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Design Thinking and Compliance as Drivers for Decision Support System Adoption in Agriculture

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ABSTRACT

To respond to increasing demands for good agricultural practices (GAP) and food safety, governments globally are introducing stringent regulations to govern agricultural compliance that affect production, storage, and sales activities. New legislation in Argentina to enforce GAP is an opportunity to test compliance as an incentive to adopt technological solutions. This research aims to determine whether compliance software is an effective gateway to shift farmers' decision-making strategies from intuition-based to evidence-based, improving agricultural productivity through technology. Integrating technology can be a significant hurdle for farms but is also a steppingstone towards more reliable processes. To address this, the authors prototype a decision support system (DSS) for greenhouse farmers in La Plata, Argentina, to help farmers keep traceable records of their crops and treatments to reduce compliance risk. The project incorporates lessons learned from previous DSS projects and utilises design-thinking strategies to involve the end-user in the development.

KEYWORDS

Agricultural Compliance, Agriculture, Decision Support System, Design-Thinking, RUC-APS, Technology Adoption

INTRODUCTION

Technology and decision support systems (DSSs) have potential to improve food safety, production efficiency and therefore profits for agricultural business especially in developing countries (Fuglie et al., 2019). Their low adoption rates proves a significant hurdle for productivity improvements (Fuglie et al., 2019; Parker & Campion, 1997; Rossi et al., 2014), however studies suggest that compliance and end-user participation in design could be effective to increase sector-wide use (Parker & Campion, 1997; Rose et al., 2016; Rossi et al., 2014). This study will explore these drivers further through developing a compliance-focused DSS within a developing economy that is introducing new food safety regulations. The authors introduce the study first through: (i) background of agriculture and

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technology adoption, (ii) the context of this study conducted in Argentina and (iii) aims and objectives to address the aforementioned challenge.

BACKGROUND

The agriculture landscape is changing. The past five decades have seen a global shift in the field of agriculture from resource-driven growth to productivity-driven growth (Fuglie et al., 2019). Previously, farms have improved agricultural output through the expansion of land, use of pesticides, more fertilisers and other inputs. Now, most farms prioritise the improvement of resource and labour efficiency alongside good agricultural practices (GAP) and technology (Fuglie et al., 2019). Agricultural productivity has been lower in economically developing countries compared to advanced economics, impeding their convergence. Whilst much of the world has embraced technology with open arms, agriculture has adopted it more gradually (Fuglie et al., 2019). Technology and innovation are crucial to accelerate improvements in the sector and embody state-of-the-art practice (Fuglie et al., 2019). The knowledge capital contained within software and hardware can transform farm owners' businesses through improved connection to customers, streamlined supply chains and enhanced yields (Fuglie et al., 2019).

DSSs, a type of software solution designed to aid users make better decisions (Dicks et al., 2014), have shown success in both private and public sectors such as healthcare, banking and engineering (Papathanasiou et al., 2016). They have the potential to benefit farmers by presenting the likelihood of various outcomes from different options (Dicks et al., 2014; Rose et al., 2016) and can guide users through decision stages by providing expert advice that automatically corresponds to the user's inputs and recorded data for analysis (Been et al., 2009). The analysis conducted by such tools provide data-driven insights which may have otherwise been inaccessible or prone to human error. Despite a wide variety of DSSs for agriculture, studies indicate a disappointingly low uptake (Parker & Campion, 1997; Rose et al., 2016; Rossi et al., 2014) which is amplified in developing countries due to reasons such as technology and software being considered 'risky' by farmers (Fuglie et al., 2019). DSSs have barely contributed to practical agriculture due to this 'problem of implementation' which has been ascribed to technical limitations of software and farmers attitudes towards DSSs (Rossi et al., 2014). There are numerous detailed analyses on reasons for failure and non-adoption (Parker & Campion, 1997; Rose et al., 2016; Rossi et al., 2014) that will be examined more closely in the related works section.

The adoption of technology in agriculture in developing countries could help provide improvements that do not solely tackle production efficiency but also raise the bar of food quality for higher-value exportable products (Fuglie et al., 2019). This can be a significant growth opportunity for small-holder producers in order to meet the standards of other markets and ultimately catalyse impact on their triple bottom line: social well-being, environmental protection and economic value (Slaper & Hall, 2011).

Compliance has been identified as an incentive factor for adoption of DSSs in agriculture (Rose et al., 2016). Compliance certification schemes, such as global GAP (GAP, 2019), are a method of ameliorating aspects of supply chain traceability and food quality, yet many farms lack the existing systems and processes to reliably track crops from seed to harvest. This includes logging of pesticide treatments that have been approved by local regulatory bodies. Multigenerational farms, and the farms included within this study, can be slow to innovate and they may collect necessary data with pen and paper and transfer this data to spreadsheet tools. McKeever et al (2009) declare "the reliability of spreadsheets are essentially the accuracy of the data it produces and is compromised by the errors found in approximately 94% of spreadsheets". These errors are common, non-trivial and can be unforgiving in directly causing catastrophic loss of institutions and companies (Croll, 2008; Panko, 2008). In the context of Agriculture, data may be incorrectly inputted causing noncompliance and revocation of a contract when perhaps data was inserted correctly but the programme was unable to highlight a breach of compliance enabling swift preventive action.

Gender Equality in Business

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