International Journal of Engineering Trends and Technology
ISSN: 2231–5381 / https://doi.org/10.14445/22315381/IJETT-V71I4P232

Volume 71 Issue 4, 359-370, April 2023

Original Article

Construction and Integration of Knowledge Grid in Agricultural Information Management Services

L. Rajasekhara Babu[1], M. Thangamani[2], R. Surendiran[3], M. Ganthimathi[4], B. Gomathi[5], S. Satheesh[6]

[1]*Computer Science and Engineering, Bharathi Dasan University, Trichy, TamilNadu,*
[2]*Department of Information Technology, Kongu Engineering College, Tamilnadu,*
[3]*School of Information Science, Annai College of Arts and Science, Kumbakonam, India,*
[4]*Department of Computer Engineering, Government Polytechnic College, Dharmapuri,*
[5]*Department of Computer Science and Engineering, Sri Eshwar College of Engineering, Coimbatore*
[6]*Department of Computer Science and Engineering, Arjun College of Technology, Tamilnadu*

Corresponding Author : rajasekharanmca@gmail.com

Received: 02 February 2023 Revised: 25 March 2023 Accepted: 20 April 2023 Published: 25 April 2023

Abstract *- Agriculture is a major employment source in the world. In India, 55% of the population is employed in the agriculture and allied sectors. The Gross Domestic Production (GDP) contribution of agriculture is 15% levels. Managing crops, soil, climate, irrigation, fertilisers, disease, pest, market, and trade information is essential to guide the farmers and other industries. Data collection, analysis, organisation and presentation are the key operations of the knowledge management structures. The knowledge grid is a graph or network formed by element entities and relational links between element entities. The concepts, events and relationships are represented in the knowledge grids.*

The schema layer and data layers are used in the knowledge grids. The knowledge representation, extraction, fusion and reasoning operations are applied knowledge grid models. The crop disease and pest information are managed under the knowledge grids. The knowledge grid is utilised with expert structures and crop query answering models. The Agriculture Information Management Services (AIMS) are building with knowledge grids. The knowledge grid construction process is enhanced with crop, soil, season, fertiliser and disease and pest information.

Food manufacturing was hypercritical action in which every single country desired to have their own sustenance. Our country, India, is the largest Autotroph of the nutrition corpuscle in the biosphere. In our country, close to seventy percentage of agricultural family stagnant be contingent on farming for their living. Being farm growers blessed mostly essential in our country by way of agriculturalists making a huge elect-vote group which leaders challenge, not spoil. All together, Administrations are necessary to stabilise the involvement of agriculturalists with patrons, the mediator, and then the social group at huge. The entire farming body is extremely statistics serious.

Even with tremendous information gathering and quantities from different administration areas, proceed to be statistics gaps. In this section, sensing the Societal Statistics Organization Supporting structure will assist in examining the agronomic segment and modifying the similar using a holistic approach.

The automatic knowledge extraction, knowledge map quality enhancement and entity alignment methods are combined in the knowledge grid process. The Machine Learning (ML) based crop pest prediction models are integrated with the knowledge grids. The Java language and MongoDB are used for the structure development process.

Keywords *- Agriculture, Apriori algorithm, Machine learning, Knowledge Grid and MongoDB.*

1. Introduction

1.1. Agricultural Information

The knowledge grid expertise integrates heterogeneous agriculture information such as the vegetables, trees, fruit, crops, melons, flowers, special breeds and livestock to share agricultural knowledge using semantic mining. This technique can control plant diseases. Figure 1 shows the content plantation information. Figure 2 represents the users of the plantation structure.

Figure 3 projects the agricultural knowledge based in advance. From the knowledge base, this system produces good decision-making in crop production using artificial intelligence and deep learning with sensor devices [1-2].

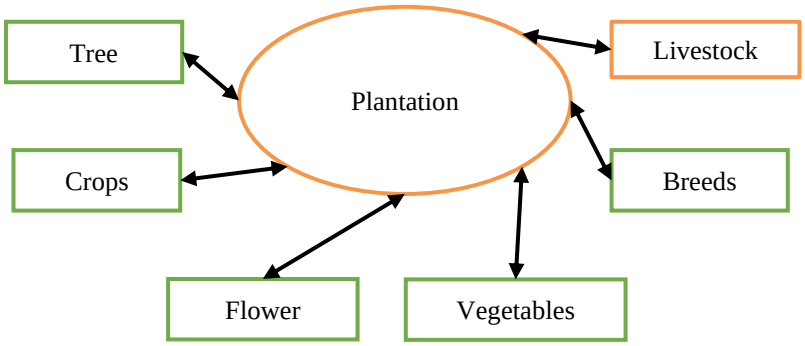

Fig. 1 Content Plantation

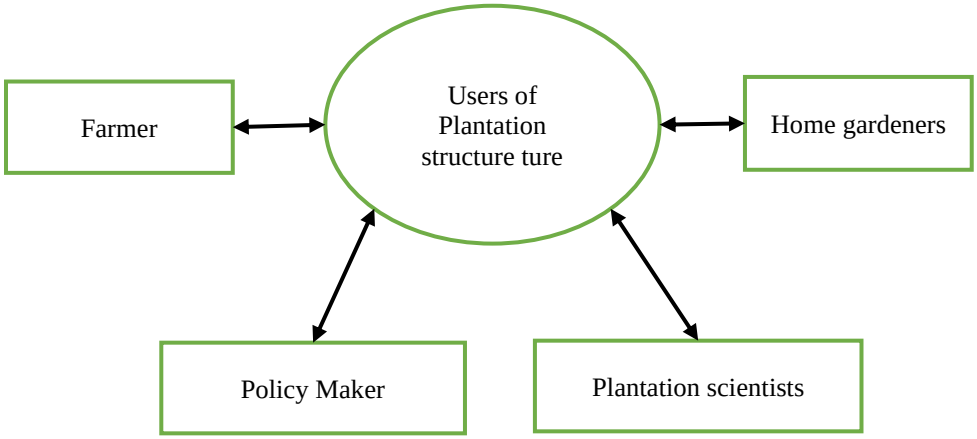

Fig. 2 Users of Plantation Information

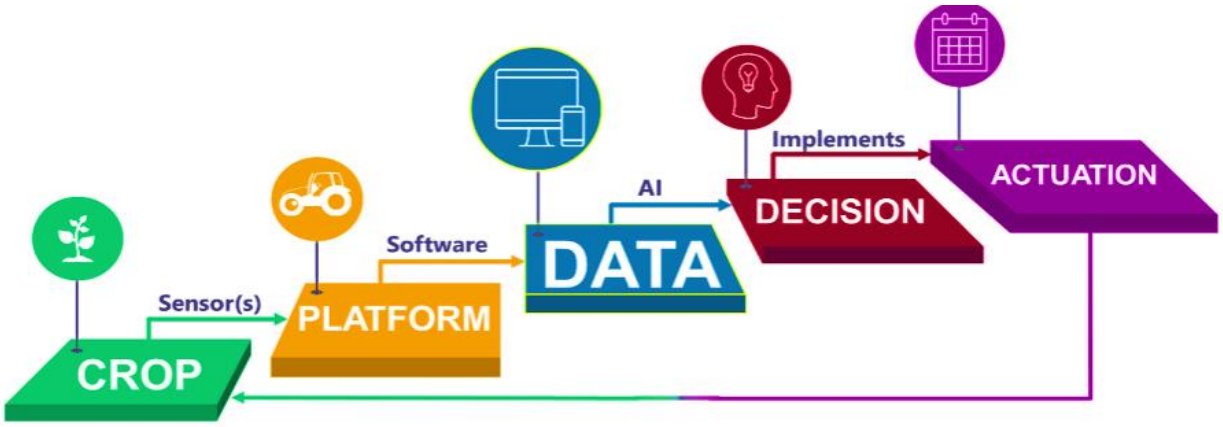

Fig. 3 Agricultural Knowledge information

Figure 4 provides information about the demand for a knowledge grid in the area of enterprise, intermediaries and research education and policy process [1]. Huibo Wang et al. [2] focused on automatically classifying agricultural sources.

1.2. Knowledge Grid

The Knowledge Grid (KG) is a smart and supportable interconnection setting that allows individuals and technologies to excellently internment, distribute, share and achieve information resources. It is the on-demand facility for decision-making, specifically in agriculture.

This provides a concept map between content plantation and users of plantation information for the farmer to know the useful information to avoid the disease in plantation and improve the crop production. The Agricultural KG gives information, crop wealth and amenities to the farmer.

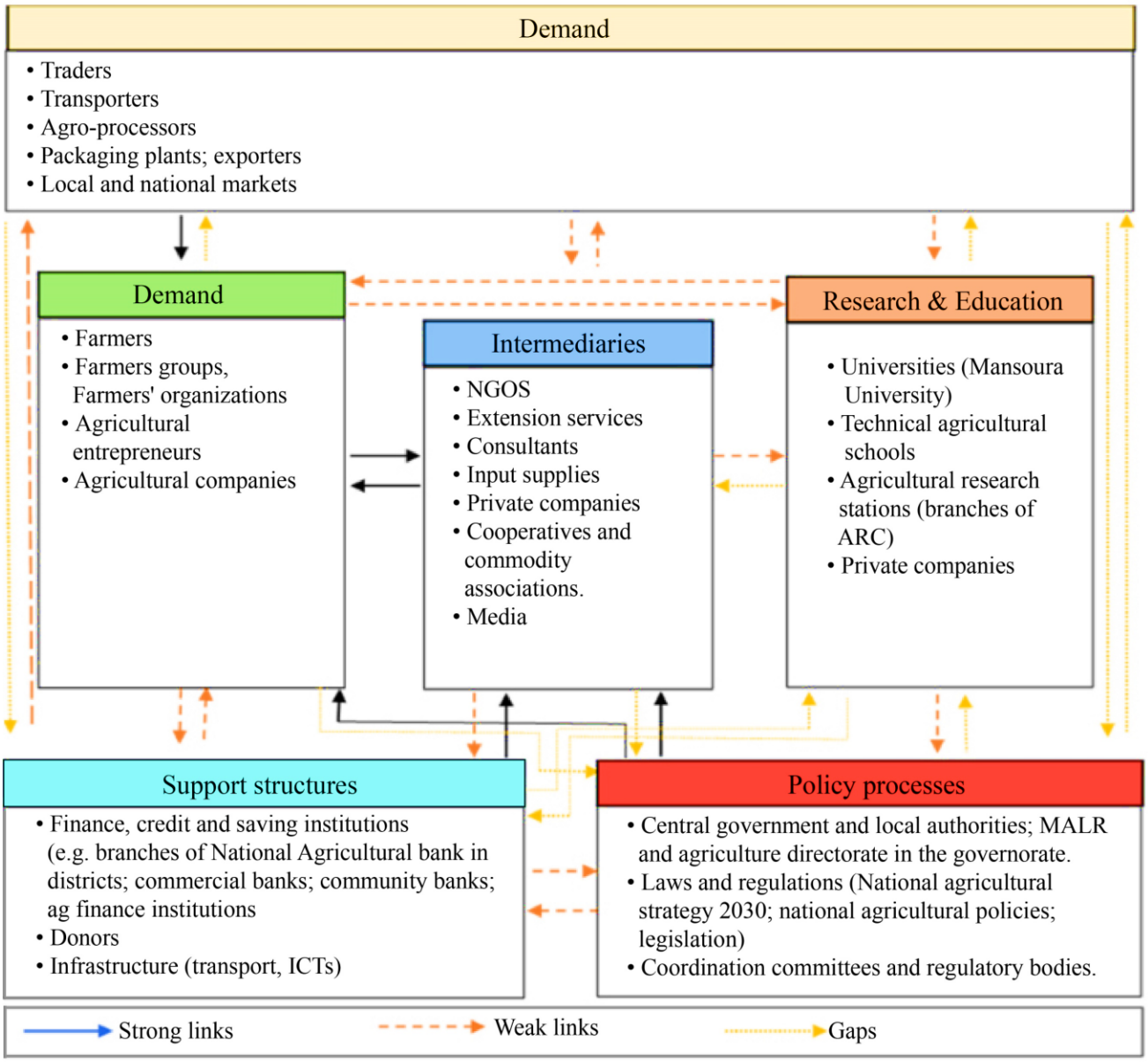

Fig. 4 Area of demand –knowledge information

Figure 5 shows the multidimensional knowledge space representation. The concept represents the domain knowledge of the system. Axioms and rules give knowledge reasoning to improve the throughput of the knowledge systems.

The knowledge grid provides a novel way and flexibility in data management. Considering the recognition of pests and crop diseases, toxicology on fertilisers and the constitution of the structure are analysed and classified in the grid. Data analysis is done based on knowledge representation, fusion, extraction and reasoning. The knowledge grid based on agriculture Information Management structure is built to support data management over different aspects.

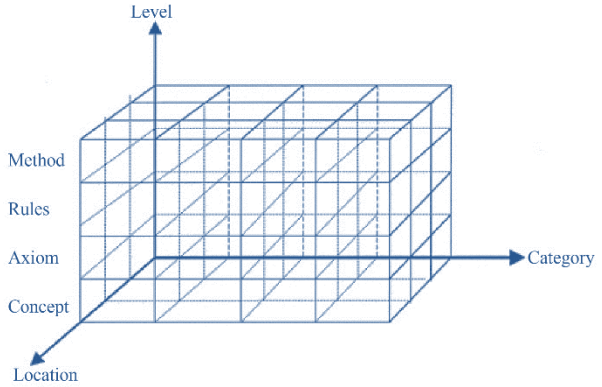

Fig. 5 Multidimensional Knowledge Space

The structure is built with the following four objectives. They are to construct an Agriculture Information Management Structure (AIMS) with knowledge grids, build knowledge grids with numerous elements on crop information, increase the knowledge map quality with entity alignment mechanism, and support machine learning-based data analysis with association rule mining and clustering techniques. To get better clustering performance, ontology's are used [2]. Ontology is nothing but the discipline of a domain that deals with nature and the association of reality with an entity-identifiable format. The knowledge grid is a graph or network formed by an element entity and the relation between the elements. It describes the concepts, element, events and their associations. An event refers to activities that impediment and manage behaviour. Element is an entity in the knowledge map. It includes behaviour like seeds, manures, Biocides; fertilisers, crop disease; lack of mechanisation which includes ploughing, harvest and weeding, irrigation and Soil erosion, crops, disease, place of disease, symptoms, pathogens, and insecticide. The association is a frequent item-mining process; its objective is to find the relationship among related concepts, events and entities or elements. Where it happens between altered units, such as indications of ailment in addition to its origin of disease, prevention and management method, determination process and its applications. Characteristics or attributes of the object refer to properties of the disease. It also includes disease characteristics, diseases name and pesticide types.

The knowledge grid network is characterised by three properties called triples, by which it is expressed, which is fundamentally a semantic web that intimates the correlation among entities. The triples represent the subject, predicate and object abbreviated as SPO—the above triple elements associate to form a grid network. The entities represent the nodes, and the associated directed edges between entities represent the interaction between entities. The direction of the directed edge of the entity identifies the subject or object of an action. Various classifications of edges represent different relationships of the entity. In Jan. 2018, Arnaout and S.Elbassuoni [3] focused on the actual probing of RDF knowledge grids. In which the knowledge which is obtained from the source is constructed as a resource diagnosis framework which helps in the construction of the knowledge grid for the easy perceptive of the field.

The organisation of a knowledge grid is alienated into the data layer and schema layer. The information level contains the essential information acquaintance of the fact session entirely. Grid records or their database from a relational network are stored in fact class. The ontology database stores the extricate the important information; the schema layer manages the data layer. Data layer knowledge was extracted by schema layer knowledge and limited the knowledge of the data layer. Top-down approaches define data schemas for knowledge maps. Well-structured hierarchy forms are constructed by analysing the top-level concepts and subclasses. To construct the Knowledge grid Top-down strategy is used Usefulness of the knowledge is determined, and the Integrity, precision and data quality is considered essential parameters of the knowledge grid. Liu xiaoxue et al. [4] presented the major analysis and Current examination of Information Grids for Harvest insects and Illnesses. It reviews constructing a knowledge grid to deduct crop diseases and pests through the expert structure.

AIMS is constructed with the support of the knowledge grids. The agriculture data resources are collected from various locations. All the collected information is analysed, and the entity and data values are extracted from the information. The crop pest and disease information is managed under the knowledge grid environment. The knowledge grid model also integrates the soil [6], season and fertiliser information. The knowledge grid model is enhanced with automatic knowledge extraction, knowledge map quality and entity alignment methods. Machine learning is a technique by which a machine learns from past data and makes its own decision for the test or given data; it also makes its own prediction operations. In 2017, Satamraju et al. [7] introduced a RURAL BRIDGE: A original structure for smart in addition to supportive farming using IoT construction. They proposed Rural Bridge, an Internet of Things (IoT) founded system, which uses sensors to accumulate dataset such as temperature data, toxicology, level of humidity, level of soil moisture, PH value of the soil, ground and surface water level and accumulate this type of data information on a cloud server. The knowledge grid information for the agriculture domain is analysed with the support of machine learning techniques. The pattern discovery tasks are carried out on the agriculture data values.

1.3. Ontology for Agricultural

Ontologies deliver [9] scalability and disseminated procedures, the fundamental need of cultivation territory. It is constructed based on a facility concerned with a method of ontology progress that permits scalability with the help of adding fresh farming facilities avoiding the changes in the basic ontograph. Onto-graph is the prescribed and clear depiction of dominion information and a method to signify the interactions amongst the dominion thoughts. It delivers incorporation of resources like the information on the internet-web, which describes using onto-graph recognised meta-data. Onto-graph for many areas is constructed owing to its authority of persuasion, cognitive, suggestion and cataloging of information. It can define Ontology by 5-tuple as

$$\text{Onto-graph} = \{C, S, I, R, A\}$$

Here, O represents Onto-graph which describes C - represents the Collection of Perceptions, I- represents established examples concepts with slits S, R- represent boundaries enforced on perceptions, instances, and slots and A- represents the collection of axioms. It can be divided into the system and domain-specific ontology graphs.

1.3.1. System Onto-graph

It embraces the perceptions relating to real computer hardware and software programs. The organisation Onto-graph is ironware and package mechanisms such as corporal and rational instruments, actuation units, data procurement interfaces, etc. The diverse concepts of the system Onto-graph currently inter associations with the concepts of core and service collection for the achievement of dissimilar purposes of services.

1.3.2. Domain Onto-graph

Domain Onto-graph delivers dominion's essential information ideas similar description of terrestrial, harvest, and facilities like inundation and insemination. This deals requirement of the dominion to confirm semantic web interoperability to maintain healthy farming conception. Dominion Onto-graph includes two sub-ontology categories.

- Core Onto-graph: The Core class represents the Cultivation purview by describing the thoughts associated with cultivation. The core subtype comprises the designation of each idea and additional attributes relating to every idea, primary interactions etc.
- Service Onto-graph: the next type of the domain Onto-graph is facilities whose key impartial is to typical facility constructed state. It might comprise inundation (irrigation), insemination also, an insecticides controller etc. Suggestion facility can similarly remain presented in accumulation to deliver provisions designed for ontological-semantic information. Toward intersect province Onto-graph to organisation domain ideas, well supposed besides exact associations remain anticipated. Also, ontological-Semantic Information Rules container be used to find and inductee proceedings and various choices for inclination.

2. Literature Review

Thangamani and Thangaraj [11] investigated the multi-domain ontology for document clustering in peer-to-peer networks to improve information retrievals. The authors [12,14] generated the fuzzy ontology to enhance information retrieval in a distributed manner.

The authors [15] proposed research about a knowledge-based structure for the numerical structure of test processes in the field of mechanical engineering. This research uses the sensitivity analysis method to explain the selection and interaction between the relative parameters. In Jan 2019, Niannian Guan et al. [16] Knowledge grid embedded with concepts. Knowledge-Based systems give a solution for the different symptoms required to identify the crop disease. The knowledge embedding helps disease prediction with disease prediction accuracy and overcomes the challenges of element identification.

In 2018 K. Lagos-Ortiz et al. introduced an Onto-graph based prediction and decision provision structure for insect control in agricultural crops [18], theme provided Onto-graph based decision support structure through this disease prediction challenges faced by the farmers can be overcome by providing a standard vocabulary for integrating physiopatholy data sources. Jinhua Dou [19] proposed a knowledge graph based on the domain of Onto-graph and Natural Language Processing (NLP) technology for Chinese indefinable cultural tradition. It delivers a domain-based Onto-graph where the knowledge plays an important role in the intangible cultural heritage of Chinese persons using natural language processing technology. Y. Zuo Q. Fang S. Qian X. Zhang and C. Xu proposed [21] representation of learning about knowledge graph with being elements, which gives the learning and the knowledge elements and the multimedia entity given in the representation of the knowledge in the field of the descript

Ganthimathi et al. [22] experimented with Machine Learning (ML) applications on cultivated information for Smart Grange development to expand harvest by deciding on Plant Virus and Earth value. They present the ML techniques on plant confrontation genes detection and plant viruses cataloguing and support the arrangement targets proceeding to examine the earth feature. The authors [24] used Feed Forward Neural Network (FFNN) for detecting and classifying disease in the leaf of the Plant in various aspects.

In Machine learning process module [25] processes frequent rule discovery where it enters the minimum support and minimum confidence values, which verifies the input value and shows the frequent patterns in the crop productions by testing by 0.01 for the minimum support and 0.02 for minimum confidence it outputs the lists the frequent patterns has the support and confidence level above the given values. Crop Yield Prediction by machine learning focuses on examining soil quality to estimate the crop which is proper for fostering according to their soil variety and make the most for maximising crop yield [26-30].

Margret Anounica [31] focused on the reusability of knowledge in the agricultural field. The authors [33,34] used a machine learning algorithm to construct the ontology for the agriculture domain. This semi-ontology needs some user-defined tasks. Anat Goldstein et al. [35] provides the structure for assessing agricultural ontologies.

3. Proposed Work

The Agriculture Information Management Services (AIMS) are building with knowledge grids. The knowledge grid construction process is enhanced with crop, soil, season, fertiliser, and disease and pest information. Irrigation is also a vital feature that decides harvest profit and development due to its connotation with several features of plant atmosphere that impact its growth improvement. The automatic knowledge extraction, knowledge map quality enhancement and entity

alignment methods are combined in the knowledge grid process. The machine learning-based crop pest prediction models are integrated with the knowledge grids. The Java language and MongoDB database are used for the structure development process.

The Agriculture Information Management Structure (AIMS) is built to provide global information collection for society. The knowledge grid is built with the data collected from various sources and formats. The collected data is organised into a single knowledge grid model to support query and data access operations. The structure is alienated into five major modules. They are Information Depiction, Information extraction, Information fusion, information cognitive operations and Machine learning process. The data collection and source organisation are handled under the knowledge representation. The knowledge extraction process is built to fetch the data and analyse its associations. The knowledge fusion model is initiated to collect and group up all the data values for grid construction in the agricultural industry.

The query submission and data retrieval operations are carried out under the knowledge reasoning process. The machine learning process is built to discover the data partitioning and frequent rules on knowledge grid data values. The knowledge representation is applied to identify the data source and its formats. The data values are collected from governmental and private organisations. The text, data file, Comma Separated Values (CSV) files and web pages are used to represent the knowledge values. The key value data representations use JavaScript Object Notation (JSON) files. The crop production details are collected for the districts with season information. The temperature and rainfall details are maintained under the climate conditions data environment. The soil information is managed with the type and locality details. The pest and disease information provides the symptom and control method for the crops. The knowledge extraction process is applied to discover the data and its element information. The data values are analysed, and knowledge is extracted with associated entity details. The data values are transferred into the database with associated element information. The entity alignment process associates the data source and its elements with relationship levels.

Knowledge fusion integrates the various data types and their values into a single environment. The knowledge grid is constructed with the knowledge fusion information. The knowledge maps are used to represent the data tree and its node details. The knowledge grid is constructed with the specification of the knowledge map. The data access and query operations are carried out under the knowledge reasoning process. The query submission process collects query values from the users. The query results are built from the knowledge grid and produced in a user-understandable format. The query log shows the query collection and its result summary details.

Machine learning methods are applied to discover the hidden knowledge from the data collections. The structure's connotation rules, excavating, and gathering techniques remain applied. The Apriori algorithm is used for the frequent rule discovery process. The candidate set and item sets are extracted from the value of crop production data. The support and confidence values are estimated with the frequency values. The frequent rules are fetched with reference to the minimum support and confidence values. The clustering process is used to partition the knowledge grid data values. The K-Means cluster technique remains implemented and is aimed at the statistics grouping procedure. In the Knowledge extraction module, Crop information from the data sources is extracted, fetching the Input Crop information from the data source and assigned into the database. In the Knowledge Reasoning module, banana is entered into the query value, which produces the crop disease, pest and production details about bananas.

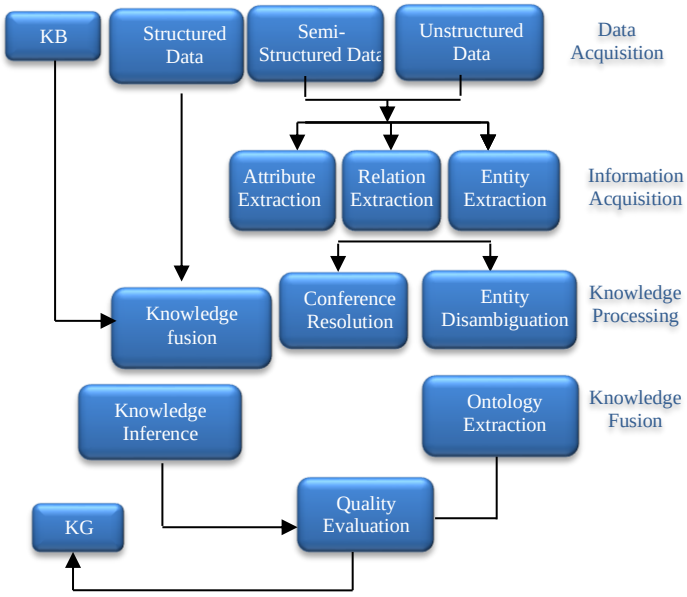

Fig. 6 Shows the Knowledge Grid

4. Analysis of the Agricultural Sector

10 major challenges threatening Indian Farming are patchy land affluences; Germs; Fertilisers, Fertilisers and Biocides; Irrigation; Absence of Automation; Topsoil Corrosion; Agrarian Promotion; Insufficient Storing Amenities; Inadequate Transportation and Scarceness of Investment. Some analysis is based on agriculture, shown below in tabular form. The solutions suggested for major agricultural sector problems are described in Table 1.

Table 1. Key Difficulties in Indian Farming Sector and their Resolutions

Sr.No.	Issues	Recommended Explanation
1.	Simple small, and patchy land assets	Association/ Supportive Agricultural
2.	Scattering of high-class seeds at reasonable charges	The administration may need to fund minor and marginal growers.
3.	Fertilisers, Manures and Biocides growth production but grounds earth deterioration.	The necessity to sense balance the practice in addition to implementing normal agriculture.
4.	Inundation takes facilitated assured conditions extremely while several others are determined merely on Rainy season.	Irrigation wants to be extended, but then again, its ill belongings must remain reserved for attention.
5.	Absence of Automation popular agricultural systems	Preparation, in addition to providing to agriculturalists
6.	Earth Destruction	Conduct of mud to create the situation productive
7.	Agrarian Promotion: Agriculturalists endure to be short changes.	Improvements should carry on at this point.
8.	Insufficient Storing Amenities	Provided that Rural Storing Cores
9.	Insufficient Transportation	Country Transportations are existence prolonged.
10.	Shortage of Investment	Nowadays, the most important percentage of acknowledgement =ment is recognised.

Below-Table 2 shows Major concerns in agronomic sectors are described below,

Table 2. Challenges in Farming Sector

Challenges	Observations
Aquatic Preparation	Water is not justifiably circulated in the area. Water boards are draining universally. Like Punjab, which is an aquatic shortfall, increasing harvests such as rice. Numerous agriculturalists produce Sugarcane which similarly earnings a lot of water for profit motives. Even with massive conjecture, cutting-edge irrigation product was sub-optimal in various belongings due to previous problems.
Earth-living	Soil is an uncommon source that is needed for industrial development and cultivation. While preferably growers would be allowed to retail their terrestrial to profitable use, extreme suburbanisation determination deteriorates rustic frugalities.
Atmosphere and Agriculture Apply	Episodic harvest fatalities owing to inopportune rainfalls, overflows and deficiency place agriculturalists in suffering—usage of nourishments in method indications to corrosion of dirt. Insecticides raise the charge as healthy as pamper fitness.
Economy	Farming involves closely half the people but accounts for minimise than twenty percentage of G D P. Pooled advance relinquishments proclaimed by 4 states in 2017 cost USD 13.6 billion.
Authority	Administration structures such as Least Support Worth assistance annoying agriculturalist share more than their inferior counterparts. Usually, rich agriculturalists acquire after reduced agriculturalists and vend to the Administration. Popular overall directing of structures remnants a weak
Source hawser and guideline	Agriculturalists are controlled to trade in their resident Mandis- foremost to an incompetent source chain. Educations require exposed a smallholding harvest, occasionally variations 10 times deprived of creation of any values in addition to. Manufacturers, in addition, buyers feel short-transformed.
Bazaar Falsifications	As Managements purchase enormous amounts of rice and wheat, it disturbs harvesting designs. A time of lack might be shadowed by plentiful yield. Popular whichever circumstance agriculturalists in addition/ Administration determination require toward tolerating the problem of source shockwaves.
Bazaar Departures	Agriculturalists in many belongings are enforced to vend in the resident market. This itself is an obstacle. Due to a diversity of reasons, agriculturalists might be involuntary to sell to collectors.
Storing, in addition to delivery	To provision agriculturalists, Managements procure many extra grains than the real requirement. These requirements provide enormous storage. Deficiency of acceptable storing resources grains endures deposited in the exposed and leads to decomposing of smidgens. Presently only ten percent of constraint is encountered as far as storage grains in strengthened storage tower is disturbed.
Interchange	For the portion of the obtaining purpose, there is a necessity for persons/organisations who do excellent valuation of the harvests. Dealers similarly correspond to the benefit of assurance services once interchange with unaware parties.
Deficiency of excellent statistics	Ample informal to object arrangements to farmstead proprietors than occupant agriculturalists or farmstead labourers payable to shortage of evidence. The outcome, those essentially require assistance whitethorn not get it.

Indian Farming Segment is undoubtedly the greatest enormous segment disturbing survives of a billion individuals. Table 3 designates the features of sector contributors and institutions.

Table 3. Contributors in Indian Farming Segment

Participants	Institutions
Moneylenders	Banks, micro investment corporations and native currency creditors. Native coinage creditors reside in an important portion.
Depositors	An agriculturalist might capitalise on their own money or revenue since further depositors. Agreement Agricultural corporations and Food Meting corporations participate in cultivation and also purchase the harvest since growers
Farming Involvement Breadwinners	Farming needs upright worth germination seeds, earth, and rain—current agricultural trusts deeply on manures and insecticides. Farmers in chance hinge on influence at little charges for lacrimation their grounds.
Farmers	Agriculturalists strength is Farm Proprietors. Farm holder might include their individual domestic in agriculture, which involves Farmstead labour.
Farmhouse labours	Farmhouse labourers work on the land. If crop value also rises, they do not get a profit.
Agriculturalist Organizations	In the circumstance of yields such as sugar, agriculturalists have recognised associations. The knowledge is to stretch reasonable worth to agriculturalists.
Mandis	Agriculturalists naturally trade their crops in management.
Traders	Who purchases from Agriculturalists straight from the growers?
Retailers	Sellers purchase from traders and achieve necessities in the locality. Sellers might also be massive suppliers.
Exporters	Exporters concentrate on distributing things in request in exportation marketplaces.
Importers	Farming harvest is im-ported in huge amounts once local manufacturers cannot encounter the request.

Table 4 designates reforms in Farming Sector.

Table 4. Improvements in Farming Subdivision

Improvements	Observations
Electric Countrywide Farming Bazaar	This is a significant creativity. This allows worldwide transaction of farming belongings, related to the usual Mandi scheme where an agriculturalist has to trade only in the local Mandi.
Biological Agricultural	Organic agricultural makes developed values. In addition, it is atmosphere responsive. Organic agriculture is far less dependent on the harvest; it may even make healthier yields.
Falling Centralising gaining	The State Administrations that run Public Spreading Scheme can acquire nutrition grain straight moderately than grow it through the Food Concern of India.
Restructuring Farmed Performs	Agriculturalists can be incentivised to move to healthier agricultural performance by generously improved healthiness and edification amenities. Upright performs also comprise aquatic preserving practices in farming.
Support Rural Economy	The farming segment cannot withstand the situation in communities if country dwellers progressively authorise metropolises and cities. It is significant to make E-commerce practice allocate evolution as an alternative to an unreasoning search for development.
Creative explanations for economic distress	Representatives were necessary to transfer from price provision strategies or finance waivers to income asset provision on a per-hectare base. The expense can ensue by means of Direct-Benefit-transfer systems. This can be both respectable politics and finances.

5. Results and Discussion

The agriculture sector data values are managed using the knowledge grid model to produce an integrated solution and easy access mechanism. The knowledge grids are constructed to organise the stored data in an organised manner. The data were collected and integrated from various sources under the knowledge grid environment. The Knowledge Grid Management (KGM) and Agriculture Information Management Services (AIMS) techniques are used to provide agriculture-related information for the users.

The KGM technique supports knowledge grid construction and data querying operations. The (AIMS) is constructed to support knowledge grid construction, data querying and data mining operations. The data mining model provides the associate rule for data mining and data clustering processes. The

mining model supports the hidden knowledge extraction for the users on the agriculture data values.

5.1. Data Sets

The crop production details are collected from the Indian government website www.data.gov.in. The website provides different types of data values for all sectors. The climatic and rainfall data values are also collected from the same source. The disease, pest and insects details are collected from the Tamilnadu Agriculture University, Coimbatore. The crop information is provided on the www.tnau.ac.in website. Here the different variety of data and information are gathered from original real datasets collected by sensory values. The IoT and ML paradigm applied [22] to collect information about the agricultural field and the historical information through time series also considered while processing. The digital technology of IoT and ML is used to form the "smart farm" model.

5.2. Evaluation Methods

Experimental evaluation is performed with the knowledge grid quality and entropy parameters to evaluate the accuracy of the knowledge grid-based application models. The entropy measurements are used to represent the knowledge grid quality and cluster accuracy information.

5.3. Knowledge Grid Quality

KGM is deployed to build the knowledge grid with crop pest and disease information. The information connectivity level is limited in the KGM for crop pest and disease management. AIMS is constructed with an improved entity alignment technique. The entity extraction and association identification is carried out for all types of sources. The interlink relationships are analysed with different path levels.

The knowledge grid quality is measured with the entities and their association levels. The knowledge grid quality (Q) is estimated with the ratio between the aligned entities and total entities. The quality measure (Q) = AE / TE, where AE is the frequency of aligned entities, and TE is the frequency of total entities.

5.4. Entropy

Cluster entropy refers to the entropy that reflects the homogeneity of a set of objects that can represent a cluster's homogeneity. More homogeneous clusters form Lower cluster entropy. The structure of the entropy measures the pre-labelled class of entities by that homogeneity of a class for the generated clusters can be represented. The less sub fragmented classes are grouped into clusters, the higher their entropy and vice versa. This is referred to as the entropy class, Cluster entropy. In the clustering result c, For every cluster cj, compute (li, cj)/n(cj), the probability of each cluster member cj belongs to class li. The standard formula used to measure the entropy of each cluster cj is,

$$E_{cj} = -\sum_i \frac{n(l_i,c_j)}{n(c_j)} log \frac{n(l_i,c_j)}{n(c_j)} \quad (1)$$

Overall, classes are the total computation. The total entropy for a group of clusters is measured as the sum of entropies for each cluster weighted by each cluster size:

$$E_c = \sum_{j=1}^{n(c)} \frac{n(c_j)}{n(D)} \times E_j \quad (2)$$

A limitation of entropy clusters is that the sub-clusters are grouped, meaning if a class is split across many clusters, it will lead to a low value for entropy. To encounter this process, the class of entropy can also be measured. The entropy for each class li is calculated by

$$E_{li} = -\sum_j \frac{n(l_i,c_j)}{n(l_i)} log \frac{n(l_i,c_j)}{n(l_i)} \quad (3)$$

The total calculated has been taken as over all clusters. The average weight of the individual entropy class is calculated by the total sum of a set of the classes of entropy,

$$E_l = \sum_{i=1}^{n(l)} \frac{n(l_i)}{n(D) \times E_{li}} \quad (4)$$

As with entropy clusters, a limitation of entropy classes is that more sub-classes are grouped into a single cluster; in some cases, the entropy can still be small. So, the Overall entropy measure can be calculated by

$$E_c\,(\alpha) = \alpha . E_c + (1-\alpha) . E_i \quad (5)$$

α is set to 0.5. Through different cluster counts and transactions, the clustering quality can be evaluated.

5.5. Performance Analysis

The performance of Knowledge Grid Management (KGM) and Agriculture Information Management Structures (AIMS) The Java language is used for the application development process. The agriculture and climatic condition dataset is used for the analysis. The knowledge grid quality and entropy measures are used in the performance analysis.

The knowledge grid quality represents the knowledge grid and its accessibility performance levels. Techniques are shown in Figure 7. and Table 5. The Agriculture Information Management Structures (AIMS) technique increases the quality rate by 15% more than the Knowledge Grid Management (KGM). The results show that the knowledge grid for Agriculture Information Management Structures (AIMS) technique is better than the other methods.

Table 5. Knowledge grid quality Analysis between KGM and AIMS Techniques

Transactions	KGM	AIMS
400	71.82	86.73
800	73.95	88.16
1200	75.87	90.62
1600	77.96	92.24
2000	79.53	94.18

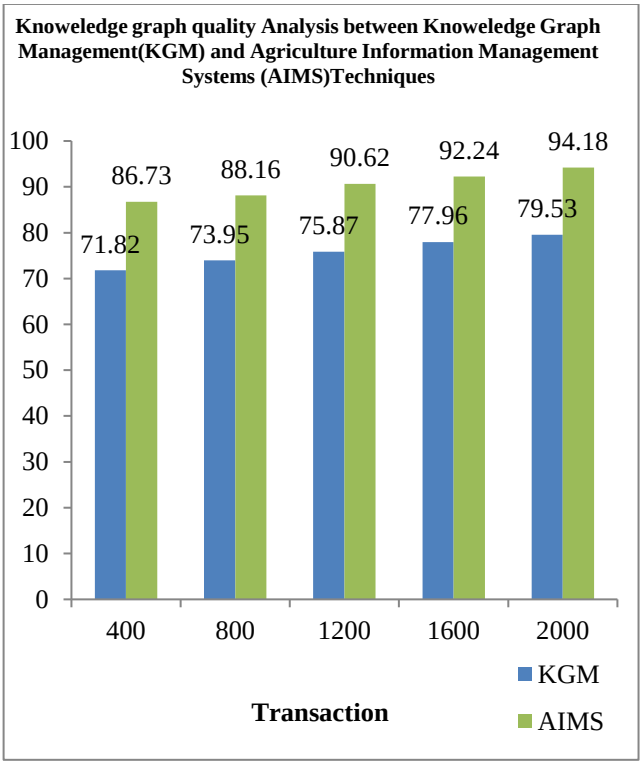

Fig. 7 Knowledge grid quality Analysis between KGM and AIMS Techniques

The entropy measure represents the accuracy levels of the clustering process of data. The class entropy and cluster entropy values are calculated for each class and cluster. The overall entropy is used to analyse the cluster quality. Class entropy and cluster entropy are used in the overall entropy estimation process. The comparative entropy analysis between KGM and AIMS Techniques is shown in Figure 8 and Table 6. The AIMS technique outperforms with 10% more accuracy than the KGM.

The results show that the overall entropy for the AIMS technique results better than the other methods.

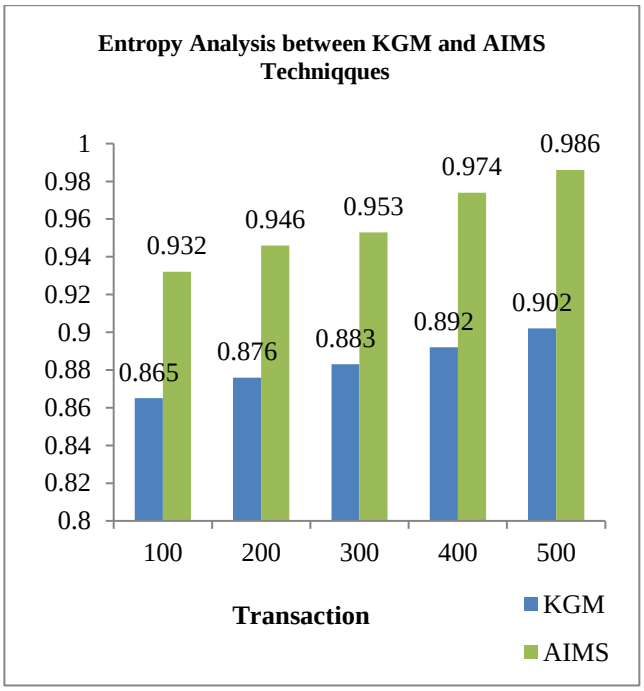

Fig. 8 Entropy Analysis between KGM and AIMS Techniques

Table 6. Analysis between KGM and AIMS Techniques using entropy

Transactions	KGM	AIMS
400	0.865	0.932
800	0.876	0.946
1200	0.883	0.953
1600	0.897	0.974
2000	0.902	0.986

6. Conclusion and Future Enhancements

Construction and Integration of the knowledge grid in Agriculture Information Management Services have been designed and developed as per the specification. The structure is tested with various sample data. There are many reasons for introducing a new machine learning-based knowledge [12] grid creation in the agriculture field. In future, it can be performed in big data, which compromise billion and trillions of data for the semantic[2] knowledge grid construction for agriculture information.

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