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A CONCEPTUAL DESIGN OF THAI LONGAN PRODUCTION VIA AN ONTOLOGY

Winai Bangkhomned[1], Janjira Payakpate[2]

Abstract- This paper aims to explain the conceptual design of Thai Longan Production. Related information is gathering and analyst. Research found out that there are five significant factors in producing longan production with quality: Pruning, Fruit Thinning, the use of Potassium Chlorate (KCIO3) and Sodium Chlorate (NaCIO3), Removal of diseases and insects and Fertilizer. An ontology is implemented by adapting the validation to the model of Noy and Maguinness via longan production experts. Therefore, the information presented in two sections: (1) The design of agricultural ontology knowledge development processes and (2) An ontology knowledge based on Thai Longan production. According to the Hozo-Ontology Editor Program, the development describes the relationship and the information structure through OWL are included in the ontology knowledge based on longan production. This lead to the further implementation of Longan Disease Diagnosis system, Fertilizer Formula Calculator system, Semantic information retrieval system, Disease and Insect Removal Recommendation System and etc.
Keywords – Longan, Ontology, Production, Conceptual Design.

1. INTRODUCTION

Longan, one of the major economic fruits of Thailand, plays an important role in the agriculture sector. Most of its production comes from the northern part of Thailand [1]. The longan output is outer during late June to early September, regularly. As an expectation of farmer, it will hit the market in January until February, which is for the New Year celebration. Both fresh and dried longan are marketable, particular, in China, Indonesia and Hong Kong [2] [3]. While the plantation of longan relies on farmer's expertise that is inherited via the generation. Nowadays, the knowledge in the production of Longan was preserved in many forms such as in the expert or philosopher longan academic researchers or research papers are in the database of responsible agencies such as National Research Council of Thailand (NRCT), Agricultural research development agency (Public organization) and the longan research and development center and Longan Hub: MJU-TRF Cooperative Project. These resources may offer solutions in order to grow the high quality longan product. However, accessing to these information and knowledge are complicate and hard for the farmer to select the scattered data. If there were any information system that would assist in selecting the right information for the farmer, the advantage would be using all research projects with be worth, increasing a number of longan with good quality, gaining the high income for farmer and, certainly, growing up of the economic value of the country.

Information associated with longan has varied. For example, the longan diseases are often called in different name, even though, they are the same disease. Perhaps, a reason is the occurring of these diseases in different location. It means the data retrieval of longan information less effective. Therefore, linking knowledge of Thai longan production together will be assist in the issue. Ontology is a technique that can organize and present knowledge in the form of groups, concepts, and relationships. In addition, features (reused and support exchange information) are included which helps in the information retrieval [4] [5] [6]. In this research, an ontological prototype of Thai Longan production for knowledge retrieval was proposed and employed as a part of model in developing the Longan Information System (LIS).

2. BACKGROUND THEORY

2.1 Thai Longan Production Technique.

Important factors in the production of Thai Longan include:Pruning, Fruit Thinning,Management of Disease and Insect Pests,The treatment of potassium chlorate (KClO3) and Fertilizer.

2.2 Pruning

Pruning is the process after harvesting the product. It is a way to prepare for the next generation of longan. Bush control is the initial technique for producing quality longan and affecting its growth. This basic technique also facilitates the pest control. Good air flow and sun exposure into a bush helping in the absorption in KClO3. Hence, flower is longer and minimize the risk of Phytophthora disease [7] [8] [9].

[1] Department of Computer Science and Information Technology, Faculty of Science, Naresuan University, Phitsanulok, 65000, Thailand
[2] Department of Computer Science and Information Technology, Faculty of Science, Naresuan University, Phitsanulok, 65000, Thailand

2.3 Fruit Thinning.

Fruit Thinning is controlling the amount of longan in each tree. Maximum of longan fruit in each bouquet is not over seventy. Result is shown in the size and nutrients of the plant which lead to high quality of longan [10].

The use of potassium chlorate(KCIO3) and sodium chlorate(NaCIO3).

Climate affects the flowering of Longan significantly [11]. Most yields are based on the appropriate weather which cannot be controlled. Thus, KClO3 or NaClO3 is used to stimulate the flowering of longan. In addition, it can stimulate the flowering of Longan in the off season [11, 12]. Farmers began to use the substance to stimulate the flowering of longan.

2.4 Removal of diseases and insects.

Removal of diseases and insects is another factor affecting the quality of longan yield. Due to disease and insects damage to longan yield, resulting in less quality of longan fruit. To eradicate diseases and insects the chemicals are utilized. However, these chemicals may affect the longan on skin color, thin shell, etc. Therefore, it should be used to eliminate the disease and insecticide in the right amount or use substances that do not affect the longan. For example, plant extracts can control the outbreak of Coccidae and does not affect the skin color of longan [13]. In addition, the cause of diseases and insects should be investigated in order to select the suitable chemicals [14, 15].

2.5 Fertilizer.

The nutrient supplies at each stage of production, significantly, affected the quality of longan yields. Fertilizer is divided into two phases 1) After harvesting to before flowering 2) Fruit set to harvest [16]

Table1 Fertilizer during after harvesting to before flowering.

Diameter of shrubs (meter)	Fertilizer formula		
	46-0-0	15-15-15	0-0-60
1	16	12	9
2	32	23	15
3	75	53	40
4	150	100	80

Table2 Fertilizer during Fruit setto harvest.

Estimated yield(kg./tree)	Fertilizer formula		
	46-0-0	15-15-15	0-0-60
50	450	480	440
100	900	960	880
200	1,800	1,920	1,800

2.6 Ontology

Ontology is a technique which is used to manage and present knowledge in the form of groups, concepts, and relationships within the boundaries of interest. Its processes show as gathering information and building relationships in a hierarchical fashion [4]. The aim of longan ontological design is to connect the knowledge of Thai longan in the database by using the ontology concept. This may leach to the development of a semantic search system effectively. [17]. Ontology has a clear structure of what is related to the concept and where the generic structure. It is in the form of a hierarchical data structure, taxonomic grouping and parent-child. So the ontology structure consists of describe the story using concept, properties, relationships, axioms and instances [18].

2.7 Concept: Ideas in one area of knowledge.

Properties, slot, roles and function: The relevant features related to the concept which is used to describe the concept [19].

Relationships: It presents a type of interaction between concepts and concepts in the knowledge domain. There is a pattern of relationships such as Taxonomy (subclass-of) and Mereology (Part – of).

Axioms: The condition or logic of converting a conceptual relationship with a concept or property to a correct definition.

Instances:Terminology with all common definitions in ontology.

There are several ways to develop ontologies. Especially, the definition of concepts or classes of knowledge [20]. Based on goals and objectives, the concept of ontology development can be shown as following:

Ontology is developed from the existing ontologies; or using other ontologies; or set the scope of knowledge, starting with the target audience in order to understand the needs of them.

Ontology can develop from the original database structure, entity analysis and relationships including gathering the question from the target audience. This will assist in defining the missing scheme of the entities and attributes.

New ontology development is the collection and analysis of knowledge from the tacit knowledge and the explicit knowledge. It also includes the information of users related to the content of the new ontology [21].

In Thailand, ontology is applied to agricultural information [22], but the development of ontology on longan production is still insufficient. Therefore, the concept of ontology of longan in Thailand is classified as designing and developing a new ontology. There are four steps of the proposed cycle in building the longan ontology of Thailand.
Define objectives, scope, specialization, scenarios, set of terms, characteristics and type of ontology
Building the Ontology. There are 3 steps.
Ontology Capture is determining key concepts and relationships of domain of interest.Create a clear demand. Definitions, concepts, and relationships, as well as related words.
Ontological presentationis presentation of knowledge in formal language. Building knowledge structures with conceptual models.

- Ontological integration.
- Evaluation to determine the validity and reliability.
- Documentation on the use and development of ontologies [23].

Based on this concept, the longan ontology is developed by improving the environment and the purpose of creating ontologies with priority to reuse ontologies [24]. In addition, these suggested improvements can add, delete, edit the improve terms, properties relationship and constraints in principle heuristic and consistency [25]. The development of the ontology of Noy and Maguinness [20] very well accepted in the field of ontological knowledge management. Knowledge engineering methodology consists of the following steps.
Step 1. Determine the domain and scope of the ontology
Step 2. Consider reusing existing ontologies
Step 3. Enumerate important terms in the ontology
Step 4. Define the classes and the class hierarchy
Step 5. Define the properties of classes—slots
Step 6. Define the facets of the slots
Step 7. Create instances

2.8 Research Methodology – Ontology Development Process
The development of ontology for longan production is based on the principle of ontology technology determining on the relationship. Conceptual description of knowledge and information are related to the production of Thai longan under the domain. The concept of ontology can be expressed in the form of notation such as class, instance, relationship, properties/ attribute and rule by knowledge representation language [26]. Therefore, this research is adapted from the development of the ontology of Noy and Maguinness [20]. Figure 1 represents the process of purpose ontology.

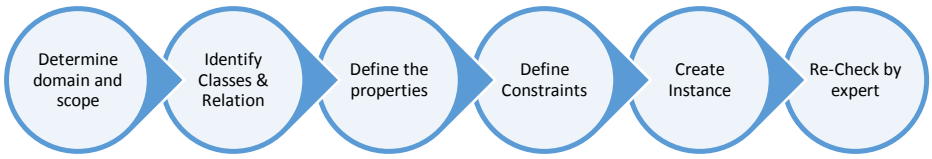

Figure 1. Ontology Development Process.

2.9 Determine domain and scope
To identify the scope and purpose of ontological development. This research is an ontological prototype of Thai longan production. It will link longan production in each phase of Thai longan production.
Identify Classes & Relation
To define class under the scope of study. So they are breed, disease, insect pests and fertilizer.

2.10 Define the properties
To identify attributes or relationships between concepts. There are three types of relationships.
a. Relationship type “IS-A”. For example, A “IS-A” B so B is a kind of A.
b. Property type relationship or “part-of”. For example, A Part-of (p/o) B so B is a property of A.
c. Property type relationship “attribute-of”. For example, An attribute-of (a/o) so B is a characteristic of A.

2.11 Define Constraints
To define the conditions and specifications for each class. For example, a class breed defines the data condition as the message type only.

2.12 Create Instance

To create the individual instances of classes in the hierarchy. Defining an individual instance of a class requires (1) choosing a class, (2) creating an individual instance of that class, and (3) filling in the slot values. Detail shows in Figure 2.

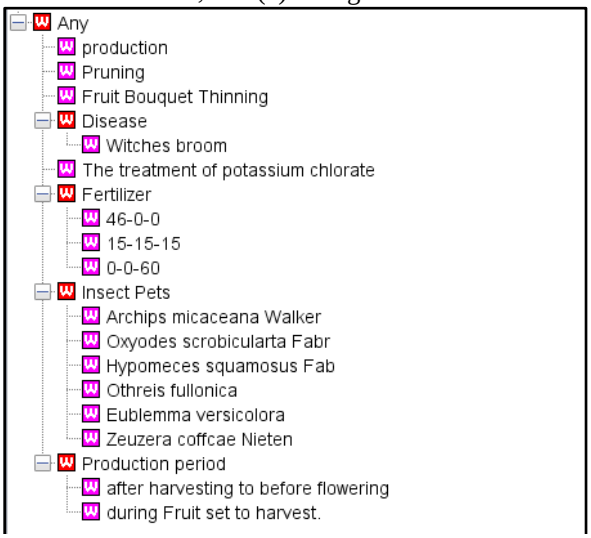

Figure 2. An overview of the class in ontology of Thai Longan production.

2.13 Re-Check by expert

To validate the design and specification of the ontology classes. It will be done by the experts in Thai longan.

2.14 Ontology Editor

At present, there are many tools that help to develop ontology knowledge base, such as Protégé program developed by Stanford University United States and Hozo-Ontology Editor Program [27] developed by Osaka University, Japan. Both of them are opened-source software which support both the world wide web Consortium (W3C) and the ontology development. In this paper, Hozo-Ontology editor is implemented as the main tool for ontology development because it supports Thai language well and can manage the structure of agricultural knowledge [28-31].

3. EXPERIMENT AND RESULT

The ontology development processes of Thai longan production which is shown in Figure 1 above, is applied to the development of the prototype of ontology on Thai longan production. Data about producing the quality of longan is collected. The relationship between related factors are defined and check by the expert. Rules are designed to support the knowledge link in various forms such as database etc. Therefore, the propose model of ontological knowledge base on Thai longan production is shown in Figure 3.

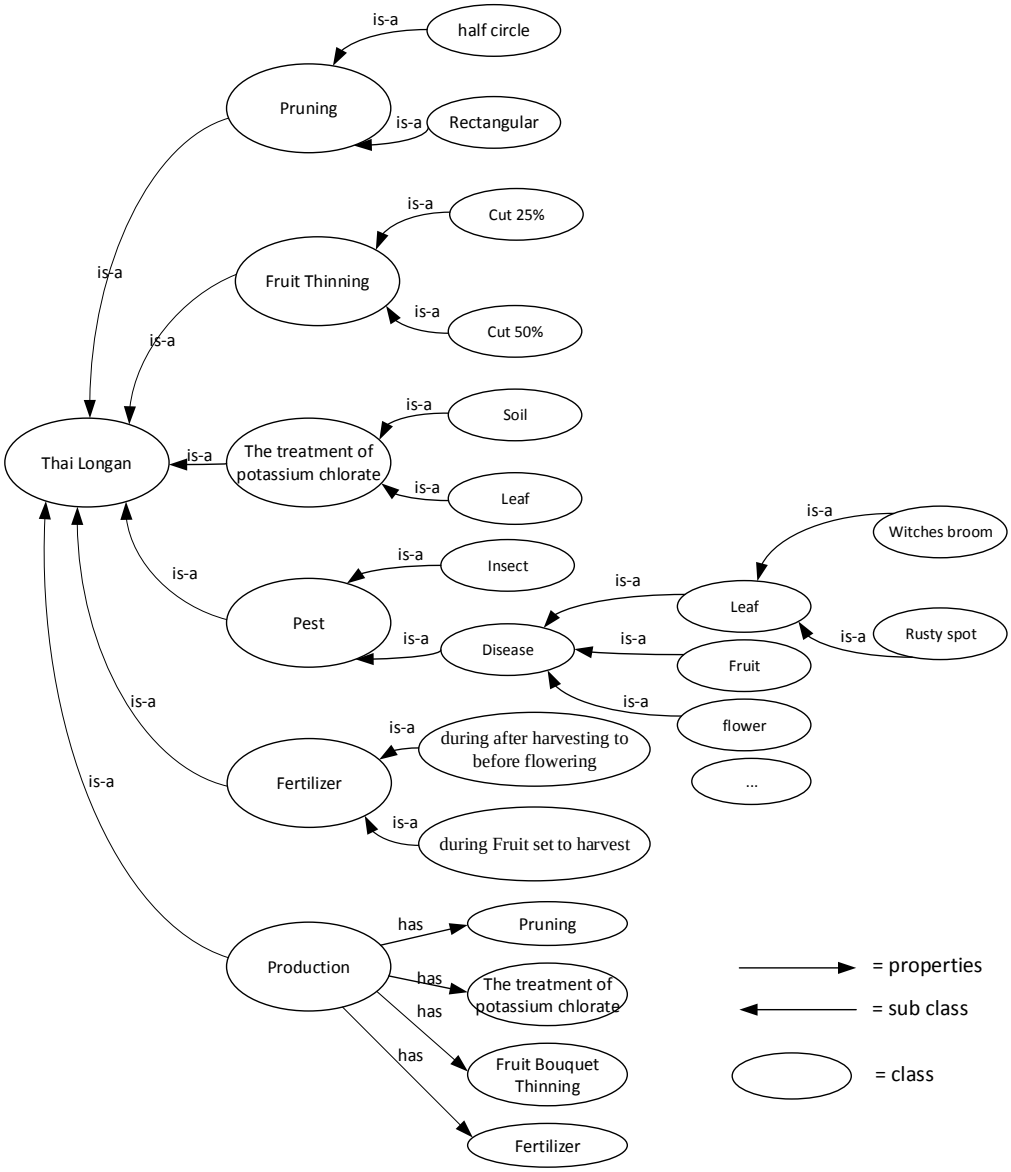

Figure 3. Model of knowledge base on ontology of Thai longan production.

Figure 3 can be explained that the production of Thai longan quality is consists Five factors: Fruit Thinning, Pruning, Removal of diseases and insects, the use of KCIO3 and NaCIO3 and Fertilizer management. These factors are link significantly with the complex data structures. For example, the disease and insect management is divided, based on, the nature of the outbreak and the physical characteristics of longan as falling leaf, flowers and fruit. Incorrect practices in some factors may affect other factors, resulting longan yield is not quality. The ontology prototype developed can store the knowledge about the critical factor.

4. CONCLUSION

A review of research on Thai longan production and found were significant factors affecting the quality of Longan fruit as follows Pruning, Fruit Thinning, the use of potassium chlorate (KCIO3) and sodium chlorate (NaCIO3), Removal of diseases and insects, Fertilizer. In addition, this paper proposed the agricultural ontology development process by adding a data validation process. A prototype of ontological knowledge based on Thai longan production is developed . The main classes are derived from factors affecting the quality of Longan fruits. This research is at the beginning stage of knowledge management in Thai longan production. Ontology knowledge of Thai longan production can be further developed in the knowledge- based system related to longan knowledge services such as Longan Disease Diagnosis system, Fertilizer Formula Calculator system, Semantic information retrieval system, Disease and Insect Removal Recommendation System etc. It is expected that the information can be retrieved or processed to meet the needs of users. However, the ontological knowledge base on Thai Longan production has been validated only for linking semantic relations of each factor produced by the expert.

It does not support automatic knowledge base updates. Implementing the full applications in order to support the longan production with quality based on this knowledge-based is challenged.

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