Chapter 1: Introduction

The objective of the research work is to facilitate the farmers to recognize about the diseases of rice plant and necessary action to be taken to control the diseases.
Introduction

1.1. Background of the Study

More than half of the world's population depends on rice, which is an important staple food (FAO, 2004), occupying 145 million hectares of land, with a global production of 468 million tonnes. Almost 90 percent of the world's rice is produced and consumed in the six Asian continental countries which are namely China, India, Indonesia, Bangladesh, Vietnam and Japan. They comprised 80% of the world's production and consumption of rice. Asian trend recently shows that production and export has been increasing but the consumption has been decreasing. In the middle and high-income Asian countries like Japan, Taiwan and the Republic of Korea, per capita rice consumption has started to decline with growing prosperity and urbanization. However, nearly one-fourth of the Asian population is still poor and has considerably unmet demand for rice such as Afghanistan, North Korea, Nepal and Vietnam [1]. Additional 300 million tonnes of rice production will be needed in 2020 to meet the need of a fast-growing human population. This requires 65% production increase within 30 years without much expansion of the actual cultivated area (International Rice Research Institute, 1989).
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Rice, the most important crop in India, currently grown on 44.6 million ha, contributing about 42% of total food-grain production. The time series of annual prominently increasing trend is superimposed onto year to year fluctuations. The increasing trend - which is attributed to non meteorological factors such as increased gross sown area, improved technology, fertilizer application, pest and disease control, etc. into the historical annual rice production data for the period 1950-2000 [2]. Addition to this fact, food security is centralized to rice; it is consider being a strategic commodity. Such an important food crop is occasionally infected by many diseases and hence reduces the productivity. Though it can be recognized from the symptoms and changes associated in the plant but identification of a disease is not an easy task. It needs experts of experience and knowledge of the rice plant diseases which mainly depends on a system for accuracy in describing the symptoms and identification of diseases, making right decision and choosing the right treatment.

Agriculture is the single largest basis of livelihood of about 70 per cent of the population. It is also the mainstay of the Manipur state’s economy. The state can be forced into two physiographic zones which are valley and hills. The valley has an average altitude of 872 meters above MSL and the climate is subtropical and warm in the summer season. The valley part is the "rice bowl" of the state. The hill areas of the state are under temperate subtropical climate at the
average altitude of 3000 metres above MSL. The state has distinct winter, warm humid and rainy seasons. The average rainfall is 1482 mm with heavy precipitation during the months of June, July and August. There is post and pre-monsoon shower in the months of October and February. The state is very small in area but the agro-climatic conditions are distinct from one place to another because of the different elevations. Rice cultivation is the major agricultural activity in Manipur and also the main food for the people. The agro-climatic conditions are also most appropriate condition for the cultivation of rice by traditional method of farming. It also contributes a major share of household income to Manipur. Out of the total hill area of 2.05 lakh ha, only 0.64 lakh ha is used for cultivation. It is approximately 3 per cent of the total land area [3]. While in the valley portion of the state, only 0.87 lakh ha out of the total land area 1.84 lakh ha, is used under rice cultivation. It is more than 47 per cent of the total area of the valley.

In any agricultural production system, gathering and assimilating of related knowledge and information of rice plant diseases from various sources play important role. It is mainly available from the knowledge and high experience of human experts. Handling uncertain information related to certain specialty, agriculture domain needs an expert system. When an expert in a specific area gives an advice to a less experienced person, they use
actual knowledge and experience to generate the piece of information. Therefore, the piece of information results in the combination of different domains and methods. It becomes more precious if the result starts solving problem where different specialists participate to solve it. This information is either found in written or unwritten forms or generated from data available in the form of audio-video and/or in the form of local and traditional knowledge.

In recent times, tools, technologies and applications of information have emerged as a resourceful measure for up gradation of the entire agricultural fields, ranging from scientific studies to farmers help. Assimilation of expert system as a powerful tool for the stakeholders of agricultural production has extensive possibility. Hence, Expert System (ES) technology can play a very important role in generating information from knowledge of human expert. So, Expert Systems can be defined as a tool for information generation from knowledge [4].

Expert System (ES) is the computer program that simulates the problem solving behaviour of human expert in a narrow domain area. It is constructed by obtaining the knowledge from a human expert and coding it into a form that a computer may apply to similar problem. Such types of systems are different from traditional software in the sense that they have dealt with a symbolic knowledge
base, not a database or mathematical models. They can be, however, integrated with traditional software to make a complete system if needed. The background of the system begins with the gathering of the rice plant disease symptoms appearing during their life span from agriculture experts, plant pathologists and literature. Then the acquired knowledge is represented to develop expert system using the Java Expert System Shell (JESS). Keeping the above points in mind, main concern of the research study is to design and develop an expert system providing the control measures of identified diseases.

1.2. Problem Area

The productivity of rice does not only vary between one country and another, but also within the same country based on the different agro-ecological zones and production systems used. The gap between the farmers' yields and those obtained by research stations is still large, even though some reduction has been reported recently. This indicates the various limiting factors affecting rice productivity and production, ranging from land development, diseases, production and marketing.

The entire north eastern region experiences wide variation in soil and climatic conditions. Problems of crop production vary with zones as the soil and climate vary from zone to zone. However, there are still many constraints of rice production which are common to
more than one zones and types of rice culture. Therefore, it is the need of the hour to find out constraints which hinder high productivity to plan research and development strategies in order to achieve as much of rice production potential as possible. The biotic stress such as high pests and diseases incidence in particular experiences is the highest biophysical constraints in the state which are mostly natural. The region have shown low level of productivity because the farmers lack dynamism, low labour efficiency and skill due to limited employment opportunities of the rural folk in the non-agricultural sectors, prevailing lack of experts availability during the time in need of the farmers to solve the problems which arises in rice plant diseases.

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The economy status in Manipur state is mostly dominant in agriculture where full concentration is on the crop rice cultivation. Out
of the total state area only 8% in the valley are of rice cultivations. The shortage of rice of about 1.5 lakh tonnes every year is one of the major problems in Manipur. The lack of rice is becoming more and more acute problem in recent years because of the rising population on the fixed area of cultivable land. As the demand for rice is increasing in the state, rice cultivation with shorter duration with high yielding varieties have been introduced to grow in areas with assured irrigations. However, such cultivation usually aggravated the problems of pest and disease during the time in the main season crop [3].

Consequently, understanding of the various components of grain yield of rice and how to improve them will help improve manpower skills and capability in increasing rice production by raising the current yield level. The decline in yield on farmers' fields has not yet been thoroughly studied and documented. It is noted that farmers are now using more numbers and higher levels of inputs than before to maintain the rice productivity.

An agricultural expert's opinion is needed to find out the exact type of disease. However, the agricultural experts are limited in number and there are too many problems to be solved at the same time. These conditions make the requirement of building a system with a capability as an expert. This system must hold the expertise
knowledge of the diseases and symptom of rice plants as agricultural experts has to have. It is, therefore, predictable that the farmers can access the expert system everywhere at any time to overcome the problem to diagnose diseases in their rice plant.

1.3. Problem Statement

Majority of rural masses and the mainstay of Manipur state's economy, rice based agriculture are the largest source of livelihood. The estimates of State Domestic Product (SDP) fluctuate from year to year according to the success or failure of rice crop production. Out of this total cultivated area of about 2.11akh hectares in the state, the area under main rice crop during kharif season is 1.95 lakh hectares, which is about 93% of the net cultivated area [5].

Every small and marginal farmers of Manipur largely cultivated rice. Near to the beginning of the season the insect-pests and diseases from of the paddy field increases in large proportions and thereby severely damage the late season crop. At the same time, excessive application of pesticides also upset the rice crop ecosystem, which significantly contributes to the diet of the people. Thus, it is an essential need of the farmers to identify the diseases of the rice plant.
The agriculture specialists and raw experiences are the common sources to provide information that the different stakeholders require for decision making to improve agricultural production. Agricultural specialists’ assistance is not always available when the need arises by the farmers for their help. The accurate and real-time identification of rice plant diseases is a problem that requires high degree human expertise, which is costly, and not always available. Therefore, such people are normally few and they often soon retire while their expertise are not yet documented and made widely available to others who may not be experts themselves. Hence, the problem is to capture human expertise in infectious rice diseases and make it readily available to others to perform expert work in a standardized high calibre manner.

1.4. Objective of the Research

The objectives of the research study are as follows;

- To investigate expert systems applications, especially in agriculture.
- To identify the common diseases of rice plant, their causing agents, predisposing factors of the disease and its control measures.
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- To develop a database that consists of the information about common diseases of rice plant and its control measures.
- To develop a rule-based expert system using the Java Expert System shell (JESS) that can diagnose the diseases of rice plant and provide control measures to control it.
- To implement the developed prototype expert system for rice plant disease diagnosis.

1.5. Scope of the Research

More than 50 percent of the areas of Manipur are under rice cultivation. Low resource base of farmers, and unavailability of appropriate technologies are varied obstacles to higher rice productivity. Though, rice research has helped to alleviate poverty and improve food security, strategic research is needed, so that it wills constraint to increase rice production. In view of the explosive increase in population, the anticipated demand for rice in future cannot be met by merely concentrating on improving yields. The growth of rice crop and natural resource management plans are needed to explore the rice potential of improved cultivars. Rice research has succeeded in recent years in developing improved cultivars and resource management practices appropriately.
Each season, the rice crop fields are affected by many problems of diseases. Effects of rice plant diseases on rice crop productivity often vary depending on inherent capacity of the variety to withstand the disease condition. Due to lack of knowledge typically on the identification of diseases by farmers and using of ineffective fertilizer leads to rice plant diseases, damaging to the environment and consequently it comes to low production from farming. The scope of the present research work is to focus on the identification of rice plant diseases and to provide the control measures of the identified diseases to the farmers by the means of using expert system. Researchers and modern farmers aim at the improvement of rice production by using the expert system. The proposed system will help to diagnose the fungal diseases, bacterial diseases, and some other diseases and disorders. The recommendation of controlling the diseases will be provided to the users after the diagnosing of the disease.

1.6. Significance of the Research

Among the north-eastern states, Manipur ranks first in fertilizer consumption per unit area (66kg/ha). But the consumption ratio against recommended dose is highly imbalance and injudicious for rice cultivation in Manipur (Kumar and Ray Chowdhury, 2000). The use of chemical fertilizer in adequate quantities is perhaps the fastest
way of increasing the production in controlling the rice plant disease and arresting the depletion of soil nutrients. However, the resource poor farmers are not able to recommend the symptoms arises in rice diseases and can’t bring quantities and in balance proportion as they are not able to trace the plant disease. This problem can be solved to a considerable extent by using available resources like crop residue, bio fertilizers and organic nature of human expert about the rice plantation and at the same time proper diagnosis of the disease. However, there are still many constraints of rice production which are common to more than one zones and types of rice culture. The problems of rice cultivation in Manipur are manifold. Hence, it is the need of the hour to find out constraints which hinder high productivity to plan research and development strategies in order to achieve as much of rice production potential as possible.

The significance of the research work is, therefore, to facilitate the farmers to recognize about the diseases of rice plant and necessary action to be taken to control the diseases. Timely identification and controlling of the rice plant diseases will improved the production in agriculture area by using expert system. The knowledge base of the system is developed using the knowledge from deferent human experts and textbook references for the expertise to be preserved for use in case the experts soon retire.
1.7. Organization of the Thesis

This research work is presented in seven chapters besides the proceeding Chapter 1: Introduction.

1.7.1. Overviews of the contents of the chapters

1.7.1.1. Chapter 2: presents the Artificial Intelligence (AI) and its relation with Expert System (ES) which includes the developments in AI, technologies in AI, advantages and disadvantages and its application. It also covers the development of expert system, its principles, limitations, advantages, characteristics, fundamentals, needs for expert system and the application of expert system in agriculture.

1.7.1.2. Chapter 3: describes about the raw knowledge base of rice plant diseases and their symptoms. Details of the rice plant diseases - fungal, bacterial and virus; its symptoms, predisposing factors and control measures are covered in this chapter.

1.7.1.3. Chapter 4: concerned with the structuring of knowledge from the raw knowledge base of rice plant diseases and their symptoms. In this chapter, it is described how to represent the knowledge from raw knowledge base in the form of rules using the Java Expert System Shell (JESS).
**1.7.1.4. Chapter 5:** covers the expert system principles, elements, architecture and its characteristic, distinction between expert system and other algorithmic, representation of knowledge in expert system - rule based, object based and logical based, development of an expert system, the role of expert system shell and some of the available expert system shells.

**1.7.1.5. Chapter 6:** presents the knowledge acquisition process of the development of the system. The chapter discuss the issues and problems in knowledge acquisition and also presents the available techniques in knowledge acquisition.

**1.7.1.6. Chapter 7:** presents the methodology adopted for the present research work which includes development of an expert system, the proper choice of an expert system shell, system design, and the knowledge base development of the system and the technical method of the evaluation of the system.

**1.7.1.7. Chapter 8:** deals with the analysis and interpretation, discussion of the findings of research work.

**1.7.1.8. Chapter 9:** covers the summary, conclusions and limitations of the research work and recommendation of the research study in future.