to present the results of analysis of Salmonella related to the definition of the carcass. The requirements are determined by negotiations between trade missions representatives of the exporting country (Brazil) and the importing country [10].

Compliance with the requirements of the CSI is an important aspect of international trade. Another important aspect concerning the characteristics of the product is the ability and quality of the product flow from the producer / exporter to the importer, keeping the product in ideal storage conditions. The quality of transport routes and the transport vehicle, the carrying out of audits by the government (area and personnel available to work, information exchange system - electronic or paper, etc.), as well as other elements of their supply chain, may represent efficiency gains or losses - which affects their competitiveness as commodities, and also the final quality desired and positive product differentiation.

The analysis of degrees generated by international agencies or bodies acting on the sector of international trade, especially by sea, as the ISPS-Code / IMO (International Ship and Port Facilities Security Code / International Maritime Organization), WCO (World Customs Organization) SAFE Framework of Standards, CSI (Container Security Initiative / USA), C-TPAT (Customs and Trade Partnership Against Terrorism / USA), SFI (Secure Freight Initiative / USA), BA (Bioterrorism Act / USA) sets a series of measures for adaptation to international safety standards regarding the supply chain, the facilities and its information systems. Among them: the non-intrusive container scanning, the commitment to adopt certain safety parameters, including by partners along the supply chain, the use of an electronic system for exchanging information in accordance with certain standards – in this case is worth highlighting the ISO28000: 2007 (International Organization for Standardization) that gives "Specifications for

security management systems for the supply chain") – and, very importantly, the product traceability.

Tracking is the ability to track the final product from its inputs, tracing the previous trajectory of the product. Thus, a tracking system consists of a set of information comprising a selected database. Tracking beef product "in natura" is the ability to reconstruct the past history of the animal at any time in its existence. The beef product traceability regards tracking the inputs that generate the product, and the final product itself.

The Law No. 12.097/09, which provides for traceability in the beef and buffalo supply chain, has imposed to the Federal Executive the creation, development and implementation of an electronic processing, integration and management of information generated by mandatory instruments for the traceability of the beef production chain.

The mandatory tools are: fire marks, tattoos or other permanent and auditable marking animals for identification of the owner; Animal Transit Guide (Guia de Trânsito Animal – GTA), Invoice (Nota Fiscal – NF), official records of the inspection services of products of animal origin at the federal, state and municipal as require legislation, and records of animals and products made in the private sector by economic agents of industrial transformation and distribution.

The adoption of the tracking system of beef "in natura" favors fiscal control and sanitary control over the products sold. Fiscal control is the responsibility of the Internal Revenue Service of the Ministry of Finance (Secretaria da Receita Federal/ Ministério da Fazenda – SRF/ MF) and the sanitary control is the responsibility of the MAPA. The sanitary control of the MAPA is guided by the demands of domestic and foreign markets - the foreign market established by the requirements for issuance of CSI.

2.1 Applicable technologies for Tracking and Monitoring Brazilian Beef Supply Chain

Tracking and Monitoring Brazilian Beef Supply Chain is an obligation of the Brazilian government dictated by Brazilians Laws. Also, it is an imposition of the foreign market, in bigger or smaller scale, as a premise to by Brazilian Beef.

Systems, equipments and devices applied to track and monitor a supply chain helps to give security, confidence, and efficiency to each chain of events contended in it. In a way, the use of those technologies, with the specifications for security management systems for the supply chain given by ISO28000, allows a Secure Brazilian Beef Logistic Chain.

Next are presented technologies that allow Tracking and Monitoring Beef.

2.1.1 Vehicle identification by ARP/OCR

A vehicle can be identify by an Automatic Reading of Plates (ARP) system, which applies equipments to capture and recognize characters on a plate (such as a combination of sensors, software, and cameras), and algorithms OCR (Optical Character Recognition). The information captured and recorded by ARP can be cross-checked with data already in the system's database, like NF-e ("nota fiscal eletrônica") and CT-e ("conhecimento de transito eletrônico") [11, 12, 13 and 14].

2.1.2 Vehicle and goods identification by identification by RFID

The RFID (Radio Frequency Identification) technology allows to locate and to identify an object by applying on it a tag that uses a short range radio frequency (typically 0.5 to 5m) that can be read by readers or antennas. Those reading equipment must be installed at a strategic location that will allow, for instance, to read more tags with less antennas. The RFID system can identify vehicles or cargo through containers, pallets, cases, individual products or bulk, depending on where the tags are.

The use of RFID can be associate with the vehicle identification, in an integrated solution. The system can collect the vehicle plate by ARP and the information transmitted by RFID and associate both between themselves or, even, with data previously in the database.

2.1.3 Electronic Weight

Electronic scales, usually applied on roads for monitoring cargo weight transported by trucks or trailers through the static or dynamic weighing stations, can generate weight data to cross against vehicles and tax documents.

2.1.4 Cargo Scanners

Areas of security and monitoring logistics (mainly port / customs) usually have X-ray equipment to inspect the cargo inside trucks, containers, tanks or chests loaded. This equipment, fixed or portable, can penetrate up to 400mm of steel, and allows the inspection from 25 to 30 vehicles per hour. The main advantages of X-ray scanners for cargo are: [15 and 16]

- a) The technology is non-intrusive under the viewpoint of user;
- b) There are equipment options for mobile operations;

- c) The equipment permit to analyze the material composition.

2.1.5 Electronic Seals

A seal is a device applied to lock the cargo in a compartment or storage. The electronic seal permit to monitor the loads indicating or preventing unauthorized access to cargo locked in a compartment to be carried or stored.

There are different kinds of electronic seals, each model provide a different level of functionality [17]:

- a) All mechanical seals provide protection / physical (sealing);
- b) Seals with electronic memory capacity allow the recording and subsequent reading of the payload data, typically through active RFID technology (with the use of battery-powered tags) or passive (using tags externally energized by the RFID reader);
- c) RFID electronic seals with memory capacity and processing allow to record the date / time of violation;
- d) GPS (Global Positioning System) location, allowing the seals to record the location of the violation, together with the date / time;
- e) Reporting of violations in real time via cellular (3G), digital radio or satellite communications.

2.1.6 Tracking with GPS technologies and communication

The GPS is a set of satellites and an electronic information system that provides a receiver moving in the same position with reference to Earth coordinates [18]. Electronic components may include tracking, communication, detection of deviation from the final destination or theft of the vehicle, storing and processing data, generating data for locating and monitoring the implementation of procedures operations that will use the data generated by the companies responsible for monitoring the fleet.

3 Problem Solution

The issue of tracking is complex, since it involves a series of actors and pervades all parts of the chain. How much traceability is more or less robust depend on the needs and demands of its stakeholders throughout the supply chain. In the case of Brazilian beef supply chain for export, the need for traceability will depend, among others, of the demand of the SRF/ MF, MAPA, importer, and final consumer.

The SISBOV makes the identification of the bull until it is delivered to the slaughter. Although the data are kept in an electronic database by DAS / MAPA this information must be print to be given to the supervisors of the Federal Inspection Service (Serviço de Inspeção Federal - SIF / DIPOA / MAPA). The same thing occurs with other electronic systems for government agencies used during the chain, as SIGSIF (Sistema de Informações Gerenciais do Serviço de Inspeção Federal – Management Information System of the Federal Inspection Service) and SIGVIG (Sistema de Informações Gerenciais de Importação e Exportação do Vigiagro – Management Information System of Import and Export Vigiagro). That is, three branches of MAPA have different platforms that do not communicate between themselves. The first proposal, therefore, is the unification of the MAPA platforms, which facilitates the traceability and especially the agility in the chain course.

The unification of the MAPA platforms is the first step. The second step is create the possibility of actors involved in the beef production to feed the database platform of the MAPA, and, the consequence, make the following agents to only access this data electronically. The second step will end the need of paper in the communication and documentation process.

Elements that assist in this process are the technological solutions listed in item 2, namely: vehicle identification by ARP / OCR, vehicle and goods by identification by RFID identification, electronic weight, cargo scanners, electronic seals, with GPS tracking and communication technologies. The unified platform allows to send information immediately to the unified database. This information is from then available to authorized persons or entities. This information will be available electronically on the system, and also monitor the physical flow of cargo, but not on paper. Electronic weight and cargo scanners will help to monitor the load.

The information can be stored in electronic or RFID tag, depending on the context. Thus, information can be read with the arrival of cargo and can be crossed with those available in the system, also based on the identification of the vehicle by ARP or the vehicle or load by RFID.

Finally, we propose the adoption of GPS technology will track real-time movement of the load, take tools to combat cargo theft and detours, as well as monitor conditions of packaging and freight transportation.

4 Conclusion

The supply chain of Brazilian beef for export begins with the creation of cattle, goes through the process of industrialization to be distributed to the final destination - in the case of exports, as a rule, the transfer of ownership of the cargo to the importer or his representative. The operations carried out along the chain occur in more than one location and has various actors involved in it. Therefore, the operations along the chain build a long and complex process, which depends on elements of the internal market, the foreign market to which the load is designed, and the international competitive landscape.

The competitiveness in international markets makes the producer have to invest in the quality of their product, service and positive differentiation. Thus, the producer and the country want reliability, safety and quality for its products and its distribution network, for what they need, safety and efficiency of surveillance systems. The adoption of a robust traceability system has this power on the supply chain of Brazilian beef for export.

The first step is the unification of platforms used by organs of the MAPA, then the possibility of other actors involved to feed the database system, so that is no longer required the use of paper - initially at some stages of the process and then in the whole process.

The adoption of these two steps increases the speed and efficiency of information exchange between the parties, and also the surveillance system. In addition, these solutions enhance and facilitate access to information that allows redo the trajectory all the way from the product inputs, therefore, the solutions here proposed allow to track the product from origin to final destination.

Adopting electronic seals on cargo transportation, vehicle identification by ARP / OCR, and goods by vehicle identification by RFID identification allow to complete the process of replacing the means of information exchange in the chain – instead of paper exchange, electronic exchange of information.

Finally, the use of electronic weight, cargo scanners, with GPS tracking and communication technologies, besides allowing real-time monitoring of the location and conditions of carriage of cargo, represents safety for government oversight, and helps to gain speed, reliability and quality of the product and the service provided. The proposals here presented are strategic tools to strengthen the supply chain linking harmonically its various components.

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