Strategies for smallholder farmer access to dynamic fresh produce value chains: An agent-based approach

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ABSTRACT

Smallholder farmer' supply of market channels such as supermarkets, wholesalers, service outlets, and informal traders is associated with a number of challenges. This warrants the adoption of innovative and entrepreneurial strategies for smallholders through which they are able to spot opportunities amidst a highly competitive and dynamic environment. Agent-based modelling (ABM), which this paper proposes, is suited to studying individual behaviour of heterogenous, autonomous agents (in this case smallholder farmers) through which they interact with other agents and with their environment with goal of maximising rent. It is also used to gain deeper insight in the market dynamics and to elaborate optimal strategies for smallholder farmers.

INTRODUCTION

Approximately 1.5 billion people are engaged in smallholder agriculture across the world. This include 75% of the world's poorest people whose food, income, and livelihood prospects depend on agriculture. Despite their important role as food producers and rural stewards, the commercial prospects for millions of smallholder farmers remain challenging (USAID, 2014). Lack of access to markets for smallholders, one of the biggest challenges that smallholder farmers face, increases household vulnerability to poverty, hence participation of small farmers in markets is important for pro-poor development (van der Heiden & Vink, 2013). Ngqangweni, *et al* (2016) defined market access in the context of smallholder farmers as the ability of smallholder farmers to seize available market opportunities. According to Louw, Jordaan, Ndanga & Kirsten (2008), the strict requirements of retailers in particular may lead to exclusion of smallholder producers from markets. This warrants the adoption of innovative and entrepreneurial strategies for smallholders through which they are able to spot opportunities amidst a highly competitive and dynamic environment. The dynamics of the market results from the behavior of many interacting agents, leading to emergent phenomena that are best understood by using a bottom-up approach, Agent Based Model (ABM).

METHODOLOGY

Agent-based modeling (ABM), a system is modeled as a collection of autonomous decision making entities called agents. Each agent individually assesses its situation and makes decisions on the basis of a set of rules. Agents may execute various behaviors appropriate for the system they represent, e.g. producing, consuming, or selling. At the simplest level, an agent-based model consists of a system of agents and the relationships between them. Even a simple agent-based model can exhibit complex behavior patterns and provide valuable information about the dynamics of the real-world system that it emulates. In addition, agents may be capable of evolving, allowing unanticipated behaviors to emerge.

The ABM can applied in emergent phenomena abound in the social, political, and economic sciences. It is best useful at this following point:

- When the interactions between the agents are complex, nonlinear, discontinuous, or discrete (for example, when the behavior of an agent can be altered dramatically, even discontinuously, by other agents).
- When space is crucial and the agents' positions are not fixed. When the population is heterogeneous, when each individual is (potentially) different.
- When the topology of the interactions is heterogeneous and complex.
- When the agents exhibit complex behavior, including learning and adaptation.

An ABM of smallholder entrepreneurship

The deregulation in the agricultural sector eliminated the old marketing regime and set objectives to promote efficiency, increase market access, optimise export earnings, and promote the viability of the industry. This has however, proven to be more challenging than anticipated (NFPDA, 2007). The below figure 1 illustrates various channels explored by producers to spot markets.

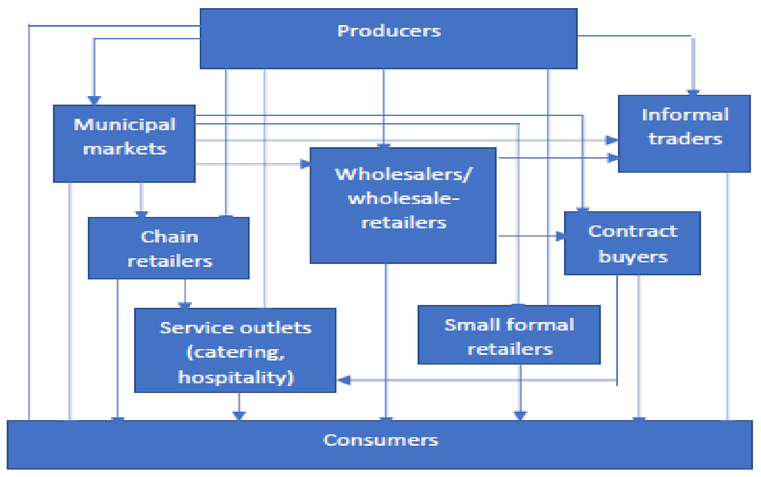

Figure 1:Stylesed depiction of the South African fresh produce value chain
Source: Adapted from Louw, *et al.* (2008)

This paper proposes an agent-based model (ABM) to study smallholder farmers' behaviour as they implement various entrepreneurial strategies in bid to access fresh produce markets and to maximise wealth creation. ABMs are beginning to be explored in literature to study the complex and dynamic nature of the entrepreneurial process (Ross, 2009). The proposed ABM for the purposes of this paper is adapted from Ross & Westgren (2009) and can be conceptually illustrated by means of Figure 1 below.

Figure 2 depicts the flow from a state of market equilibrium, the search for and exploitation of new opportunities, and the extraction of rent from the market. A hypothesis could therefore be developed as follows: smallholder farmers that exhibit more entrepreneurial capabilities are more likely to find lucrative opportunities in the fresh produce value chain than those who do not. The testing of this hypothesis will be subject of a future empirical study.

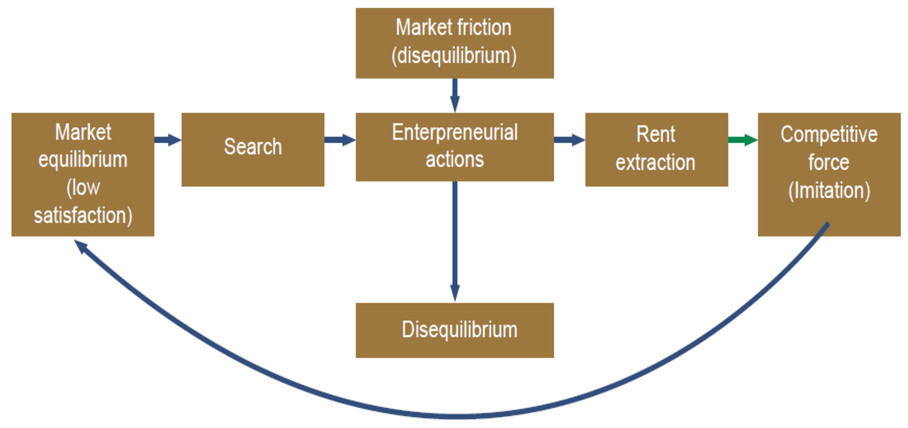

Figure2: Illustration of the rent-extracting entrepreneurial behaviour
Source: Adapted from Ross & Westgren (2009)

CONCLUSION

Simulations (notably agent based simulations) have been used in recent studies to understand impact of interactions between firms of varying entrepreneurial capability and with their business environments. This article proposes the use of an agent-based model to test the hypothesis that more entrepreneurial smallholder farmers are more likely to perform better in exploiting opportunities in the dynamic and competitive fresh produce value chain. To be able to design efficient and effective automated trading strategies, one first needs to understand the workings of the market, the strategies that traders use, and their interactions as well as the patterns emerging as a result of these interactions. Results from this simulation could be useful in informing smallholder support policies and interventions to assist in the commercialisation of smallholder farmers.