

# Cloud Computing to Improve Agri-Supply Chains in Developing Countries



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## INTRODUCTION

The economies of developing countries are largely dependent on agriculture (Diao, 2005) as their agricultural sector is main contributor to the GDP and a major employer. Three quarters of the population in developing countries live in rural areas (Sangraula, Chen, & Ravallion, 2007) and majority of this population depend on agriculture related activities to maintain their subsistence livelihood. There has been general agreement on the importance of agriculture to overall economic growth and ensuring a better quality of life to the people in agriculture sector; however, the majority of these people tend to be poor and have a low standard of living (World Bank Report, 2008).

Some of the reasons for the failure of the agricultural sector to reduce poverty and improve the quality of life in developing countries are the absence of robust supply chain management (SCM) practices, illiteracy of workers, unavailability of up-to-date information related to agriculture best practices, and unavailability of specialized information related to storage, packaging, transportation, and a lack of knowledge of quality and safety standards (Gebresenbet, et al., 2005). Efficient supply chain systems help reduce waste, make production system more responsive, and enable farmers to respond to consumers need in terms of quantity, quality and safety of products.

Supply chain management is an integral approach in which supply chain partners collaborate to jointly plan and control the flow of goods, information, and capital from 'farm to table'. Usually, supply chain partners are separated by time and space and they progressively add value to the products when it passes from one partner of the chain to the next. In addition, supply chain management aims at coordinating pro-

duction, storage, and distribution processes (Lambert, et al., 2000). Successful implementation of supply chain management results in lower transaction costs and increased margins. Collaboration in supply chain is attained through implementation of specialized information and communication technologies (ICT); however, the cost of implementing and maintaining dedicated information systems is significant. Effective use of information sharing along supply chains can result in less waste and improved outcomes (Wood, 2011). Recent advances in software and infrastructure means that 'cloud computing' can be introduced in agri-supply chains in an attempt to reduce cost and facilitate collaboration and coordination among various actors of supply chain. ICT can often help workers in the supply chain understand how to coordinate actions better to overcome problems associated with long chains and little visibility between partners, such as not understanding quality requirements or what products are most desired in what location (Shi, Cheng, Lei, Wen, & Merrifield, 2011).

Cloud computing is a combination of virtualization techniques that connect numerous computers through a real-time communication network. Cloud users can perform a variety of tasks like running operating systems, software, and store and retrieve data by remotely accessing hardware via vast global networks even without owning the underlying software or hardware (Hayes, 2008). Therefore, cloud computing is a promising technology to improve economic conditions of developing countries by providing low-cost but real-time information (Greengard, 2010). That information can be used to coordinate and collaborate with various supply chain partners.

The objective of this article is to propose a 'cloud computing' solutions to the challenges faced by farmers

in developing countries. Cloud computing can provide customized, updated, real-time information to desktops or mobile phones through Internet connectivity at reasonable costs. First, we examine agri-supply chains and how ICT can aid improved SCM. This is followed by our discussion of cloud computing as a solution to the problems faced by managers of IT companies in designing an efficient supply chain system for farmers in developing countries.

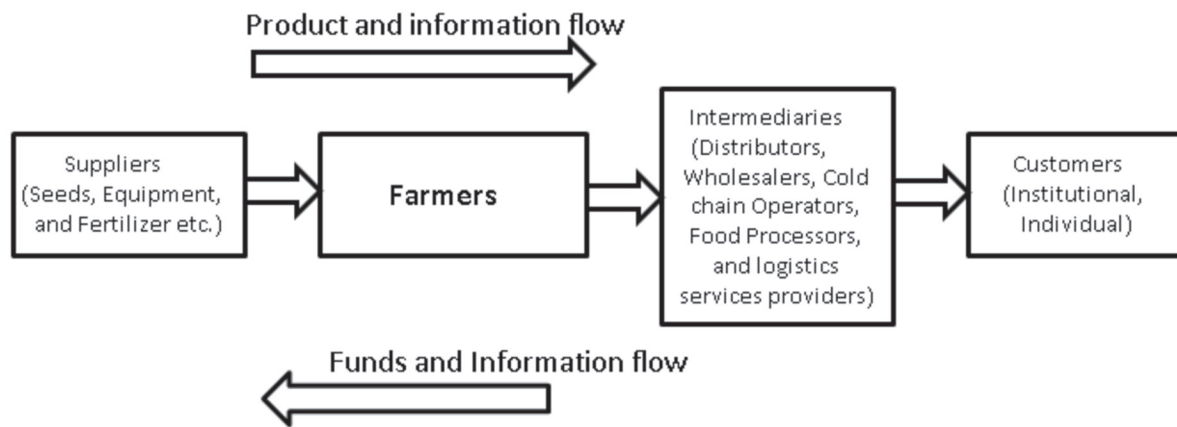
## OVERVIEW OF AGRI-SUPPLY CHAINS IN DEVELOPING COUNTRIES AND CHALLENGES FACED BY THE FARMERS

Agri-supply chains provide a collaborative framework that link different actors from farm-to-table including growers, pickers, storage and transport service providers, processors, distributors, and retailers responsible for efficient flow of products with minimum costs to satisfy customers' requirements in terms of quality, quantity, price, and safety (Figure 1).

Developed countries have practiced agri-supply chain management for a long time to increase profitability and reduce cost. This has not occurred in developing countries as their agri-supply chains tend to be fragmented and involve many more players from production level to the point of consumption; their supply chains tend to have strong social elements and

are less transactional. Even in such a transactional environment, investment in ICT-enabled initiatives to support transactional services can provide significant benefits (Ali & Kumar, 2011). Usually, farmers in developing countries are not concerned with customers' requirements in terms of quantity, quality, and price; the farmers lack market information regarding these requirements. They are either selling their produce in the local market themselves in anticipation of making good profits or deal with marketers. There is always a communication gap between farmers and consumers and due to inadequate supply chain systems, profitability is depressed which results in slower economic growth (Worimo, 2007). ICT resources can positively influence relationships along agriculture supply chains. Present supply systems are scattered and attention is given to maximize individual profit without considering system-wide costs. Small-scale producers are disadvantaged in larger supply chains because they struggle to align themselves with changing market conditions; this struggle is exacerbated as they continue to use traditional farming and marketing strategies, are disadvantaged by illiteracy, and they have little investment capital. Significant post-harvest losses occur due to unavailability of specialized knowledge relating to temporary storage, packaging, and transportation options. Such post-harvest losses reduce profitability and also lower the quality of the produce. Cloud-based services could support the introduction and use of 'intelligent systems' to support farmers' use without

Figure 1. Conceptual diagram of agri-supply chain



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