International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 04 | April -2020 ISSN: 2582-3930

Agricultural Product Traceability System for Agro Food Quality

Prof. Komal Surawase[1], Akash Kamble[2], Pranav Mhetre[3], Prerna Ranaware[4], Swapnali Patole[5]

[1] *Professor, Dept. Of Computer Engineering, MMIT, Pune, Maharashtra, India*
[2,3,4,5] *Student, Dept. Of Computer Engineering, MMIT, Pune, Maharashtra, India*

Abstract - In recent times, the correct and timely traceability of agriculture products and activities in the supply chain has become a brand new factor in food and agribusiness. More and more, consumers in several elements of the globe demand for verifiable proof of traceability as an important criterion of agriculture product quality/safety. This trend has been underpinned by many market-pull factors as well as increasing world demand for food product originating from various sources, high incidence of food-related health hazards and increasing concern over the impacts of genetically changed organisms (GMOs) on the human organic phenomenon and therefore the surroundings. so as to fulfill consumer demands for consistent offer of high quality, safe and wholesome foods, also make public confidence within the organic phenomenon, the planning and implementation of full backward and forward traceable supply chains from farm to end-user has become a vital half of the overall food quality assurance system. Farmers, post-harvest handling operators, marketers, analysis practitioners and policy manufacturers want sensible understanding of the ideas and implications of supply chain traceability to help in developing and implementing acceptable technological interventions to fulfill consumer demands. The objectives of this article is to review the concepts of supply chain management and traceability in agriculture, and highlight the technological challenges in implementing traceable agricultural supply chains. Development of acceptable measurement tools for food product labeling and identification, activity/process characterization, info systems for knowledge capture, analysis, storage and communication, and therefore the integration of the general traceable supply chain are essential for fulfillment.

***Key Words*:** traceability, supply chain, agriculture, records, analysis, software system

1. INTRODUCTION

Agricultural traceability system plays an important role to improve our food safety. Based on the analysis of existing agricultural traceability systems, this paper analyses the weaknesses of these systems, that is, they are too dependent on a certain of production. Motivated by this consideration, this paper introduces a common agricultural traceability method based on data center. The method describes the traceability information of different agricultural products with different processes of circulation by quoting the following three concepts: traceable resource unit, information granule, supply chain, which can be applied to all agricultural traceability. Finally, this paper designs a common agricultural traceability system on this method.

A traceability system (TS) has to the assignment to provide strategic information in the unfortunate case when a lot of product has to be recalled. Product recalls are an increasing concern for food companies and government agencies (e.g. FDA for US and RASFF for EU). Traceability can be voluntary, when disposed by the food manufacturer itself, or forced. The main causes of product recalls are incorrect labeling and packaging, failures in good manufacturing practice, and, of course, the identification of conditions that can compromise the safety of the food and consumer's health (chemical contamination, microbial agents, foreign material, under cooking of product etc.). Another frequent cause is the (undeclared or accidental) contamination of raw and semi-processed materials with allergens (especially eggs, peanuts, dairy and wheat). The occurrence of food and feed recalls is increasing and exceeded 3700 notification cases.

This fact can also be imputed to food safety standards and new government regulations, to the development of new detection technologies and the increasing importation from low-cost 1countries, where food safety standards are frequently less severe. The management of a recall procedure involves many activities, ranging from the risk assessment, the identification of the interested products, the notification of the measure to the actors of the supply chain (suppliers, distributors, buyers etc.), and, finally, the recall action identified common data requirements for traceability and data exchange, and analysed opportunities for the automation of the notification process in the case of a recall. There are many consequences in a recall action. One of the first, is the potential drop in consumer confidence. Indeed, a negative image of the brand can remaining the subconscious of potential consumers for long periods. The company has then to incur costs related to the logistics of the recall and the destruction of all the products that are, in some way, connected with the incriminated batch.

Since this could be absolutely critical for a company, it is important to prepare action plans to be ready to such undesired event. Some studies have been carried on for modelling and forecasting the effects of recall actions. What resulted is that most companies do not have reliable methods to manage a recall strategy on the basis on estimation the real amount of product that has to be discarded in the case of a recall. The recall of a product typically follows two steps that should be performed in very short time: the backward identification of potential deficient lots and then the forward identification of potentially affected products that have to be withdrawn. Considering the main task of TS, the performances of a TS can therefore be associated to its ability to react to a crisis, holding down the amount and the costs of the product to be recalled. Following the entering to force of EC Regulation 178/2002 and subsequent normative, traceability has evolved in different directions, engaging many aspects among which the definition of optimal lot size and mixing routing rules, the tracking of products in

distribution net-works and the embedding of product quality information for supply chain managements purposes.

This paper presents a brief overview of the state of the art of their search on traceability and the open problems nowadays subject of research. To enter in a deeper detail, authors have chosen two specific aspects: the definition and the evaluation of the performances of a traceability system (TS) connected to the minimization of the impact of a possible product recall, and the management of traceability information related to bulk products. These research lines have been selected considering their impact on the supply chains, on the market, and on the consumer, and the very recent results published in literature. These arguments are very up-to-date and rich of ongoing applications in different food and product supply chains.

2. RESEARCH OBJECTIVE

The main analysis objective of the thesis is to outline a reference knowledge model that may enable continuity of product info chain of custody throughout the value chain. Determining the mandatory knowledge components and their transformation inside the concept of Product Lifecycle Management (PLM) allows the product's info to be coupled within the chain to future to expand traceability for any product throughout all stages of production, processing and distribution. Track and trace needs that each one components of the availability chain invest in compatible technology and agree upon capturing and sharing info concerning product movement. for instance, the time that a TRU has touched from the first producer to the retail store, we'll realize it's going to have capable variety of steps. These steps are named as transformations, like mix, merging, pooling (clustering), splitting, joins, convert, etc. Therefore, this analysis proposes a model for registering and maintaining the TRU information chain of custody throughout the availability chain by employing a product centrical knowledge modeling supported PLM, ISO/TC 10303 - IEC 62264 standards. within the second a part of the thesis, I propose a style methodology for associate degree internal/external traceability system implementation. future a part of the thesis can cowl XML and its use in traceability as a common language for knowledge exchange between organic phenomenon participants. The final a part of the thesis proposes a tool for watching and recording traceability knowledge at farm level by victimization GIS. In general, traceability at farm level sometimes is neglected because of the high value of system implementation and maintenance. within the past the reason for many food borne sicknesses were copied back to farm level. These outbreaks for sure brought the importance of traceability at farm level underneath the measuring device.

3. TRACEABILITY SYSTEM

Agricultural traceability involves the collection, documentation, maintenance, and application of information related to all products and processes in the supply chain in a manner that provides guarantee to the consumer and other stakeholders on the origin and life history of a product as well as assisting in crises management in the event of a safety and quality alert. With respect to a food product, traceability represents the ability to identify the farm where it was grown, the sources and types of input materials, and the ability to conduct full backward and forward tracking to determine the specific location and life history of the product in the supply chain by means of documented records. Traceability adds value to the other quality and safety management strategies by providing the communication linkage for identifying, verifying and isolating sources of non-compliance to agreed standards and customer expectations.

Growing loss of consumer confidence and food and environmental regulatory pressures leave the agriculture and food industries with little option but to implement traceable supply chains as part of the overall food safety and quality management system. As these pressures intensify and agriculture continues to experience declining terms of trade in favour of the high-tech and service industries, there are good reasons to believe that the future of traceability as an important quality attribute and agricultural trade index is assured. Developing cost-effective technological innovations for implementing reliable traceability systems is therefore paramount for new market access as well as meeting existing physical to sanitary requirements.

As mentioned earlier, traceable resource units are the smallest uniquely identified entities corresponding to physical objects of the value chain, and the success of the traceability system relies on tracing and tracking these core entities throughout the value chain.

Determining what the Traceable Entities are is a major part of creating a dynamic traceability model for a particular value chain. For example if the production batches are too big or there is too much mixing occurs during production, the precision of the traceability system will be compromised (Dupuy et al., 2005).Therefore it is important to analyze the current production practice within the organization as well as how TRUs are defined. If it is needed, necessary adjustments have to be made to implement an effective traceability system. According to Moe et al. (1998), defining the TRU for continuous processing can be challenging. It may depend on how the raw material TRU was received and or on a change in processing conditions such as the clean out process for production equipment.

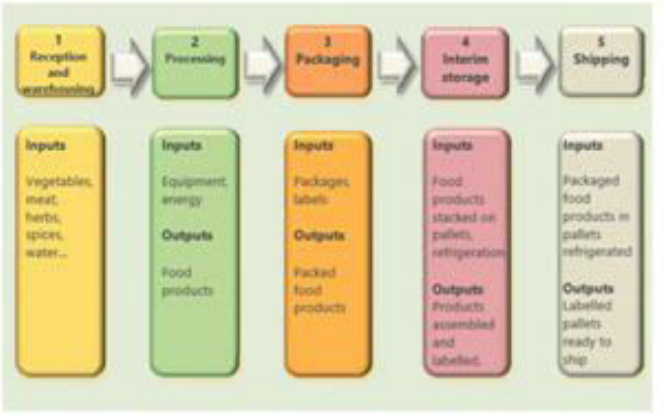

Fig -1: Execution Model

4. MODEL DEVELOPMENT

To use of GIS in making farm base traceability system for informatics grain, IP key techniques is enforced as well as style of abstract and logical design of traceability geodataset, the development of traceability information demand, and mapping

of production method flow. Each following and tracing info have spacial information elements that is tied to non-spatial information that provides nice convenience for accessing and managing these information geographically. Secondly, usage of Grain safe Program for determinant essential information components for non GMO and informatics crops traceability provided sturdy foundation for effective traceability system development at farm level. For the aim of this thesis, the merchandise description was based mostly on non-GMO food corn. The supposed finish use of this product was domestic processors, or international markets that have strict standards to stop getting into GMO corn into their market. The method flow sheet below was style to stipulate every step for production of non-GMO corn in line with HACCP principles. The diagram includes each steps starting from fields choice, assessment of the neighboring fields and ends with cargo of the grain off the farm. These processes were taken as an essential information capturing purpose for this project.

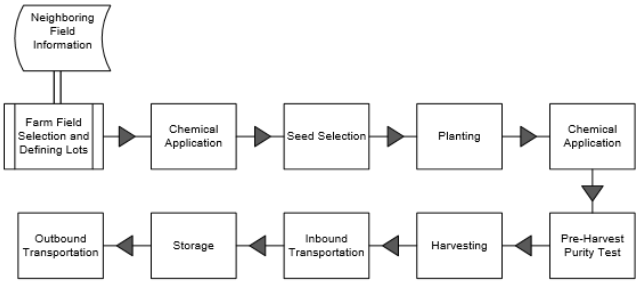

Fig -2: Process Flow Diagram

5. TRACEABILITY TOOLS AND TECHNOLOGY SOLUTION

Automated information assortment removes abundant of the time and expenses needed for knowledge processing and maintenance. Gathering data represented within the previous section for giant operations manually is time-consuming, as a result of workers should initially record the knowledge at the purpose of activity then relay this data either manually or transcribe and enter the info into the computer system. This could cause risks of recording the knowledge incorrectly. For example, errors occur in thirty-six % of shopper grocery orders in step with a study by the Grocery makers Association (GMA) within the United States9. Such errors result in inventory inaccuracies, and stock ruptures. The chase or forward traceability makes it attainable to see the finished merchandise containing a specific ingredient or having undergone a specific method. Tracing or backward traceability, in turn, is beneficial in characteristic suppliers and processes that have contributed to the production of a specific product. Therefore, most traceability initiatives have faith in technologies to supply economical, correct ways that to track and trace merchandise and their movement across the provision chain. This includes technology for product identification, data capture, analysis, storage, and transmission of knowledge as well as overall system's integration. Such systems embrace hardware like measuring/sensing equipment, identification tags and labels, with computer code. Traceability information could also be minimum and will contain solely the date of manufacture, expiry date, and batch range, for instance. It will likewise be richer, as well as method information serialized at an item level. The finer the traceability information, the foremost targeted the recall (Moe, 1998; Berman, 1999). Targeted recall borderline the recall to solely defective things. It therefore reduces the direct and indirect impacts of the recall. Kumar and Budin (2006) offer samples of recollects during which a vast recall was conducted on the far side the non-compliant merchandise as a result of that traceability was lacking.

6. QR(QUICK RESPONSE) CODE

With the operation methods designed in the system, the administrator can conveniently operate the system; the number of required work tools or materials can be added or deleted, and QR codes are easily generated and printed on the work zones in accordance with the demand, which significantly simplifies the procedures and reduces the difficulties of operations for the administrator

Fig -3: Diagram for the product traceability system automatically generating a QR code

7. DESIGN AND IMPLEMATATION

Database Design

Agricultural traceability database (data center) is an important information carrier, which stores and manages the information of all the circulation links. Each link in the agricultural supply chain, which focuses on enterprises, has defined its TRU that includes traceability code and information granule. Figure 3 shows the E-R diagram of the agricultural traceability database, in which the traceable resource unit is the core entity, including two attributes: trace id and information granule. The material of the trace-able resource unit is also a traceable resource unit. Trace-ability resource unit relationship is used to achieve tracing and tracking. Traceability resource unit table is comprised of product trace id and information granule, which is stored as CLOB.

Data Acquisition

The agricultural traceability system based on data center builds a data acquisition system from enterprises to datacenter. Enterprises are required to paste or print the traceability code to products, and submit the traceability code, information granule and the material traceability code of their products. In this way, it will generate the information of each traceable resource unit

and the relationship between product traceable resource unit and material traceable resource unit in the data center.

Traceability Query

Agricultural traceability inquiry system is able to track and trace agricultural products. Users only need to input the traceability code to the special textbox in the inquiry sys-tem, when want to trace the products. The system will find and display the traceability information and the material products of the products by accessing the traceable resource unit table and the traceable resource unit relation-ship table in the data center. It can also offer the traceability information of the products' material products in the same way. Users can track the products by repeating the similar operation.

Applications of the Traceability System

The common traceability system has been applied as a demonstration in 31 enterprises and 12 supermarkets or hypermarkets in 11 provinces or cities of china which have realized agricultural traceability information sharing and exchange. Up to the present the method has already been applied in many agricultural products such as Hunan tea, Anhui honey, Chengdu ducks, Pinggu peach of Beijing and so on.

7. ADVANTAGES

A. Minimize recall size

Since it's clear what product is in danger, wherever it went, and when, it's possible to travel straight to the distributors and even retailers carrying the affected product. This keeps each the prices and visibility of the recall low.

B. Respond quickly

Info will return from several sources. A provider might observe a problem when the event, a client might notice a defective product, or internal method observance, control and examination activities would possibly unearth a problem. The linkage with ERP through recipes and formulas, provider info, and customers makes it doable to retrieve info quickly and to understand wherever the affected product went. This will be force up as unjust information for those working on the recall.

C. Information integrity

Traceability systems that associate degree integrated part of your ERP systems connecting multiple departments on the provision chain, together with sales, production, quality, and distribution reduces keying errors and generates reliable information. This minimizes uncertainty and confusion throughout a recall, and helps to scale back its scope and scale. It conjointly ensures there's information to know once each at-risk product has been recalled.

D. Maintain client trust and confidence

Associate degree aura of competency is made once a manufacturer is evident concerning what ton numbers, batches, or distribution shops are affected. This reassures customers that the case is in check and there's no risk to them.

E. Information for liability claim protection

Effective traceability forms the premise of systems that guarantee every at-risk item is far from shelves, protective a corporation against claims of negligence.

F. Pain reduction

Coverage on the benzene contamination recall in might 1990, the LA Times noted that, prices related to the recent leads to a seventy five % plunge in earnings for 1989. It's not possible to mention with any certainty that a contemporary traceability system would have lessened the costs, however given the tools currently obtainable, it looks affordable to believe therefore. Ought to your business ever be concerned in an exceedingly recall, effective traceability can reduce the pain.

8. LIMITATIONS

Needless to mention traceability needs are heavy for producers, significantly those in developing countries, wherever the assembly of little operators is commonly mixed before exportation. Record keeping obligations also can sway be overly difficult for them to befits. There are some immediate operational disadvantages to traceability systems. The problem of "mixage" is one in all them. Raw agricultural commodities are usually mixed shortly when harvest. This can be done to create little quantities into exportable quantities. Undoubtedly, these are extra prices to most market operators and presumably prohibitive ones for developing countries' exporters and producers. It's easier to manage traceability systems inside single enterprises wherever the knowledge is available in an exceedingly single format to any or all participants within the production method from seed to farm and client.

3. CONCLUSIONS

Today, in many developed countries, traceability necessities became obligatory. The issue of food safety has been the main cause for adopting such rules. Indeed, each the government and patrons have reason to require such measures due to crises like outbreaks of avian contagious disease or bovine spongiform encephalitis. What is more, a traceability system additionally guarantees product genuineness and gives reliable info to customers. However, developing countries could face vital obstacles in achieving ample traceability standards. They lack info and correct infrastructure to implement an efficient traceability system that they understand as pricey.

ACKNOWLEDGEMENT

We would like to express our gratitude to all those who helped us to complete this work. We want to thank our guide Prof. Komal Surawase for her continuous help and generous assistance. She helped in a broad range of issues from giving us direction, helping to find the solutions, outlining the requirements and always having the time to see us.
We have furthermore to thank Mr. S.G. Rathod, Head of the Department of Computer Engineering and Information Technology, to encourage us to go ahead and for continuous guidance.

We would like to thank Marathwada Mitramandal's Institute of Technology who helped us time to time from preparing report and giving good suggestions. We also extend sincere thanks to all the staff members of Department of Computer Engineering and Information Technology for helping us in various aspects.

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BIOGRAPHIES

Prof. Komal Surawase was born in Maharashtra, India in 1990. Graduated from Mumbai University in 2012 (major in computer engineering), post graduated from Savitribai Phule Pune University in 2014 (major in computer engineering). She is the assistant professor at Marathwada Mitramandal's Institute of Technology.

Akash Kamble was born in Maharashtra, India in 1991. Perusing graduation degree from Savitribai Phule Pune University (major in computer engineering). He is a student of final year engineering at Marathwada Mitramandal's Institute of Technology.

Pranav Mhetre was born in Maharashtra, India in 1998. Perusing graduation degree from Savitribai Phule Pune University (major in computer engineering). He is a student of final year engineering at Marathwada Mitramandal's Institute of Technology.

Prerna Ranaware was born in Maharashtra, India in 1998. Perusing graduation degree from Savitribai Phule Pune University (major in computer engineering). She is a student of final year engineering at Marathwada Mitramandal's Institute of Technology.

Swapnali Patole was born in Maharashtra, India in 1998. Perusing graduation degree from Savitribai Phule Pune University (major in computer engineering). She is a student of final year engineering at Marathwada Mitramandal's Institute of Technology