An Efficient C4.5 Algorithm based Heuristic to Endure Sustainability in Multi-Tier Agri Food Supply Chain

Dr. E. Sophiya[1], Dr. E. Gurumoorthi[2], J. Vijayabarathy[3], M. Jothimani[4]

[1] *Asst.Professor, Dept of CSE, Sree Vidyanikethan Engineering College, Tirupati, India*
[2] *Asst.Professor, Dept of CSE, St Peter's Engineering College, Hyderabad, India*
[3] *Asst.Professor, Dept of Computer Science, Perunthalaivar kamarajar arts college, Puducherry, India*
[4] *Associate Professor, Dept of Computer Science, St.Mary's College, Thoothukudi, India*

Abstract: Multi-tier agri food supply chain (MT-AFSC) is gaining momentum in academia and practise these days. After all, there has been little focus on social sustainability, and attempts to integrate it into supply chains, especially among low-tier suppliers, have run into major obstacles. As a result, the aim of this study is to model a sustainable multi-tier framework for agri-food supply chain that is controlled using C4.5 with Internet of Things (IoT) technology. The proposed architecture would help the agri-food supply chain make more reliable decisions and use better data over time. The operation of the internet of things is addressed to track and trace the Agri food quality to check the data acquired from agri land, production process and supplier. The main work of C4.5 algorithms is to predict unsafe agricultural products and further access will be blocked at every point on the network.

***Keywords*: Internet of Things, Agri Food Supply chain, C4, C4.5, and Sustainability**

1. Introduction

Over the past decade, Agri food has been the primary source of energy for human society, and its quality and protection has been a major concern around the world, especially in China, for a variety of reasons. Agriculture is the primary component of the global economy, especially in developed nations. Agriculture is the world's main source of jobs, revenue, and food, and it meets many of these fundamental needs. The agricultural population accounts for 67 percent of the total population, according to the Food and Agriculture Organization (FAO). Agriculture goods account for 43 percent of all exports, accounting for 39.4 percent of GDP [Neha Khanna and Praveen Solanki 2014]. Many developed agricultural producing countries depend on agricultural imports for food security, and many emerging countries cannot refine until local demand increases significantly. It is undeniable that agriculture's position in global economic growth has improved significantly in recent years.

Agriculture occupies about 11% of the world's territory, with animal grazing accounting for about 26%. Food, fuel, fibre, and raw materials are the four primary forms of agricultural production. The top five agriculture production countries, are China, United states, Brazil, India and Russia.

When we look at China from on, we can see that 13 percent of the soil is suitable for planting, and China produces 23 percent of the world's rice. China is the world's largest rice-producing region. They grew soybeans, kaoliang (sorghum), wheat, millet, and corn as a result of this. Since 1990, agriculture in the United States has grown at a rate of 5% per year, with 0.84 percent of all farm workers producing more.

In United States, 80% of the total production is occupied by wheat. When we look agri in Brazil, 41% of the total land is occupied by agriculture and 7% of the area is used for crop production in Brazil.

Agriculture employs 58 percent of Indians and accounts for 18 percent of the country's GDP. Agriculture and horticulture account for 60% of India's gross domestic product [dextrainternational 2019]. In the last 14 years, 11 percent of India's agricultural production has improved. India ranked first in the world for milk production, second for dry fruits, third for fish production, fourth for egg production, and fifth for poultry production.

As a result, expanding technology is vital to maintain success in agriculture farms, storage, cleaning/grading, manufacturing, warehouse, transportation, and distribution (retail/export) are all considered part of the Agri food supply chain (AFSC).

The rest of the paper is structured as follows: Section 2 shows Related Works, Section 3 reveals the proposed work, Section 4 reveals the results assessment, and Section 5 is the paper's conclusion.

2. Related work

Growing population and shifting dietary habits, especially in developing countries, increase demand for reliable, organised agri-food networks, which solidified the agri-foods value for both the farmer and consumer levels. (Mason, Flores, Villalobos, & Ahumada, 2015).

At a wide scale, focusing on optimising the organised decisions of agri-food supply chain participants in both development and marketing will provide new possibilities for developing a sustainable food system.

In order to achieve such an agri-food supply chain, diverse facets of strategic planning must be considered, such

ISSN (Print): 2204-0595
ISSN (Online): 2203-1731

as farmer cooperation in trans-local and trans-regional alliances, farmer viability, taking advantage of climatic variation and regional capacities in the geographical range of decision-making, and natural resource management, such as irrigation water and cropland from the standpoint of environmental protection, as well as the use of complementary business markets in other countries.

Today's technical global agri-food systems, dominated by vertically integrated major corporations, are struggling to fulfil the challenge of feeding an increasing global population beyond the constraints of the "Planetary Boundaries", and are marked by a "triple fracture" among agri-food economies and their three constitutive elements: nature, consumers, and producers [Pancino. et al 2019].

At the same time, irrigated agriculture has been an essential contributor to the expansion of world food supplies, and subsequently, irrigation water supply is expected to be the most important factor limiting feeding the growing world population (Hanjra & Qureshi, 2010). More over 500 million moderate farmers around the world, in the largest part of rainfed, provide up to 81% of food disbursed in the developing world (Graeub et al., 2016).

The “deepening process” [ ] is the first component of a territorialisation plan based on a multifunctional farming model, and it seeks to counteract the farm cost-price squeeze by adding more added value to agricultural goods (value creation) and increasing the farms' value capture capability (value capture).

The cycle of “value creation” unfolds by product differentiation, which is achieved by shifting from the production of agricultural products with uniform characteristics to the production of unconventional quality goods, typical, traditional and also organic products. The deepening strategy aims at and results in the creation of more value added per unit of end product-produced within the farm.

As per the report of economic and social department (United Nations), the world wide population may increase to 8.5 billion by 2030. As a result, globalised agri-production must rise to meet market needs, potentially increasing global sustainability concerns. For this, environmental measures such as the “Paris Agreement” on lowering Green House Gas (GHG) emissions during various agricultural practises and the Popular Agriculture Policies (CAP) for improving AFSC practises as a multi-tier framework have been implemented (Achabou et al., 2017).

Agri-food security may not be possible without taking into account long-term considerations. As a result, the word "sustainable based agri-food secure framework" is becoming increasingly popular among researchers, educators, and policymakers.

By implementing sustainable activities of AFSC and effectively developing SCM, the sustainability approach in AFSC can provide adequate agri-food (Allaoui et al., 2018). In India, the conventional AFSC is experiencing difficulties in procuring, preserving, and supplying produce, as well as agri-food losses and deteriorations (Misangyi et al., 2016).

To overcome above problems, IoT based SCM must be employed for ensuring transparent, traceable and accountable system at different levels of AFSC (Kauppi and Hannibal, 2017). This paper investigates various IoT developments such as Blockchain, Artificial Intelligence (AI), Robotics, and RFID, among others (Aboah et al., 2019).

Various enablers are included in the IoT-driven multi-tier food security framework, which is focused on three decision models: strategic (long-term planning), tactical (putting plans into motion), and organisational level activities (actual action implementation) (Busse et al., 2016). Thus, three decision based model have been opted for enabler identification to address the different issues related to IoT driven food security system to ensure global sustainability.

Thus, food organisations required to implement sustainable practices at different multitier stages related to processing, transporting, retailing, packing, handling, cold storage and loading. As a result, an IoT-based framework for effectively transmitting information about agri-food safety requirements to various AFSC suppliers is needed (Talavera et al., 2017). Furthermore, in this global pandemic scenario, there are growth opportunities for businesses to provide rapid response/online shopping (e-commerce) or local/short SC focused supplying the needs of customers, resulting in long-term survival (Farahani et al., 2020; Li and Zobel, 2020).

The core elements for sustainable growth in Global AFSC are multi-tier configuration types and IoT-based governance structures. Global AFSC included IoT-based participation in multi-tier sustainability practises and projects led by FF, ES (External Supports) provided by government and NGOs, Third Parties (TP), and other stakeholders. There is a need for direct regulatory frameworks. Without any overt influence from FF, the ability of FF to have time and resources for efficiently forming relationships with multi-suppliers and indirect governing structures is dependent on third-party requirements and legislation. In the Global AFSC, this accountability mechanism has a variety of consequences for long-term success (Formentini and Taticchi, 2016)

<u>The following research objectives may be set:</u>

- Identification of the conditions that influence AFSC's multi-tier survival as a result of IoT.
- To determine the relationship between the defined enablers for IoT-based food security mechanisms.
- By categorising the enablers into induced and affected clusters, a contextual interrelationship between them could be created.
- Recommending the proposed research's administrative consequences

ISSN (Print): 2204-0595
ISSN (Online): 2203-1731

3. Proposed

The various researchers have carried out enormous research over Multi-tier agri food supply chain, but still improvement is needed in every day scenario. Figure 1 explains various levels of agri based supply chain. Staring from the farmers, transport, grading, packaging, manufacturing, distribution and retails/Export. Now we will discuss on how the proposed system has been working. The various data has to be collected from the farm lands which includes. Those data were classified based the crops wise data. Those data were collected through Internet of Things. Then collected data were classified based on crop wise, vegetable wise and fruits wise.

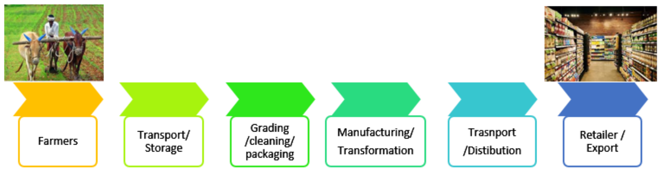

Fig.1 Multi-tier agri food supply chain

Then from the main dataset, several sub data set were categorised. To predict unsafe agricultural products, the C4.5 algorithms has been applied to make decision. So that the agricultural issue can be sorted out easily. To train the algorithm few data set values has been utilized. After that the real data set has been forwarded to the algorithm. The entire set of work flow of a proposed system has been represented in figure 2.

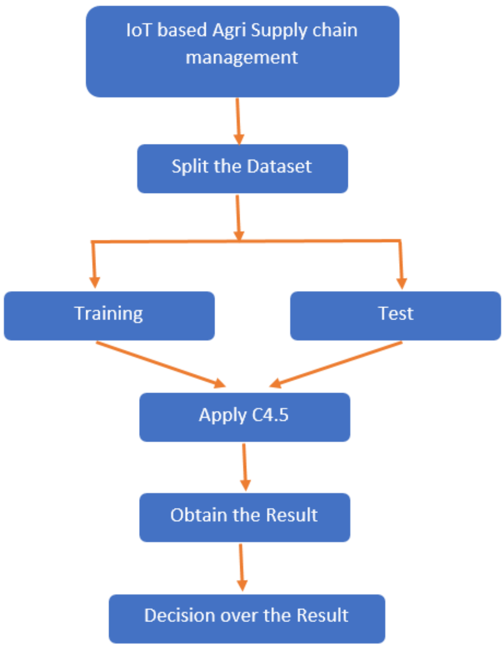

Fig.2 Proposed system work flow

3.1 C 4.5 Algorithm

The below part represent the working schema of a c4.5 algorithms.

Input: An attribute valued dataset D
1. Tree={}
2. If D is "pure" or other stopping criteria met then
3. Terminate
4. End if
5. For all attribute a ϵ D do
6. Compute information theoretic criteria if we split on a
7. End for
8. a_{best}= Best attribute according to above computed criteria
9. Tree= Create a decision node that test a_{best} in the root
10. D_v=Induced sub datasets from D based on a_{best}
11. for all D_v do
12. $Tree_v$=C4.5(D_v)
13. Attach $Tree_v$ to the corresponding branch of Tree
14. End for
15. return Tree

4. Result:

The proposed system has been executed with various training dataset and test data test for C4.5 algorithms. After this process the original and actual data set were assigned to get the decisions. Here in figure three different algorithm like ID3, C4 and C4.5 algorithms were tested with same dataset. And the result shows that the C4.5 algorithms has performed better than remaining algorithm. Figure 3 represent the output for sustainability over agri food supply chain.

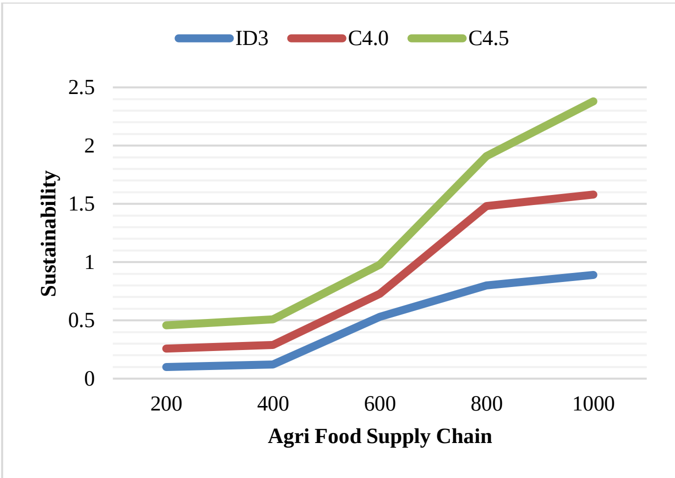

Fig 3 chart for sustainability over agri food supply chain

5. Conclusion

This paper has provided an architecture framework for sustainable multi-tier framework for agri-food supply chain that is controlled using C4.5 with Internet of Things (IoT) technology. The proposed architecture helps the agri-food supply chain make more reliable decisions and use better data over time. The operation of the internet of things is addressed to track and trace the Agri food quality to check the data acquired from agri land, production process and supplier. Aside from the end-results, or architecture views, we can say that the process of recording the architecture aided in understanding the structures, making explicit and discussing design decisions, evaluating the architectures' suitability for

ISSN (Print): 2204-0595
ISSN (Online): 2203-1731

farmers and retailer's needs, and ultimately guiding the creation of IoT systems.

References

[1] Neha Khanna and Praveen Solanki, Role of agriculture in the global economy, 2nd International Conference on Agricultural & Horticultural Sciences, Radisson Blu Plaza Hotel, Hyderabad, India February 03-05, 2014

[2] http://www.dextrainternational.com/agriculture-occupies-41-of-brazils-total-land-area/

[3] Mason, Nicholas & Flores, Héctor & Villalobos, J. & Valenzuela, Omar. (2015). Planning the Planting, Harvest, and Distribution of Fresh Horticultural Products. 10.1007/978-1-4939-2483-7_2.

[4] Rockström, Johan & Sachs, Jeffrey & Öhman, Marcus & Schmidt-Traub, Guido. (2013). Sustainable Development and Planetary Boundaries. Sustainable Development Solutions Network Report for the UN High-Level Panel of Eminent Persons on the Post-2015 Development Agenda.

[5] García-Tejero, I.F. & Durán Zuazo, Víctor & Bocanegra, Juan & Muriel, Jose. (2011). Improved water-use efficiency by deficit-irrigation programmes: Implications for saving water in citrus orchards. Scientia Horticulturae - SCI HORT-AMSTERDAM. 128. 274-282. 10.1016/j.scienta.2011.01.035.

[6] Qureshi, Muhammad & Hanjra, Munir. (2010). Global water crisis and future security in an era of climate change. Food Policy. 35. 365-377. 10.1016/j.foodpol.2010.05.006.

[7] Dekhili, Sihem & Achabou, Mohamed. (2018). Could sustainability improve the promotion of luxury products?. European Business Review. 31. 10.1108/EBR-04-2018-0083.

[8] Allaoui, Hamid & Guo, Yuhan & Choudhary, Alok & Bloemhof-Ruwaard, Jacqueline. (2016). Sustainable Agro-Food Supply Chain Design Using Two-Stage Hybrid Multi-Objective Decision-Making Approach. Computers & Operations Research. 89. 10.1016/j.cor.2016.10.012.

[9] Tsolakis, Naoum & Keramydas, Christos & Toka, Agorasti & Aidonis, Dimitrios & Iakovou, Eleftherios. (2013). Agrifood supply chain management: A comprehensive hierarchical decision-making framework and a critical taxonomy. Biosystems Engineering. 10.1016/j.biosystemseng.2013.10.014.

[10] Siddh, Man Mohan & Soni, Gunjan & Jain, Rakesh & Sharma, Milind & Yadav, Vinod. (2017). Agri-fresh food supply chain quality (AFSCQ): a literature review. Industrial Management & Data Systems. 117. 2015-2044. 10.1108/IMDS-10-2016-0427.

[11] Kauppi, Katri & Hannibal, Claire. (2017). Institutional pressures and sustainability assessment in supply chains. Supply Chain Management: An International Journal. 22. 10.1108/SCM-01-2017-0004.

[12] Aboah, Joshua & Wilson, Mark & Rich, Karl & Lyne, Michael. (2018). Operationalising resilience in tropical agricultural value chains. Supply Chain Management. 10.1108/SCM-05-2018-0204.

[13] Portocarrero, Jesús & Tobon, Luis & Gómez Escobar, Jairo Alejandro & Culman, Maria & Aranda, Juan & Parra-Sánchez, Diana & Quiroz, Luis & Hoyos, Adolfo & Garreta, Luis. (2017). Review of IoT applications in agro-industrial and environmental fields. Computers and Electronics in Agriculture. 142. 283-297. 10.1016/j.compag.2017.09.015.

[14] Li, Yuhong & Zobel, C. (2020). Exploring supply chain network resilience in the presence of the ripple effect. International Journal of Production Economics. 228. 107693. 10.1016/j.ijpe.2020.107693.

[15] Formentini, Marco & Taticchi, Paolo. (2014). Corporate sustainability approaches and governance mechanisms in sustainable supply chain management. Journal of Cleaner Production. 112. 10.1016/j.jclepro.2014.12.072.

[16] Pancino, B., Blasi, E., Rappoldt, A. et al. Partnering for sustainability in agri-food supply chains: the case of Barilla Sustainable Farming in the Po Valley. Agric Econ 7, 13 (2019). https://doi.org/10.1186/s40100-019-0133-9

ISSN (Print): 2204-0595
ISSN (Online): 2203-1731