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Cloud-based system for rational use of pesticide to guarantee the source safety of traceable vegetables

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ABSTRACT

Recent legal requirements and market demands have motivated more food companies to implement traceability systems. Ensuring safe farming practices is the first step in food supply chain traceability, and reasonable pesticide use is a main feature of food safety and sustainable production. This study describes the design and development of a cloud-based platform for rational pesticide use to guarantee the source safety of traceable vegetables. The system includes a pesticide use control cloud platform (PUCC) and a pesticide user application (PUA), which interactively guide users through the steps of pesticide purchasing, pesticide application, harvest time, and pesticide evaluation. Models for evaluating and recommending potential pesticides were developed based on an open library of pesticide use rules. The PUCC, which includes the main functions of farmer registration, authentication of platform administrator, and information management for plant protection service agencies, was developed using Microsoft Visual Studio 2010 and deployed on the Internet. The PUA provides interfaces for pesticide purchasing guideline, pesticide application, optimal harvest time, and feedback. As a case study, the system was used for about a year in 24 vegetable bases in Tianjin. The effectiveness of the system was evaluated by investigating 8 management center staff members and 41 farmers. Management agencies noted the positive effects of promoting reasonable pesticide use, facilitating information accessibility, and enhancing management. Advantages to farmers included reducing the risk of unreasonable pesticide usage, decreasing the risk of counterfeit pesticides, and improving vegetable quality and safety; disadvantages included increased costs and reduced efficiency. In addition, the system improved external and internal traceability to ensure crop quality and safety.

1. Introduction

Human activities are posing increasingly severe threats to ecosystem health and global food security and safety (Popp, Pető, & Nagy, 2013). For example, the impacts of global climate change, desertification, pesticide exposure, antibiotic-resistant strains of microorganisms, animal growth hormone residues in human food, development and widespread dissemination of GMOs, and other challenges are causing widespread environmental problems (Notarnicola, Hayashi, Curran, & Huisingh, 2012; Thiollet-Scholtus & Bockstaller, 2015). Over recent years, many agro-foods have failed to meet market and consumer demands due to difficulty in complying with quality, security, and environmental sustainability requirements (Borit & Santos, 2015). Traceability is an effective way to ensure food safety and quality as well as reduce the costs associated with recalls (Regattieri, Gamberi, & Manzini, 2007). Based on existing definitions of traceability (Bertolini, Bevilacqua, & Massini, 2006; Dabbene & Gay, 2011; McEntire et al., 2010), Olsen and Borit (2013), a new definition can be provided: the ability to access any or all information related to the product under consideration throughout its entire life cycle by means of recorded information.

For vegetable traceability, farming is the original step in the product's life cycle. Pesticides are an essential part of agricultural management and play an important role in increasing the yield and quality of crops (Barriere, Lecompte, & Lescourret, 2015; Hossard

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