Chapter 27
The IoT Research in Sustainable Agricultural Supply Chain Management: A Conceptual Framework

Arnesh Telukdarie
Faculty of Engineering and the Built Environment, University of Johannesburg, Johannesburg, South Africa

Pavitra Dhamija
Faculty of Engineering and the Built Environment, University of Johannesburg, Johannesburg, South Africa

ABSTRACT

Timely information and decision making are vital for success of agricultural supply chain management, which is possible through capturing information by using wireless sensor networks. The Internet of Things comprises of such devices, which are laid in the form of communicating network around the agricultural setting for obtaining information. The current study aims to review prior studies based on the usage of IoT in sustainable agricultural supply chain management. A literature review has been conducted by using selected studies from reputed journals. It has been found that IoT applications in the sustainable agricultural supply chain and is currently under a nascent stage in developing countries. This is due to influence of multiple barriers, which poses serious problems, and therefore it is imperative for agricultural scientists and managers to understand the interrelationships. Farm managers, research scientists, and policy makers must aim to remove the barriers for achieving sustainability in agricultural supply chain management. The study is unique, first, in terms of scope of study; second, it identifies and categorizes the barriers to IoT application in agricultural supply chain; and third, it proposes a conceptual framework with research propositions and finally provides food for thought to the research community.

DOI: 10.4018/978-1-6684-5352-0.ch027

1. INTRODUCTION

Agriculture and allied sector are the backbone of the Indian economy (Jamil et al., 2011). Gross Value Added at current prices for agriculture and allied sector is estimated at 23.82 lakh crore INR (Papadopoulos et al., 2017). In 2016, this sector accounted for 16.5 percent of country's Gross Domestic Product (Kshetri, 2017a). Agricultural sector includes proper agriculture and livestock, forest and logging, fishing, and related activities. The agriculture supply chain can be divided into three broad stages i.e. production planning, cultivation, and post-harvest management and marketing. Proper planning may avoid certain issues such as succession of certain crops on the same land, which may deteriorate soil quality and become susceptible to diseases, insects or weeds (Bag and Anand, 2015; Yan et al., 2017). Timely information and knowledge can aid farmers in production planning while undertaking the right practices such as rotating crops on the same land, multi-cropping and testing of soil samples for better yield. In the post-production planning, every farmer needs to perform other farm related operations for maximizing entire production in the farm (Bag, 2017). However, agricultural products are not consumed immediately after production and involve complex logistical activities such as material handling, safe storage, processing, packaging, sales, and marketing. The logistical activities determine the final quality of product and therefore necessary to control and monitor the performance through application of modern technologies. Information and Communication technologies (ICTs) play a big role in the success of agriculture supply chain (ASC). ICTs provide advanced and real time information to the farmers, which can aid in quality decision-making (Ali and Kumar, 2011; Fountas et al., 2015a).

In western countries, ISOBUS is considered as a standard within the agricultural industry, which consists of fourteen parts (such as data link layer, network layer, task controller, and management information system data interchange), providing functionalities and other targeted options to farm management information system (FMMIS) developers. The machine entity is at the centre of the system (Bag, 2016a). As part of the complete system, additional devices and sensors are connected to Global Positioning System (GPS), crop sensors (i.e. NDVI), soil sensors (i.e. electrical conductivity) to obtain adequate data on field status and overall system functionality and performance together with the information derived from the tractor ISOBUS. The acquired data by the FMMIS is thus analysed and processed by specific FMMIS modules and other components and formulated as control actions or decision support guidelines. The data can be tremendously helpful for planning and control of agricultural operations because it provides real time information and better visibility (Fountas et al., 2015b). So, every moment the data generated from the agricultural operations need to be captured, sorted, prepared, and analysed for effective decision-making. However, managing the big data is a challenge in front of agricultural researchers and managers of agricultural farms primarily due to large amount of data, high speed of data generation and delivery, different sources of big data, quality of big data and trustworthiness of sources (Fosso Wamba et al. 2015). Big data and analytics can be helpful for supply chain network design and managing the risks in this highly uncertain environment (Papadopoulos et al., 2017).

The research gaps that emerge from the literature conveys that although there has been technological progress in the area of Internet of Things (IoT) and application in ASC, yet there is a lack of managerial capability which motivated to pursue this research study. Manageability would possibly be enhanced through better understanding of barriers to IoT application and understanding the control mechanisms for enhancing sustainability. The overall objective of the study is to achieve a chain of objectives i.e. (a) to understand the role of IoT in enhancing performance of ASC, (b) to identify the barriers to IoT