Content Development for an Agricultural Expert System on Organic Vegetable Cultivation

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DEPARTMENT OF AGRICULTURAL EXTENSION

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM-695 522

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by

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2014

DECLARATION

I, hereby declare that this thesis entitled **"Content Development for an Agricultural Expert System on Organic Vegetable Cultivation"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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Date: (2012-12-163)

CERTIFICATE

Certified that this thesis entitled **"Content Development for an Agricultural Expert System on Organic Vegetable Cultivation"** is a record of research work done independently by Ms. Anupama S., under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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Anupama S.

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LIST OF ABBREVIATIONS

AA	-	Agricultural Assistant
AO	-	Agricultural Officer
CABI	-	Commonwealth Agricultural Bureau International
CRP	-	Community Resource People
ICAR		Indian Council of Agricultural Research
ICT	-	Information Communication and Technology
IFFCO	-	Indian Farmers Fertiliser Cooperative Limited
IFOAM	-	International Federation of Organic Agriculture Movements
IIIT		International Institute of Information Technology
IKSL	-	IFFCO Kissan Sanchar Limited
INDOCERT	-	Indian Organic Certification Agency
ISOFAR		International Society of Organic Agricultural Research
KAU		Kerala Agricultural University
MSSRF	-	Prof M.S. Swaminathan Research Foundation
NGO	-	Non-Governmental Organisation
PRA	-	Participatory Rural Appraisal
RML	-	Reuters Market Light
SIM		Subscriber Identity Module
SMS		Short Message Service
UN	-	United Nations

INTRODUCTION

1. INTRODUCTION

With the increased use of chemical pesticides and fertilizers, a chain of problems had created in the environment, starting from the change in the basic structure of soil and water in many places. This intensive chemical based agriculture followed since green revolution is causing heavy pollution in our food, drinking water and air. Though life expectancy has improved, there has been a substantial deterioration in our quality of life. There has been an increased tendency among rural farmers to depend on purchased inputs such as seed, fertilizers, pesticides, growth promoting chemicals etc. The adverse effect of the chemical agriculture can be cancelled or limited to an extent by the adoption of organic farming practices.

Organic agriculture is a farming system based on integrated relationship among soil, water, plant and micro flora. Organic agriculture helps in reducing the dependency on off farm inputs and create more nutrient and energy flows, which in turn strengthens the ecosystem resilience, increased food security and also helps in the generation of additional income. Apart from these facts, organic agriculture is the method of sustainable farming where the nature is not disturbed. Organic production is a system that lends itself well to small-scale and part-time farming operations. Although the cost of certification and the time and labour involved in managing the system are high, returns can also be, on average, 20 percent higher than conventionally produced products, provided that a market exists.

Development and dissemination of new technology is an important factor in determining the present and future of agriculture. In Kerala efforts are now being developed to produce some of the crops organically not only on account of the ecological consideration but also for the need for production of safe food for human consumption. A limited number of farmers produce vegetables by organic methods for their own consumption and also for sale in the local markets.

Foreseeing the future requirements, KAU had come out with an ad-hoc organic farming package of practices recommendations for crops. One of the impediments for large scale adoption of organic farming practices is lack of awareness on the scientific information on organic farming among the farmers. This is because that the information and communication support during the last fifty years has mainly been conventional.

The people working in the agriculture sector are least equipped with proper tools to deal with rapidly changing agricultural production scenario and international competitive environment. Also, the existing transfer of technology mechanisms and extension programs, mostly run by the government departments, are slow and in many cases ineffective as bridges between the research community and the farmers.

The present study entitled "Content development for an agriculture expert system on organic vegetable farming" attempts to identify and prioritizing need based information on the organic farming in vegetables and development of content for a farmer- friendly expert system on the organic farming in vegetables.

1.1. THE MAIN OBJECTIVES OF THE STUDY

1. To analyse the information need on organic vegetable cultivation.
2. To inventorize information for the different systems in Kerala, in-order to develop content for farmer- friendly interactive multimedia aid.
3. To assess the extent of knowledge on organic vegetable cultivation practices.
4. To study the profile characteristics of the respondents.

1.2. SCOPE AND IMPORTANCE OF THE STUDY

Organic agriculture has been gaining importance due to growing concern of the people for having a safe and healthy food. Farmers are attempting to practice organic agriculture irrelevant of the fact that they lack proper scientific knowledge in the do how. Even, most of the certified organic farmers are also lacking knowledge in organic cultivation practices. The number of farmers having organic certification in vegetable farming is very low. Most of the certified farmers interacted were cultivating vegetables organically in their homesteads for their domestic purposes alone.

Organic farming over the last few decades has proved to be successful; but the differences in culture, ecology and geographical factors necessitate adoption of situation-specific principles and techniques (Balachandran, 2004). The fast changing scenario of agriculture for organic production calls for the revitalization of the extension system so as to make effective transfer of technology. Information and communication technology (ICT) acts as a highway in getting the quickest and reliable up to date information. With the availability of agri kiosks, telephone and internet, it is now possible to bridge this gap to quite a large extent by using an appropriate mix of technologies.

Taking these facts into consideration, the present study attempts for content development for an expert system where the farmer can retrieve the data from it as fast as possible and also attempts to formulate a quick and easy methodology

The study was confined to two districts where the largest number of farmers are involved in organic practices in vegetable cultivation. Also, the number of farmers having organic certification is very limited. The statistical methods applied were used for studying the profile characteristics of the respondents alone. Simple methods such as percentage analysis and correlation were used for the purpose. In spite of these, every effort is taken to conduct the study as systematic as possible.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

For having a strong foundation for the scientific investigation, review of literature is essential. It provides a better understanding of the present study and gives ideas for the interpretations of the findings. The review of literature connected with the study on hand is organised on the following headings:

2.1 Introduction to expert system

2.2 Concept of content development

2.3 Stages of content development of an expert system

2.4 Information need analysis on organic vegetable cultivation

2.5 Inventorization of information on organic vegetable cultivation

2.6 Extent of knowledge about organic farming practices

2.7 Profile characteristics of organic vegetable farmers

2.1. INTRODUCTION TO EXPERT SYSTEM

An expert system is a software application that attempts to reproduce the performance of one or more human experts. Expert systems are mostly based on a specific problem domain, and are a traditional application of artificial intelligence. The expert system is used to behave like a human expert to solve the problem with the help of pre-set conditions in the software application.

The most common form of an expert system is a computer program, with a set of rules, that analyses information usually supplied by the user of the system about a specific class of problems, and recommends one or more courses of user action. The expert system may also provide logical or mathematical analysis of the problem. The expert system utilizes what appears to be reasoning capabilities to reach conclusions.

Expert systems, particularly in agriculture sector can be used effectively to provide proper advice to the farmers in the area of nutrition management, pest control, selection of crop based on soil and water availability and many more. In short, expert systems unite the accumulated expertise of individual disciplines, e.g., plant pathology, entomology, horticulture and agricultural meteorology, into a framework that best addresses the specific on-site needs of farmers.

2.1.1. Definition of Expert System

An expert system is defined as "a computer program designed to model the problem solving ability of a human expert" (Durkin, 1994).

According to Dubey *et al.* (2013), "an expert system can be defined as a tool for information generation from knowledge." Information is either found in various forms or generated from data and/or knowledge.

Text, images, video, audio are forms of media on which information can be found, and the role of information technology is to invent, and devise tools to store and retrieve this information.

2.1.2. Characteristics of Agricultural Expert System

In agriculture, expert systems unite the accumulated expertise of individual disciplines, e.g., plant pathology, entomology, and horticulture, into a framework that best addresses the specific, on-site needs of farmers. According to Prasad and Babu (2006), the main characteristics of an agricultural expert systems are:

1. It simulates human reasoning about a problem domain, rather than simulating the domain itself.

2. It performs reasoning over representations of human knowledge.

3. It solves problems by heuristic or approximate methods.

2.2. CONCEPT OF CONTENT DEVELOPMENT

Useful content is required to anyone, but to have the right content in the right form is the most effective for the right users.

Content development is the process of gathering together, writing, editing, optimizing and otherwise adapting content materials especially for publication on the web.

According to Chin Hua *et al.* (2005), developing an expert system based on integrated information on organic waste composting and utilization in a CD (compact disk) format may enhance the composting protocol adoption and efficiency in recycling of organic waste as well as promotion of organic vegetable production. Databases on organic wastes and materials, organic manures, composting technology, compost utilization, organic manuring of vegetables, and non-chemical disease and pest controls have been established in the expert system. Stepwise guidelines and user-friendly menu for searching the composting technological consultancy shall be designed so as to increase its applicability.

Jalal (2007) defined content development as a collaborative and continuous interactive process with the objective as to gather, organize, edit and improve the quality of message in the text, image, audio and video etc. These collaborative and continuous interactive process can be surveys, PRA, focus group discussions, and participatory monitoring and evaluation which will be helpful to support continual definition of appropriate content in ICT projects.

Deciding content for an ICT project is very important as it can influence the relevance and action-ability of that content to the end users. In addition, the excludability and rivalry of the information may influence whether payment is required for the delivery of that information. Sulaiman and Ramasundaram (2011) opined that timely and localized information to context-specific situations may be more costly, it may also have greater impact for targeted groups.

2.2.1. Content Development of an Expert system

Glendenning and Ficarelli, (2012) stated that the development methodology is divided into two main parts: knowledge engineering, and software engineering. The knowledge engineering methodology included: acquiring the knowledge, analysing and modelling the acquired knowledge, and verifying the modelled knowledge.

The knowledge acquiring was done by using structured interview, concept sorting, and protocol analysis techniques. During this stage all types of media such as images, video clips and texts that can be used to enhance the explanation capabilities of the systems were collected.

The knowledge analysis and modelling procedure included: domain analysis, inference analysis, and task analysis. In domain analysis, the documented knowledge was analysed aiming at identifying concepts, properties of these concepts, and relations. In inference analysis the documents and tapes generated from knowledge acquisition activities were analysed with the purpose of finding the domain knowledge which the expert was using to reach a conclusion from specific components in the domain layer. So, the inference analysis was aiming at modelling the acquired knowledge. The knowledge was verified at the knowledge acquisition stage, analysis stage and implementation stage. (Rafea, 1998)

According to Roman and Colle (2003), the content development process will influence how relevant, trustworthy, affordable, useful, and usable that information is for the user. Balaji *et al.* (2007), reported that in ICT projects, content needs to be gathered, stored, retrieved, adapted, localized, and disseminated.

Low content relevance could also be the result of language and other localization issues, poor awareness of users, or inadequate understanding of local needs by program implementers (Dossani *et al.,* 2005).

Chakraborty and Chakrabarti, (2008), opined that the development of an expert system for crop protection is a dynamic process rather than a one-time activity. The occurrences of most crop diseases are greatly influenced by the changes in the environmental and edaphic conditions of the region. The disease scenario is also affected by the introduction of new crop varieties. Therefore, an expert system for crop protection should be updated regularly using the feedbacks obtained from the fields. To develop a reliable expert system for crop protection, the various factors that may influence the occurrences of the diseases in crops must be tracked continuously for at least 10 years.

The most appropriate channels and formats for information dissemination need to be considered. These channels include the information delivery mechanism that is the technology itself, as well as the offered language options, with the local language being the preferred one (Mittal *et al*., 2010). Agricultural information may need to be interpreted and then translated and evaluated, it should also being continually updated and adapted simultaneously while it is disseminated.

For any expert system, knowledge base is the intelligent component. Knowledge base provides the required expertise in solving complex and unstructured problems. For answering the various questions, a database, having two levels, on crop description is enabled. The first level of the knowledge base will contain the information gathered from weather station and collected from the expert and survey of literature like crop sowing date, growing stage, water requirement and basic information of a crop for a particular week. The second level of knowledge base will store of the result of various models based on the input given to the system (Kumar *et al.,* 2011).

2.3. STAGES OF CONTENT DEVELOPMENT

The way in which ICT projects access, assess, apply, and deliver content may increase the likelihood of ICT use by farmers and thus may become an

important factor in a project's success. To address the information needs of farmers, relevant content is a key component of ICT projects. The extent to which content is customized and localized to a farmer's condition influences its relevance.

Ballantyne (2002) defined local content as content that is intended for a specific local audience, as defined by geographic location, culture, or language or as content that is socially, culturally, economically, and politically relevant to a given society. Thus, local content is the expression of a community's knowledge. Local content includes external or global content that has been transformed, adapted, and assimilated into a knowledge base.

Determining what content to provide is important in ICT projects, because it influences the relevance and actionability of that content to the end users (Figure 1, Step A). In addition, the excludability and rivalry of the information may influence whether payment is required for the delivery of that information. The process of sourcing the content (Figure 1, Step B) influences not only the content quality but also the costs and the time needed to gather appropriate content. It also determines credibility and sustainability.

Reliability of content by users can be ensured by appropriate quality of information (Figure 1, Step C). If the information is known to be reliable, farmers may be more likely to use the information to make decisions in their farming enterprise. Usability may be increased by sourcing content from farmer perceived trustworthy local sources, which may not necessarily need to be a scientific or government authority. Because all of these projects utilize expert knowledge from the ICAR institutes, NGOs, and other industry partners, the reputation and reliability of the organizations is the base on which quality of content is assessed

Context-specific, localized content is an important aspect of relevant information provision—the information collected must be adapted, localized, and packaged to be relevant to the users. (Figure 1, Step D) The technology aspects now come into play, with storage and retrieval components (Figure 1, Step E) and

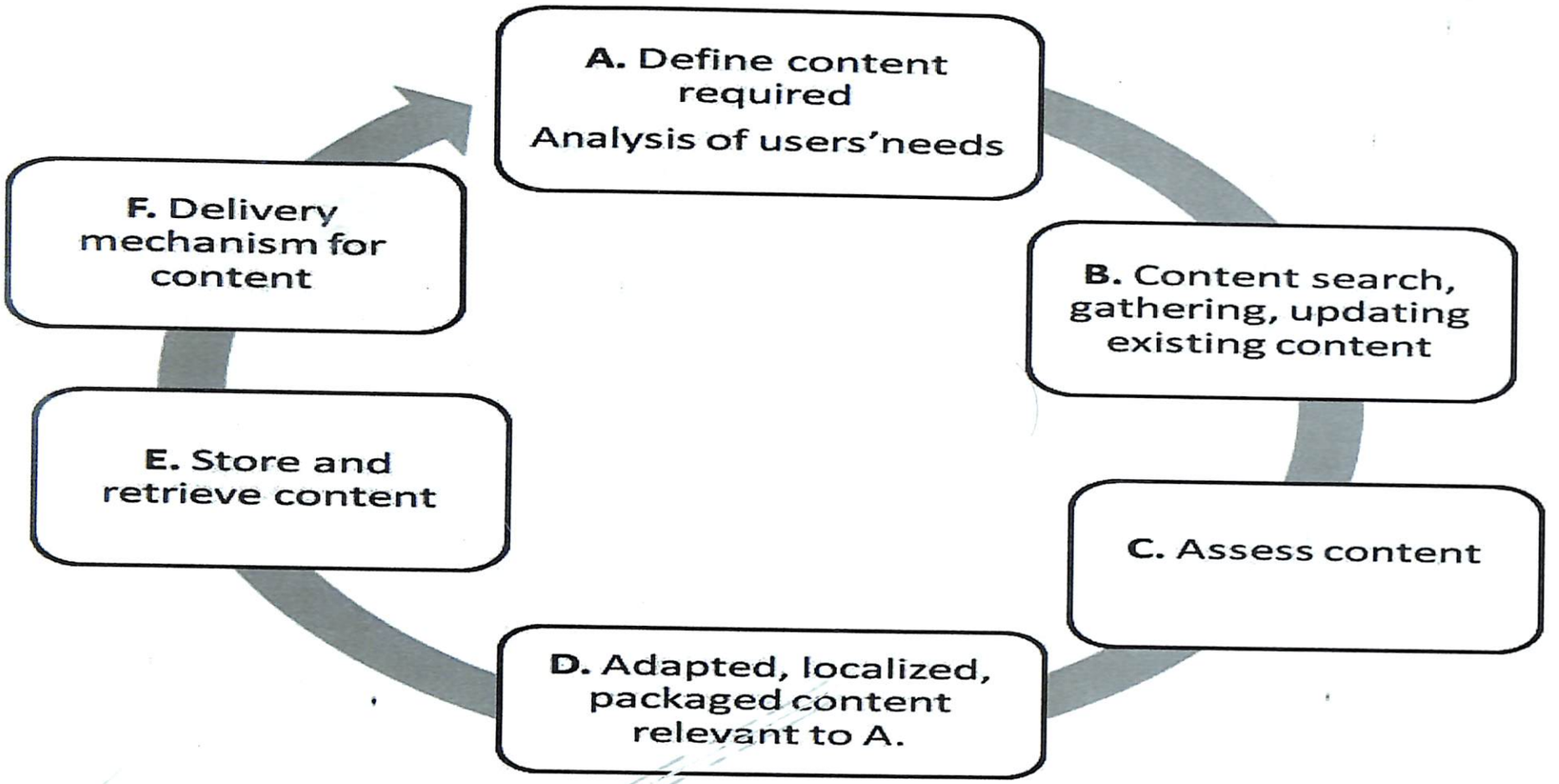

Figure 1. The continuous content development and management cycle

delivery mechanisms and dissemination (Figure 1, Step F), all of which influence how the content is packaged and made accessible to users.

According to Glendenning and Ficarelli (2012), continual consultation and feedback from users on the applicability of the content and the use of the technology are important elements of the content cycle's learning process. Although the framework follows logical steps in content development and management, integration of steps may be fluid and dynamic.

2.3.1. Content Management Process in Different Expert Systems

2.3.1.1. Content Management Process in Reuters Market Light (RML)

Reuters Market Light (RML) started in October 2007, a business of Thomson Reuters, is a mobile-SMS that provides personalized information to subscribed farmers, which today number about a million unique subscribers in more than 40,000 villages. The service is delivered through SMS in eight local languages, across 13 states, and over any service provider or mobile phone (RML, 2010).

RML collaborates with a network of partners for content generation, in addition to employing more than 300 who collect content that is not readily available, such as market spot prices and locally relevant news. (Figure 2) Weather information is provided by Indian Meteorological Department and other private weather services, as needed. Agro advisory information is provided by experts from various academic and private sources. (Fafchamps and Minten 2011)

2.3.1.2. Content Management Process in Indian Farmers Fertilizer Co-operative Limited (IFFCO) Kissan Sanchar Limited (IKSL)

Indian Farmers Fertilizer Co-operative Limited (IFFCO) Kisan Sanchar Limited (IKSL) is a partnership between IFFCO and the mobile service provider

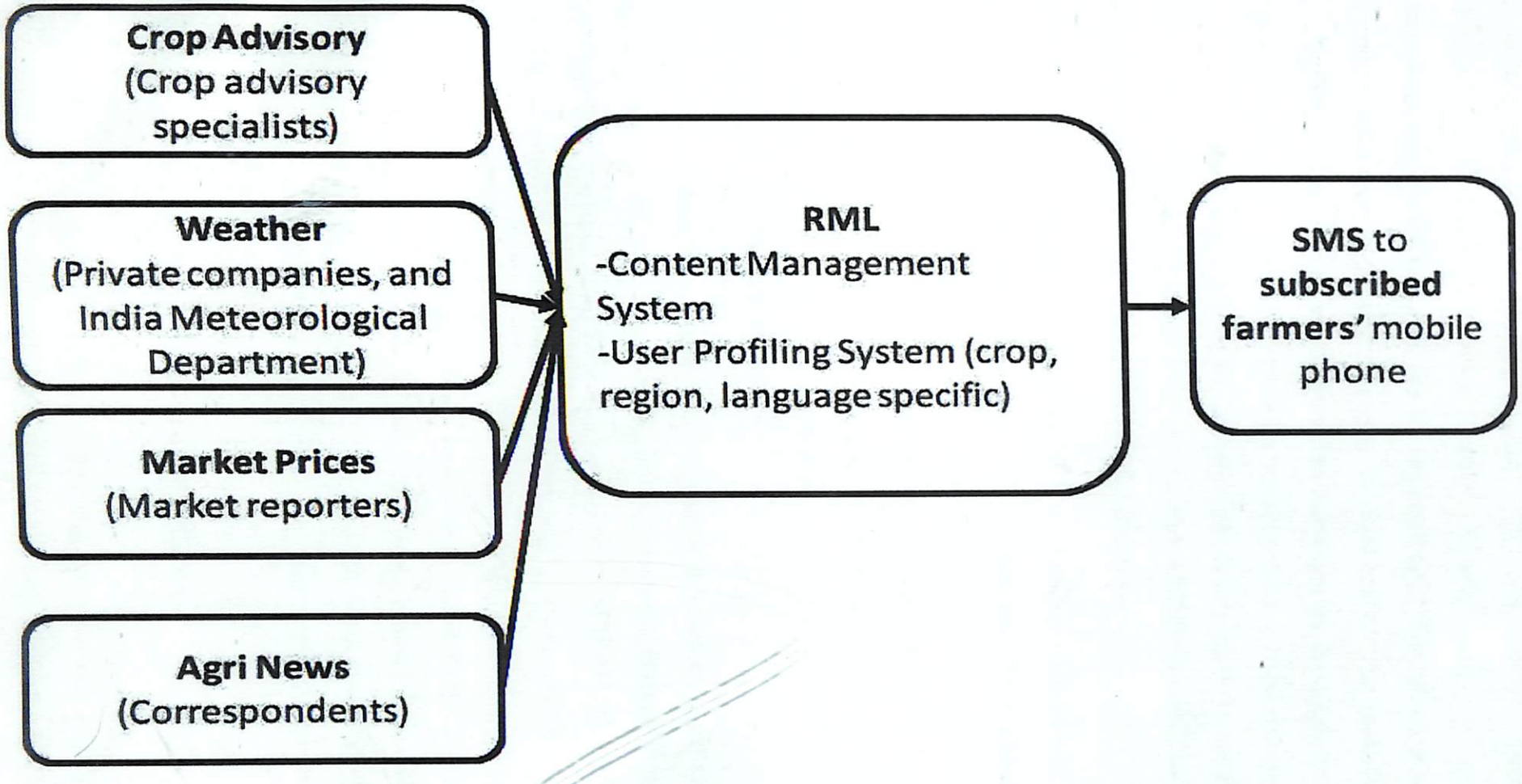

Figure 2. Content management process in Reuters Market Light (RML)

Bharti Airtel. The initiative started in June 2007. ubscribers purchase an IFFCO-Airtel *Green* SIM (subscriber identity module) card, and revenue is generated from the use of talk time by the subscribers. The green SIM card is seen by Airtel as a way to attract customers in rural areas. The main service of IKSL is the provision of five free daily voice messages in the local language to subscribers. To date, around 139,000 voice messages have been developed, and 95,000 messages have been delivered. Information is provided on weather, crop and animal husbandry advisories, market prices and miscellanea such as fertilizer availability, electricity timings and government schemes.

IFFCO Kissan Sanchar Limited (IKSL) determines content via a mixed strategy, including structured surveys by universities and third parties, needs assessment by in-house teams in different states, crop calendars and analysis of agro climatic conditions by experts based on existing data, PRAs in focus communities, capture of specific interests of farmers at the initial farmer registration, and provision of a mix of messages capable of covering various areas of interest. (Figure 3). (Srinivasan, 2010)

IKSL collaborates with a number of partners to develop content for its voice messages. Partners include Commonwealth Agricultural Bureau International (CABI), Prof M.S. Swaminathan Research Foundation (MSSRF), Commonwealth of Learning, selected Agricultural Universities, the Department of Agriculture, and Agricultural Research Institutes. Due to the huge variability in agriculture across India IKSL sourced knowledge from local agricultural institutes and universities (GSMA, 2012). CABI provides crop and livestock fact sheets, based on cropping season, ecological zones, and dominant farming systems. These fact sheets are suitable to be directly translated into voice messages in different languages.

2.3.1.3. Content Management Process in Digital Green

Digital Green is a non-profit organization that partners with NGOs, and also government agencies like the National Rural Livelihood Mission, to improve the

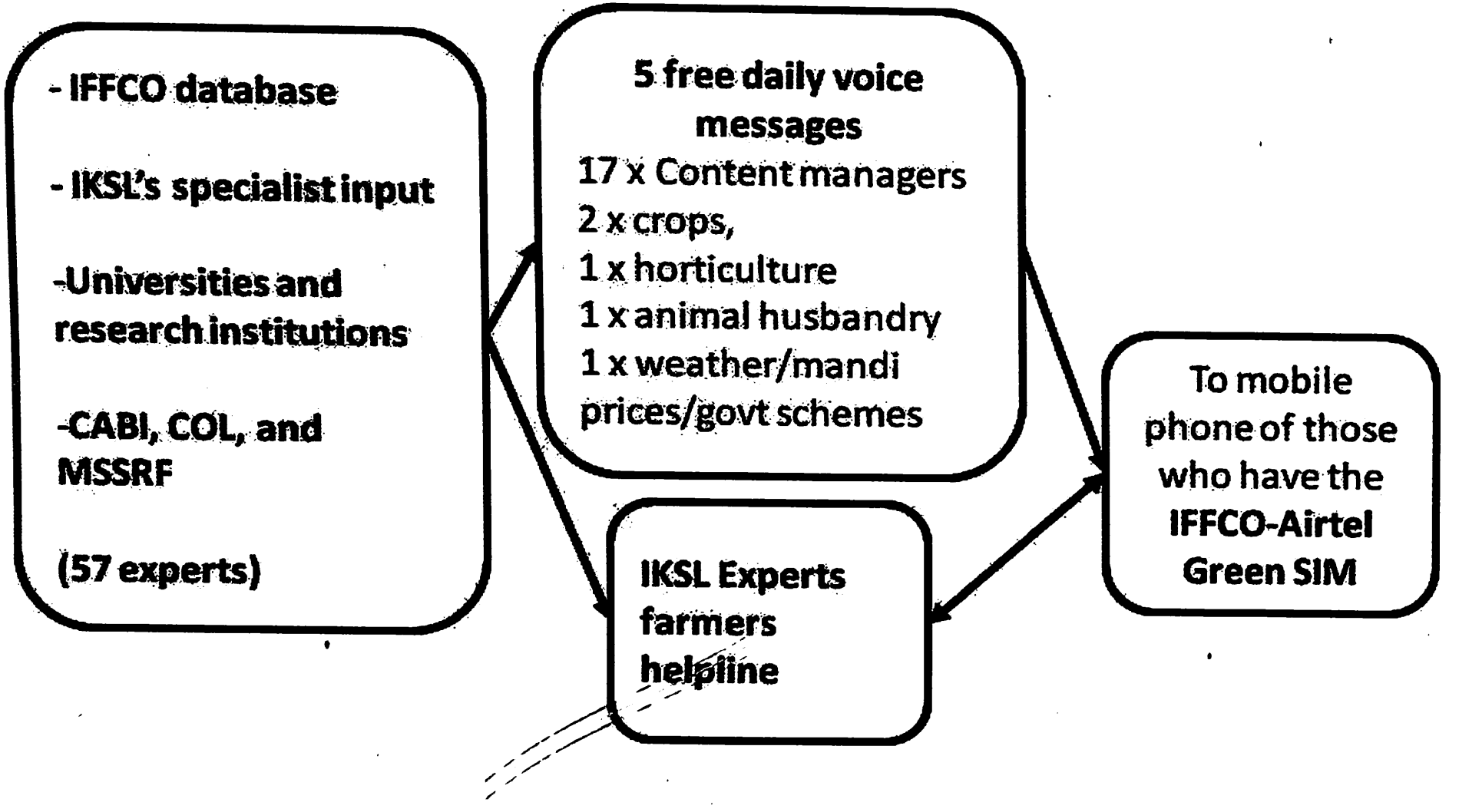

Figure 3. Content management process in IFFCO Kissan Sanchar Limited (IKSL)

effectiveness of their field extension services by disseminating agricultural practices using video as a medium. (Figure 4) Digital Green works to support existing extension services rather than substituting them. Digital Green was incubated by Microsoft Research India in 2007, when Digital Green partnered with the Green Foundation in Karnataka. Digital Green receives core funding from the Bill and Melinda Gates Foundation.

In Digital Green, the onus is on the NGO partners to provide the relevant agricultural expertise, the agricultural technology, or the package of farm practices that is best suited for or needed by the community. Videos are produced by Community Resource People (CRPs), who are familiar with the local context and who have a basic knowledge of local agricultural practices. The video-based content topic depends mainly on identified practices or technologies that have been successfully field demonstrated and that were actively disseminated by the partner NGO through conventional extension methods. If farmers have an innovation, it may also be included in the video; however, in majority of the cases, it is the expertise of the NGO extension agent that contributes to content. Videos are repeated if the audience demand them. During the video presentations, farmers' feedback, questions, and concerns are transcribed and entered into a database. This information is then reflected in the production of new videos. Content themes of videos include innovations, demonstrations, testimonials, approaches, methods and mistakes (Gandhi *et al*., 2009).

2.3.1.4. Content Management Process in e-Sagu

e- Sagu (*sagu* means *cultivation* in Telugu) uses the medium of digital photos of farmers' fields to provide expert advice. Photographs are captured every 15 days by a local coordinator employed by e-Sagu; these photos are then sent to the e-Sagu main center in Hyderabad, where they are examined by experts who provide advice, which is sent back to the local coordinator. The advice is provided on a regular basis (typically once a week) from sowing to harvesting (Reddy, Ramaraju, and Reddy 2009). It is a project of International Institute of

Figure 4. Content management process in Digital Green

Information Technology (IIIT) Hyderabad, funded by Media Lab Asia. Launched in 2004, this service has been tested on 5,000 farms in 35 villages in more than six districts of Andhra Pradesh.

According to Reddy, Ramaraju, and Reddy (2009), e- Sagu considers the content supported by public-sector extensions too generic and sees it as not being based on context-specific situations. The existing content is not developed or updated based on farmers' feedback and on local knowledge, in part due to a lack of specific farmer demands.

e- Sagu takes a problem-solving approach to content provision, but it does not rely on farmers' demand for content generation. Experts (graduates of agriculture) work in the main center in Hyderabad and virtually visit the farmers' field through photographs sent by coordinators. (Figure 5) The required expertise to grasp various problems faced in the farmers' field from photos differs, depending on the experience of the expert and local exposure to field conditions. Recent graduates may lack the required location-specific, crop-specific capabilities that the e-Sagu platform requires, and their skill base needs to be developed (Reddy *et al*., 2009).

2.4. INFORMATION NEED ANALYSIS ON ORGANIC FARMING PRACTICES

In a study conducted by Middendorf (2007) on organic farmers, the information needs required by them were mainly found on organic methods of weed control, cropping system design, soil health and testing specific to organic production, online lists of sources/dealers of organic inputs (e.g., information on products, costs, availability, distribution), regionally specific Extension publications for organic agriculture, plant breeding and seed history for organic production, organic methods of fly control in cattle (e.g., bio-pesticides), innovative equipment for organic production (e.g., for cultivation), and need for local/regional scale organic grain, meat and dairy processing.

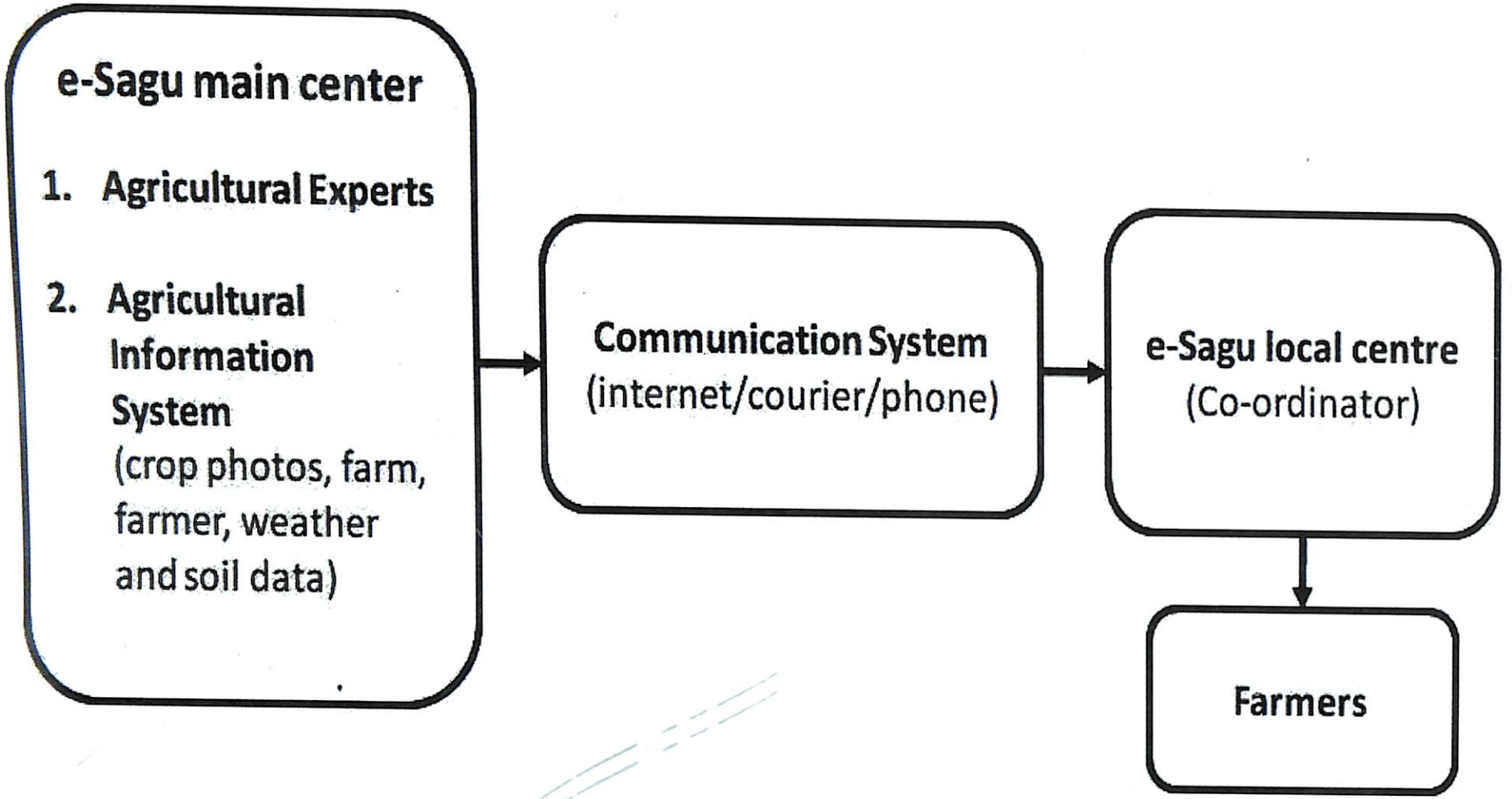

Figure 5. Content management process in e- Sagu

The farmers needed information on online source guide for marketing options, online directory of organic producers (regional and state-wide), including what they produce, online directory of grocery stores that retail organic products and information on certification groups and issues.

Ganasen (2007) reported that preparation of knowledge base, preparation of flow charts, and data entry in to the shell and compiling of knowledge base are the procedures for development of the system. For the preparation of knowledge base, information like data, photographs and video graphs for crop protection, fertilizer requirement, water management and agricultural implements were collected from the scientists of Kerala Agricultural University as well as other research institutes especially Entomologists, Pathologists, Agronomists, Horticulturists and Agricultural Engineers and coded.

Hassan (2008) reported that the respondents needed information on agriculture such as market rates, bio-pesticides and bio- fertilizers. These areas ranked top in their information needs. These were followed by organic farming, plant protection and cropping patterns.

Sunil (2010) recommended that ICT services should provide early warning of disease and pest problems, information on cropping systems and planning, best and latest packages of practices for commercial crops, soil testing and sampling, input prices/ availability and farm business information. Also, since small and marginal farmers are using ICT services, more emphasis should be given to providing information relevant to their farming systems.

In their study, Babu *et al.,* (2012) reported that targeting small holder farmers with low agricultural income is important as they search for less information. These farmers may lack motivation and interest in agriculture, so improving the timely delivery and reliability of information will be important to encourage small landholder farmers to improve their information search strategies and consequently could have important farm outcomes. Information needs of

farmers could be targeted according to the farm characteristics, and channelled through their preferred medium.

Eria (2012) reported that the respondents confirmed that the Farmer's Friend mobile application was indeed being used by the local farmers, and making an impact on their knowledge base on organic farming methods.

According to Bijulal (2014), content development is a group approach which shall incorporate the information from scientists, experts, extension personals as well as farmers, who are the intended beneficiaries. In order to create content for an expert system, first of all there must be a brain storming session with scientists, experts and extension personnel for deciding on the content. A pilot study will be conducted among the respondent group for confirming the information requirement. The content will be developed based upon the study and it will be further discussed among the scientists and experts. The content thus created will be subjected for authentication among the beneficiaries. After incorporating the opinions from them, the content will be finalized.

2.5. INVENTORIZATION OF INFORMATION ON ORGANIC FARMING PRACTICES

2.5.1. Need for Organic Farming

Organic farming is the need of the hour in the present day context of serious threat to our ecology and environment. Great harm is being caused due to large scale pollution of our soil, water and air which have resulted in degradation and loss of these natural resources and a declining trend has set in the productivity of our soils.

Chemical agriculture with a heavy dependence on fertilizer and pesticides is affecting the quality and safety of produce and well-being of humanity. For a sound future, organic farming offers a dynamic interaction between soil, plants, animals, humans, ecosystems and environment (Daniel, 1996).

In India the demand for organic produce increases year after year, particularly in international trade market. Organic produce will help us to avoid the dumping of thousands of tonnes of agrochemicals every year, and will give us residue-free food, save environment from pollution and provide better living standards (Sujit, 2003).

According to Naves *et al*. (2008), organic agriculture offers the opportunity to accept the challenge of maximization of the use of the nitrogen and carbon through biological process available in nature. Both of these chemical elements, which are very important for vital process of biogeochemical cycles, receive special attention in organic management of soil. Those elements are responsible for the most important components of the human and animal food (carbohydrates, proteins, vitamins etc.) and of organic substances that keep the soil alive.

Organically managed farms recorded lower productivity and yield losses but there was an overall improvement in soil quality parameters, indicating better soil health. It is economically feasible to practice organic farming when the farmers are able to get premium price for their produce and with the reduced cost of cultivation by not depending upon the purchased off-farm inputs. Low productivity in organic farming highlights need in the current international and national research activities. (Ramesh *et al.,* 2010)

2.5.2. Inventorization of Information on Organic Farming Practices

Juroszek *et al.*(2008), reported that tropical farmers cultivating vegetables organically, whether by design or by default, must overcome significant challenges organic growers in temperate climate seldom face, including lack of suitable varieties, heavy rainfall, the round presence of pests and diseases and abiotic stressors such as heat, drought, tropical cyclones and temporary flooding.

According to Naves *et al*. (2008), intercropping the green manure legume plant with an annual cash crop is a system particularly adapted to smallholders since it optimises the use of natural resources. In tropical region fast

mineralisation of the vegetable residues can lead to rapid loss of N from soils. For this reason intercropping the green manure is an alternative capable to increase the availability of this nutrient for the main crop.

Espindola *et al*. (2006), reported that using legume as dead mulch is a beneficial cultural practice especially in horticulture. Legume straw shredded and left on soil surface releases nutrients as well as maintains adequate root temperature and protection against soil erosion.

Ramesh *et al.* (2005), stated that the organic farming may increase yields in India compared to "low-input" conventional agriculture, particularly under rain-fed production, as improved soil characteristics contribute to better water and nutrient holding capacity.

Bayu (2008) reported that the repeated application of farm yard manure improved soil physicochemical properties by the increased build-up of soil nutrients. Thus adding farm yard manure appears to be an attractive strategy for resource poor farmers to sustain soil productivity.

A combination of preventive and direct plant protection methods is the most successful strategy in organic vegetable production (Varghese, 2000). In general, preventive methods such as maintaining soil fertility and health are geared towards enhancing the vigour and health of the crop plants. (UN, 2003)

Balestra (2008) stated that the management of plant diseases by the application of plant extracts such as garlic and neem plants were found to be effective in reducing the pathogens growth and the disease incidence caused by bacterial streak, bacterial spot and bacterial canker on tomato plants. Organic control of plant pathogens shows a great potential and sustainable solution for the reduction of losses caused by dangerous phyto pathogenic microorganisms.

Dabbert *et al.* (2008), reported that organic certification schemes are influencing all kind of production methods, but organic is still seen as the top of all certification schemes. Organic products will be yielded according to organic agriculture standard which is desired by market. Also European Union and

United States have different standards so multiple program certification will be required.

2.6. EXTENT OF KNOWLEDGE ABOUT ORGANIC FARMING PRACTICES

Rogers and Shoemaker (1971) opined that knowledge of innovation could create motivation for their adoption.

Manoj (2000) revealed that education, annual income, social participation, innovativeness, exposure to information, economic motivation, and risk preference were found to have positive relationship with knowledge. Majority of rice farmers (54.29%) were in the low group regarding knowledge about the recommended practices.

Thomas (2000) found that farming experience in medicinal plant cultivation, farm size, area under medicinal plant cultivation, annual income, extension contact, mass media exposure and information source utilization were having significant and positive relationship with knowledge on medicinal value.

Jaganathan (2004) stated that 70 per cent of the vegetable growers had medium level of knowledge followed by high (18%) and low (12%) levels of knowledge. Also knowledge about organic farming practices had positive and significant relationship with education, training attended, innovativeness, risk orientation, self-confidence, environmental orientation and awareness.

Singh (2004) revealed that around 29.2 per cent of farmers were found to be having more knowledge about zero tillage while 41.6 per cent were having medium level of knowledge and only 29 per cent of the farmers had less knowledge about zero tillage.

Sharma (2006) reported that knowledge of plant protection measures had positive and significant relationship with their adoption.

Jayawardhana (2007) reported that 68 per cent of the coconut based homestead farmers had medium level of knowledge followed by high (21%) and low (11%) levels of knowledge about organic farming practices.

2.7. PROFILE CHARACTERISTICS OF ORGANIC VEGETABLE FARMERS

2.7.1. Age

Jaganathan (2004) reported that majority of the vegetable growers (48%) belonged to old age category.

Jayawardhana (2007) reported that majority of the coconut based homestead farmers (84%) belonged to the old age category.

Hanjabam (2013) revealed that majority (80%) of the precision farmers belonged to the old age category while 63.33% of the conventional farmers belonged to the middle aged category.

2.7.2. Educational Status

Sherief (1998) reported that knowledge of homestead respondents was positively and significantly related to educational status.

Jaganathan (2004) revealed that educational status of the farmers had positive and significant relationship about knowledge and adoption of organic farming practices and majority of the respondents (52%) had secondary level education.

Sasankan (2004) stated that nearly half of the respondents (49%) had education up to secondary level. There were negligible per cent (<2 %) of illiterate farmers.

Hanjabam (2013) found that 100% farmers were literate and also more than 50% of the farmers had attended high school

2.7.3. Farming Experience

Fayas (2003) reported that about 75% of the farmers had more than 20 years of experience in cultivation among the respondents.

Jaganathan (2004) reported that 47% of the respondents were having medium level of experience in vegetable cultivation.

Jayawardhana (2007) revealed that 38% of the respondents were having more than 25 years of experience in coconut cultivation.

Hanjabam (2013) found that majority of the farmers (76.7%) were having more than 25 years of farming experience. Farmers with less than 10 years of experience were negligible because of the reason that farming has been the primary occupation.

2.7.4. Extension Agency Contact

Manoj (2000) observed that 48.57 per cent of the farmers had high level of extension orientation.

Parvathy (2000) reported that 53 per cent of rural women were found to have high level of extension orientation.

Suthan (2003) revealed that most of the vegetable growers (60%) had high level of extension orientation.

Patil (2008) reported that majority (70.00%) of the respondents were from medium extension participation category, followed by low (19.00%) and high extension participation categories (11.00%), respectively.

Hanjabam (2013) stated that majority of respondents had medium extension orientation followed by high and low levels of extension orientation among the respondents.

Sobha (2013) reported that 48.89% of the respondents had medium level of contact with extension agencies.

2.7.5. Innovativeness

Parvathy (2000) revealed that innovativeness had positive and significant relationship with respondents' attitude.

Beena (2002) opined that low level of innovativeness was expressed only by 35.83 per cent of the farmers and the majority of the respondents (64.17 %) constituted high group.

Jaganathan (2004) observed more than half of the respondents (55 %) had medium innovativeness and also found that innovativeness had a positive and significant relationship with respondents' extent of awareness, extent of knowledge and attitude.

Jayawardhana (2007) reported that more than half of the respondents (69%) had medium innovativeness.

Patil (2008) stated that more than half of the organic vegetable growers had high innovative proneness (53.57%), followed by medium (32.14%) innovative proneness and only 10.29 per cent of them belonged to low innovative proneness category.

2.7.6. Information Seeking Behaviour

Manju (1996) reported a non-significant relation between knowledge of the farmers and information seeking behaviour.

Preetha (1997) observed that information seeking behaviour had a positive and significant relationship with knowledge of the respondents.

Beena (2002) reported that information seeking behaviour was found to be medium for the vast majority (88.33 %) of the respondents. Only 11.67 per cent of the respondents belonged to low group.

Jayawardhana (2007) revealed that 51% of the respondents had medium level of information seeking behaviour.

Hanjabam (2013) observed that majority of the respondents belonged to medium category with respect to information seeking behavior.

2.7.7. Livestock Possession

Sherief (1998) reported that majority of the homestead farmers had low level of livestock possession.

Jaganathan (2004) revealed that nearly three fourth of the respondents had medium level of livestock possession.

Jayawardhana (2007) observed that nearly three fourth of the respondents had medium level of livestock possession.

2.7.8. Scientific Orientation

Oommen (2007) reported that 74 per cent of the respondents had medium level of scientific orientation.

Patel and Chauhan (2009) observed that scientific orientation was significantly correlated with knowledge of farm televiewing farmers about improved practices of animal husbandry.

Hanjabam (2013) found that the respondents were medium to highly scientific in their approach to take up precision farming practices.

Sobha (2013) stated that 53.34 per cent of the respondents had medium level of scientific orientation followed by 23.33 per cent each with high and low levels of scientific orientation.

2.7.9. Economic Motivation

Fayas (2003) stated that majority of the respondents (86%) had medium level of economic motivation.

Suthan (2003) reported that more than half of the vegetable growers (57.33 %) had high level of economic motivation.

Priya (2003) indicated that majority of the vegetable growers (92%) had medium level of economic motivation.

2.7.10 Market Perception

Suthan (2003) reported that 54.67 percent of the farmers had medium market perception.

Jaganathan (2004) found that 55 per cent of the respondents had medium level of market perception and respondents' awareness and attitude towards the organic farming practices had a positive and significant relationship with market perception

Jayawardhana (2007) opined that 62% of the respondents had medium level of market perception.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them. It is necessary for the researcher to know not only the research methods/techniques but also the methodology (Kothari, 1985).

This chapter includes the description of methods and procedures used to conduct the study. In accordance with the objectives of the study the research methodology adopted is presented under the following heads.

3.1 Research design

3.2 Information need analysis and inventorization of information on organic vegetable farming

3.3. Locale of the study

3.4 Selection of respondents

3.5 Selection of variables and their measurements

3.6 Operational definition of variables

3.6.1 Selection of independent variable and its measurement

3.6.2 Selection of dependent variables and their measurements

3.7 Method and tools of data collection

3.8 Statistical tools applied

3.1. Research Design

Research design is the entire process of planning and carrying out research. Kerlinger (1978) defined “Research design is the plan, structure and strategy of

investigation so as to obtain answer to research questions and to control variance". Research designs are developed to enable the researcher to answer research questions with validity, objectivity and accuracy.

In the present study, "*Ex post-facto research design"* was employed to identify the organic farming practices for the study. In this study the investigator draws inference regarding the relationship between variables on the basis of independent variables whose reflection has already occurred. Based on these reflections inferences on the relationships between independent and dependent variables are drawn.

3.2. Information Need Analysis and Inventorization of Information on Organic Vegetable Farming

The study was taken up in order to develop a methodology for developing the content for an expert system. For this purpose, an extensive study on the previously available data on organic farming practices in vegetable cultivation was done.

An extensive review of activities indicated that 65 distinct organic farming practices on vegetable cultivation are relevant (Appendix. I). These practices were given to scientists and extension personnel for judging the relevancy of the practices, as well as to classify those practices into three categories *viz*., organic crop production practices, organic crop protection practices and organic certification and marketing practices.

Organic crop production practices are those agronomic practices/activities that are undertaken in the farm to bring maximum yield/returns for the farmer in an eco-friendly and environmentally safe way. Organic crop protection practices are those bio- protection practices/activities undertaken by the farmer in the farm to protect the plants from pest and disease incidences in an eco-friendly and environmentally safe way. Organic certification and marketing practices are those information or farm management procedures/practices followed by the farmer to

maintain his or her field as an organic farm, required for obtaining an organic certification and aspects he or she have to take care of while marketing.

The practices were then sorted out to 45 practices according to the rank obtained (Appendix II and Appendix III). The practices that were sorted out was given to farmers for its classification as organic crop production practices, organic crop protection practices and organic certification and marketing practices. Among the 45 practices, 36 statements (Appendix IV) were formulated and a pilot study was done in the non-sampling area. Hence, 21 statements were found to be relevant and was given to the respondents to test their extent of knowledge on organic farming practices in vegetable cultivation. (Appendix V)

3.3. Locale of the Study

In Kerala, at least 40 % of the farming is organic and the state is set to become the second fully organic state after Sikkim in 2016. From 7,000 ha in 2007, the state has spread organic cultivation to 16,000 ha. More than grains and pulses, in Kerala organic farming is prevalent in cash crops, rice and vegetables (Siddiqui, 2013).

The study was conducted in Kannur and Wayanad districts of Kerala. These districts were selected as the study requires respondents having organic certification.

Description about the Study Areas

Kannur

Kannur district lies between latitudes 11° 40' to 12° 48' North and longitudes 74° 52' to 76° 07' East. The district is bound by the Western Ghats in the East (Coorg district of Karnataka State), Kozhikode and Wayanad districts, in the South, Lakshadweep Sea in the West and Kasaragod, the northern most district of Kerala, in the North.

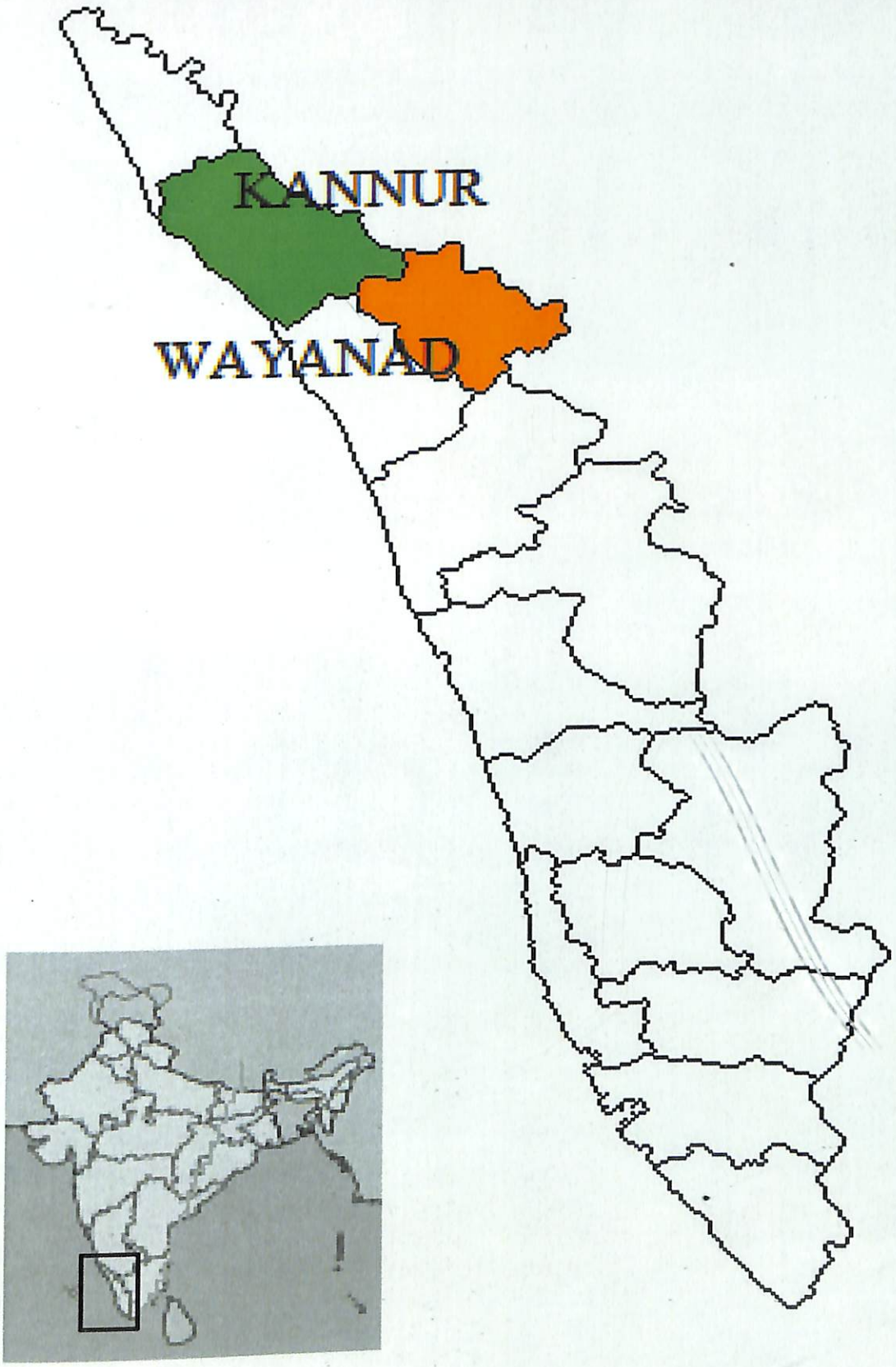

Figure 6. Location of the study areas

Figure 7. Map of Kannur district

The district can be divided into three geographical regions - highlands, midlands and lowlands. The highland region comprises mainly of mountains. This is the area of major plantations like coffee, rubber, tea, cardamom and other spices. Timber trees like teak, veetty, etc., are grown in plenty in this region. The midland region, lying between the mountains and the low lands, is made up of undulating hills and valleys. This is an area of intense agricultural activity. The lowland is comparatively narrow and comprises of rivers, deltas and seashore. This is a region of coconut and paddy cultivation.

Wayanad

Wayanad has a salubrious climate. The average rain fall in Wayanad is 300mm per year. In Wayanad the mean maximum and minimum temperature for the last five years were 29^{o}C and 18^{o}C respectively. This place experiences a high relative humidity which goes even up to 95 per cent during the south west monsoon period. This high altitude district is characterised by the cultivation of perennial plantation crops and spices.

The major plantation crops include coffee, tea, pepper, rubber, coconut, cardamom, tea, paddy, cassava and ginger. The average size of holdings is 0.68 ha. A variety of crops including annuals and perennials are grown in these small holdings. The crops include coconut, arecanut, pepper, vegetables, tuber crops, drumstick, papaya, etc. and fruit trees like mango and jack.

In both districts, the organic certification was done under group certification. The farmers were practicing farming without the use of chemicals, from the time of their forefathers. The respondents were having certification since 1998, certified by an agency named SGS certification agency and since 2000, the group is certified by INDOCERT. The majority of the farmers are practicing vegetable cultivation in their homesteads. They were able to market the produce as well. But unavailability of continuous supply of the produce was a major problem on marketing the produce.

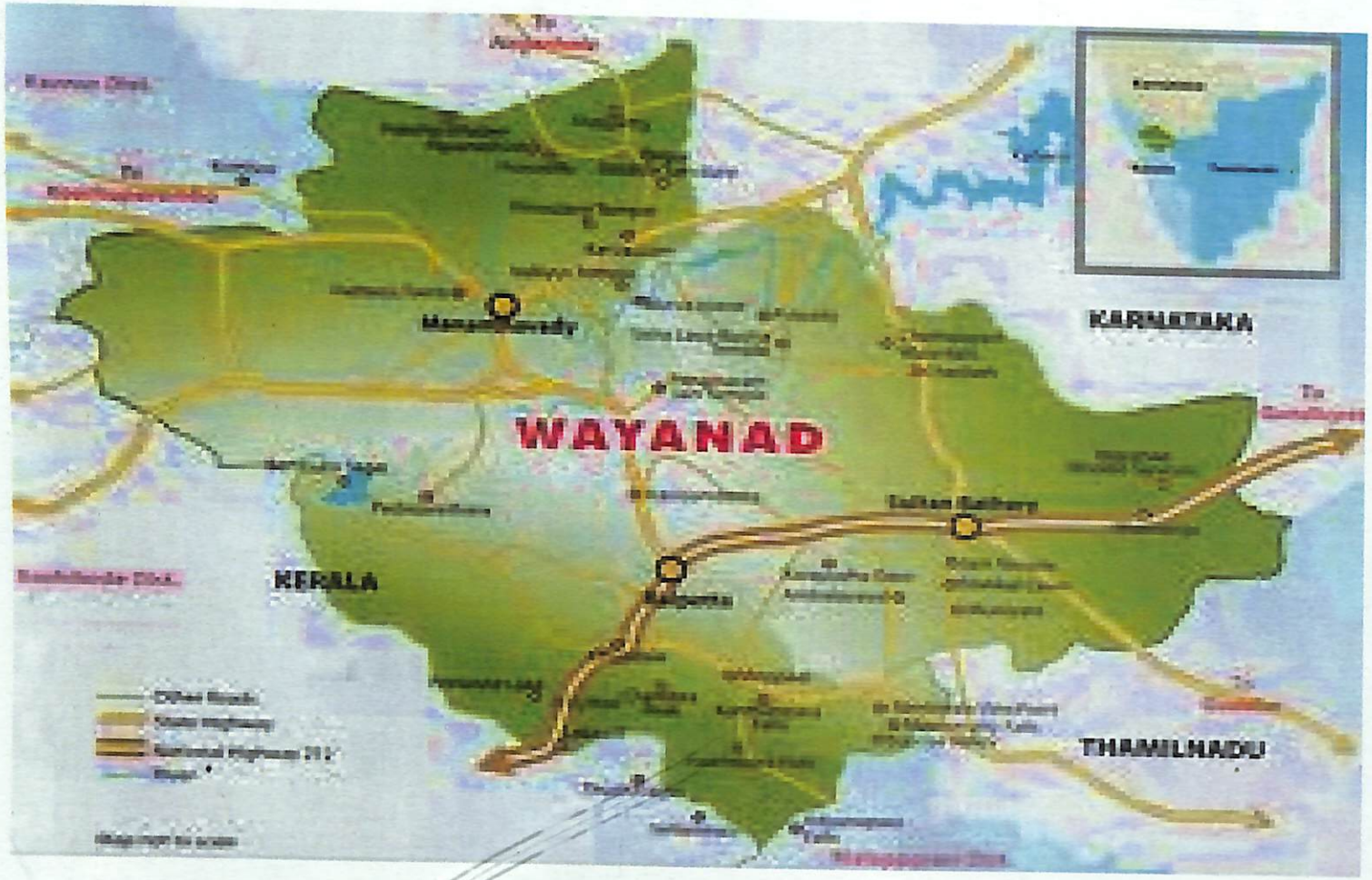

Figure 8. Map of Wayanad district

3.4. Selection of the Respondents

Simple random sampling procedure was administered to select 100 farmers who are having organic certification from the study areas *viz*., Iritty in Keezhur-Chavassery Panchayath, Kannur and Pulpally grama pancahyath in Wayanad districts.

3.5. Selection of Variables and their Measurements

After reviewing literature, a list of independent variables were selected (Appendix VIII) and after discussion with extension scientists and the advisory committee, ten of them were selected. (Appendix IX). Extent of knowledge among the organic farmers was taken as the dependent variable.

3.6. Operational Definition of the Variables

Table 1. List of variables and their measurements

Sl No:	Variables	Measurements adopted in the study
1	Age	Method followed by Hanjabam (2013)
2	Educational status	Modified by Mansingh (1993)
3	Farming experience	Technique followed by Chinchu (2011)
4	Innovativeness	Technique followed by Sreedaya (2000)
5	Information seeking behaviour	Method used by Hanjabam (2013)
6	Extension agency contact	Method used by Manoj (2000)
7	Livestock possession	Technique followed by Jayawardhana (2007)
8	Economic motivation	Scale developed by Supe (1969)
9	Scientific orientation	Scale developed by Supe (1969)
10	Market perception	Technique followed by Fayas (2003)
11	Extent of knowledge	Teacher made test used by Nachiappan and Srinivasamurthy (1976)

3.6.1. Selection of Dependent Variable and its Measurement

3.6.1.1. Extent of Knowledge

In the present study knowledge refers to the extent of information possessed by the respondents about organic farming practices in vegetable cultivation.

Nachiappan and Srinivasamurthy (1976) used the teacher made test to find out the knowledge levels of small farmers with respect to farm technology. They calculated the knowledge index by the following formula.

$$\text{Knowledge Index} = \frac{\text{Actual Score Obtained}}{\text{Maximum Possible Score}} \times 100$$

21 statements which were found to be relevant on information need analysis and inventorization of information on organic vegetable farming was given to the respondents to test their extent of knowledge level on organic farming practices in vegetable cultivation (Appendix V).

A score of "one" was assigned to the correct answer and a score of "zero" was assigned to each wrong answer. The sum of scores obtained for all items indicated the knowledge score of the respondent. Thus the maximum knowledge score that could be obtained by a respondent was 21 and the minimum zero.

3.6.2. Selection of Dependent Variables and Their Measurement

3.6.2.1. Age

Age was operationalized as number of calendar years completed by the respondent at the time of investigation. Classification of respondents followed by Hanjabam (2013)

Table 2. Classification of respondents based on age

Sl. No:	Category	Score
1	Young (≤ 35 years)	1
2	Middle aged (36-55)	2
3	Old (≥ 55 years)	3

3.6.2.2. Educationn

Education was operationalized as the level of literacy possessed by an individual respondent. Illiterate was an individual who did not know to read and write. Primary school education referred to the formal schooling up to fourth standard. High school education referred to the education from sixth to tenth. Higher secondary school education meant the education from eleventh to plus two levels. Collage education referred to degree diploma after schooling. The scoring procedure modified by Mansingh (1993) was used.

Table 3. Classification of respondents based on education

Sl. No:	Category	Score
1	Illiterate	1
2	Primary school	2
3	High school	3
4	Higher secondary school	4
5	College education	5

3.6.2.3. Farming Experience

Farming experience refers to the number of completed years of experience of the respondents in farming. The actual number of years of experience was considered as the score. The respondents were categorized into four categories

based on the years of experience in farming. The scoring procedure followed by Chinchu (2011) was used in this study.

Table 4. Classification of respondents based on farming experience

Sl. No:	Experience in years	Score
1	Up to 5	1
2	6-10	2
3	11-25	3
4	More than 25	4

3.6.2.4. Innovativeness

Innovativeness was defined as the degree to which the respondent was relatively earlier in adopting new ideas. The procedure followed by Sreedaya (2000) was adopted for measuring innovativeness as follows,

Table 5. Classification of respondents based on innovativeness

Sl.No:	Response	Scores
1	As soon as it is brought to my knowledge	4
2	After I have seen other farmers try it successfully in their farms	3
3	I prefer to wait and take my own time	2
4	I am not interested in adopting	1

The score range obtained will be 1-4. Based on this, the respondents were classified into high, medium and low categories.

3.6.2.5. Information Seeking Behaviour

Information seeking behaviour was operationalized as the sources from which organic farmers get technological information regarding the organic vegetable cultivation. The scoring procedure followed by Hanjabam (2013) was used with modification for the study. The scores for frequency of use of the sources for seeking information were ranging from 5 to 1 for rarely, frequently, less frequently, occasionally and rarely in the order of sequence. Based on the score obtained from the organic farmers, they were classified into high, medium and low by using cumulative frequency method. The range of measuring the information seeking behaviour is 10-50.

Table 6. Classification of respondents based on information seeking behaviour

Sl. No:	**Sources**	**Most frequently (5)**	**Frequently (4)**	**Less frequently (3)**	**Occasionally (2)**	**Rarely (1)**
1	Radio					
2	Television					
3	Newspaper					
4	Magazines					
5	Agrl. literatures					
6	KIOSKs					
7	Mobile Phone					

Table 6. Classification of respondents based on information seeking behaviour (contd.)

8	Relatives/ Friends					
9	Fellow growers					
10	Any other					

3.6.2.6. Extension Agency Contact

The degree to which an individual have contact with research and extension agency for the purpose of obtaining information and advices of organic vegetable cultivation technologies is referred to as research and extension agency contact. The scoring procedure used by Manoj (2000) was followed in the study. The organic farmers were classified into high, medium and low categories by cumulative frequency of the scores obtained as indicated below. The range of measuring the information seeking behaviour is 9-27.

Table 7. Classification of respondents based on extension agency contact

Sl. No:	Category	Regularly (3)	Occasionally (2)	Rarely (1)
1	Agricultural scientist			
2	Agricultural officer			
3	Agriculture assistant			
4	Grama sevaks			
5	Seminars			
6	Exhibition			

Table 7. Classification of respondents based on extension agency contact (contd.)

7	Study tours			
8	Demonstrations			
9	Any others			

3.6.2.7. Livestock Possession

Livestock possession referred to the number of animals by an individual. The present value of each livestock was calculated and added to get the total value and was categorized into following intervals as given by Jayawardhana (2007). The organic farmers were classified into high, medium and low categories based on the cumulative frequency of the scores obtained.

Table 8. Classification of respondents based on livestock possession

Value (Rs)	Score
≤ 5000	1
5001-10,000	2
10,001 – 15,000	3
15,001- 20,000	4
≥ 20,000	5

Table 9. Livestock possession of the respondents

Category	**No:**	**Value (Rs)**
Buffalo		
Bullock		
Cow/Calf		
Goat		
Poultry		
Others please specify		

3.6.2.8. Scientific Orientation

Scientific orientation is the orientation of the farmer towards the scientific methods of farming. Scientific orientation was measured with the help of a scale developed by Supe (1969). The sixth statement was a negative one of the statements.

Table 10. Scoring procedure of scientific orientation

Nature of statement	**SA**	**A**	**UD**	**DA**	**SDA**
Positive statement	5	4	3	2	1
Negative statement	1	2	3	4	5

Table 11. Scale for measuring scientific orientation of the respondents

Sl. No:	**Statements**	**SA**	**A**	**UD**	**DA**	**SDA**
1	New methods of farming give better results to a farmer than the old methods					
2	The way of farming by our forefathers is still the best way to farm					
3	Even a farmer with a lot of experience should use new methods of farming					
4	A good farmer experiments with new ideas of farming					
5	Though it takes for a farmer to learn new methods of farming it is worth the effort					
6	Traditional methods of farming have to be changed in order to raise the standard of living of the farmer					

SA- Strongly Agree **A-** Agree **UD**- Un-Decided

DA- Disagree **SDA-** Strongly Disagree

The range of score was 6-30. Based on the cumulative frequency of the scores the farmers were classified as high, medium and low levels of scientific orientation.

3.6.2.9. Economic Motivation

Economic motivation has been operationalized in terms of profit maximization and the relative value placed by a farmer on economic ends. It was measured with the help of the scale developed by Supe (1969). The scale consisted of five statements with five were positive and one was negative. These items were rated over a five point continuum which ranged from strongly agree to strongly disagree. The scoring procedure used was as follows.

Table 12. Scoring procedure of economic motivation

Nature of statement	SA	A	UD	DA	SDA
Positive statement	5	4	3	2	1
Negative statement	1	2	3	4	5

Table 13. Scale for measuring economic motivation of respondents

Sl. No:	Statements	SA	A	UD	DA	SDA
1	A farmer should work towards larger yields and economic returns					
2	The most successful farmer is the one who makes the most profit					

Table 13.Statements for measuring economic motivation of respondents (cond.)

3	A farmer should try any new farming idea which may earn him more income					
4	A farmer should grow cash crops to increased monetary profit in comparison to growing of food crops for home consumption					
5	It is difficult for the farmers children to make a good start unless he provides them with economic assistance					
6	A farmer must earn his living, but the most important thing in life cannot be defined in economic terms					

SA- Strongly Agree **A-** Agree **UD**- Un-Decided

DA- Disagree **SDA-** Strongly Disagree

The range of score is 6-30. Based on the cumulative frequency of the scores the farmers were classified as high, medium and low levels of scientific orientation.

3.6.2.10. Market Perception

Market perception is defined as the capacity of the respondents to foresee the market trend to sell the produce for greater returns. The scale followed by Hanjabam (2013) was used with slight modification. The method consisted of scoring the responses obtained to selective questions presented to the respondents

to elicit their perception of the market of the produce. The questions and the scoring procedure were as follows,

1. Do you think the farmer will be able to sell vegetables at higher price/demand if he adopts organic farming practices?
    a. Yes (1)
    b. No (0)
2. Do you find it difficult to sell the produce in the local market?
    a. Very difficult (0)
    b. Difficult (1)
    c. Easy (2)
    d. Very easy (3)
3. How much price the organic produce will fetch compared to those produced under conventional methods?
    a. Low (0)
    b. Same (1)
    c. High (2)

Based on the cumulative frequency of the scores, the farmers were classified as high, medium and low levels of scientific orientation

3.7. Methods and Tools Used for Data Collection

Considering the scope and objectives of the study, an interview schedule was prepared after perusal of available literature, through consultation with experts in the field of extension education and other related fields. After incorporating their suggestions, a well-structured interview schedule was finalized in English.

To check with the relevancy of the schedule, a pre- testing was done in the non – sampling area. Based on the results of pre-testing, suitable modifications were made and a final interview schedule was prepared (Appendix VI). The respondents were personally contacted for collection of data. The data so collected were subjected to statistical analysis and interpretation was made for drawing meaningful conclusions**.**

3.8. Tools for Statistical Analysis

The data collected from the respondents were scored, tabulated and analyzed using suitable statistical methods.

Keeping in view the objectives of the study and amenability, the data were subjected to different statistical tools. These tests included mean, standard deviation, percentage analysis and cumulative frequencies were for classification of respondents and comparison. Correlation coefficient was also used in analyzing the data. A brief description of the tools used is given below.

Mean

The arithmetic mean scores for all the variables were worked out to make suitable comparisons wherever necessary.

Percentage Analysis

Percentage analysis was done to make classification of the respondents wherever necessary.

Cumulative Frequency

Cumulative frequency is used to determine the number of observations that lie above (or below) a particular value in a data set. The classification is done as

the value less than mean minus standard deviation gives the low category and the value more than the sum of mean and standard deviation gives the high category. The values that ranging in between will fall under the medium category.

Correlation Analysis

Correlation coefficient is a measure of the relationship between two variables. The correlation coefficient was worked out to measure the relationship between the dependent variable and the independent variables.

RESULTS AND DISCUSSIONS

4. RESULTS AND DISCUSSIONS

The findings of the present study have been highlighted in tune with the objectives. They are described under the following heads.

4.1 Information need analysis and inventorization of information on organic vegetable cultivation

4.2 Extent of Knowledge on organic vegetable farming of the respondents

4.3 Profile characteristics of the respondents

4.4 Relationship between the characteristics of the organic farmers with the extent of knowledge

4.5 Content development

4.1. INFORMATION NEED ANALYSIS AND INVENTORIZATION OF INFORMATION ON ORGANIC VEGETABLE CULTIVATION

4.1.1. Information Need Analysis on Organic Vegetable Cultivation

Information on organic farming practices were collected from different sources. 65 such practices were identified and it was then given to 25 farmers and 25 agriculture officers to rate its relevancy. This was given to 25 agricultural scientists for classifying these practices into three different categories as organic crop production practices, organic crop protection practices and organic certification and marketing practices.

After the classification into organic crop production practices, organic crop protection practices and organic certification and marketing practices, these were again given for judges' rating to agricultural scientists for its scientific validity

and practical applicability. Ranks were given to the 65 practices primarily identified. (Appendix II)

From that, 45 practices were again sorted out based on their important (Appendix III). These practices were given to 25 farmers in order to ascertain the practices in which farmers need more information. The 45 practices thus obtained were subjected to a pilot study among 25 farmers in the non-sampling area. Thirty six statements were formulated from those practices which were having high scoring in the rating.

After the pilot study among respondents from the non- sampling area, from the 36 statements which were found to be relevant, 15 statements were excluded as many of them were aware about the practices on which those were based on. Thus the remaining 21 statements (Appendix V) were finally selected for conducting the knowledge test among farmers in the sampling area.

4.1.2. Inventorization of Information for the Different Systems

From the 45 practices, those having high scores were used for formulating questions for measuring the knowledge of the certified organic farmers who were practicing vegetable farming. Knowledge list consisted of 21 questions (Appendix V) with 7 questions under each category.

On analysing three categories, 89% of the organic farmers were in need of information on organic production practices, 82% were in requirement of information regarding crop protection practices and 93% of the organic farmers were seeking information on organic certification and marketing practices (Figure 9). Gaps in knowledge level was taken up a measure for information need. The low and medium categories obtained after knowledge test was considered as the high information need. Thus, 7 distinct practices were inventorized under each category. (Appendix VI).

Table 14. Distribution of respondents according to their information need on organic vegetable farming practices.

(n=100)

Category	Production		Protection		Management	
	Score Range	Percentage	Score Range	Percentage	Score Range	Percentage
Low	< 3.65	14	< 1.87	11	< 4.43	16
Medium	3.65-6.20	75	1.87-4.76	71	4.43-6.24	77
High	> 6.20	11	> 4.76	18	> 6.24	7
Mean	4.93		3.32		5.34	
SD	1.27		1.44		0.90	

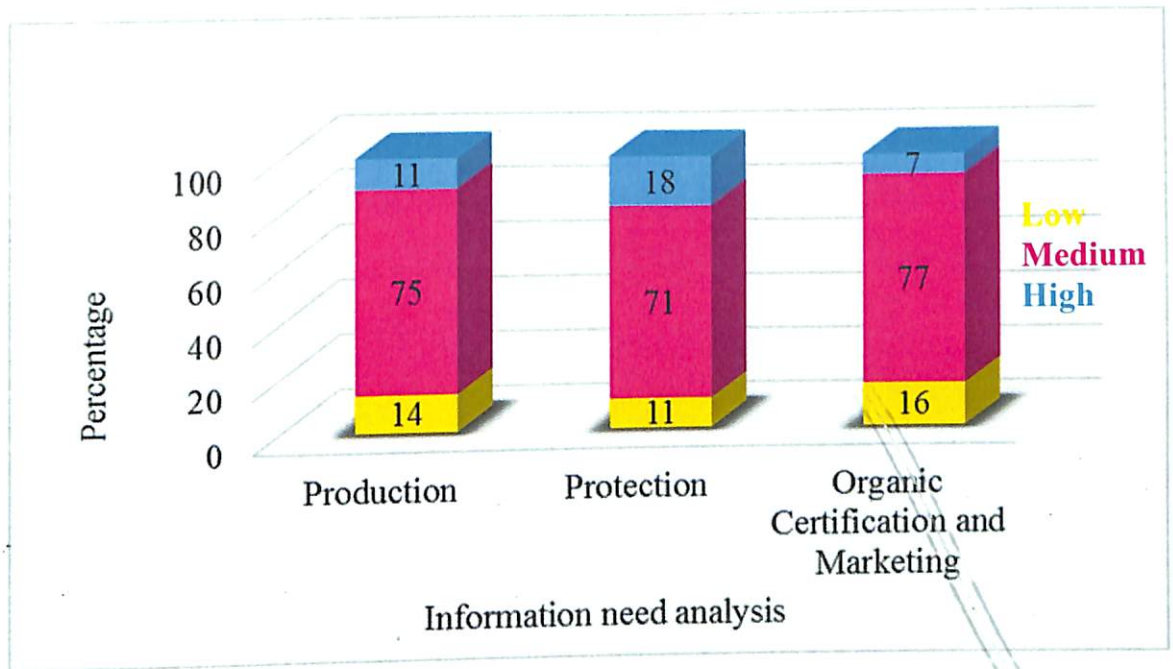

Figure 9. Distribution of farmers according to information need on organic farming

Table 14 shows that the information need of the famers are less regarding organic production practices as well as organic protection practices. As for the organic crop protection practices, many of the farmers are unaware of the usage of different kinds of traps as well as neem based crop protection practices. The table shows that the extent of knowledge of farmers lies in slight variation from the normal distribution.

4.2. EXTENT OF KNOWLEDGE ON ORGANIC VEGETABLE FARMING OF THE RESPONDENTS.

The mean value of the scores obtained for the extent of knowledge variable was 58.83 and the standard deviation was 13.90. The organic farmers were classified according to cumulative frequency as low with a score range less than 44.92, medium with a score range of 44.92-72.73 and high with score range of more than 72.73 respectively.

Table 15. Distribution of organic farmers according to their extent of knowledge

(n= 100)

Category	Score range	Frequency	Percentage
Low	<44.92	20	20
Medium	44.92-72.73	67	67
High	>72.73	13	13
Mean = 58.83		SD = 13.90	

From the perusal of the table, it is clear that majority (67%) of the farmers had medium level of knowledge followed by low (20%) and high (13%) levels of knowledge about organic farming practices in vegetable cultivation. That is 87 % of the respondents were lacking proper knowledge on organic vegetable farming practices (Figure 10). From the test, it is clear that the respondents are lacking proper scientific knowledge on organic farming.

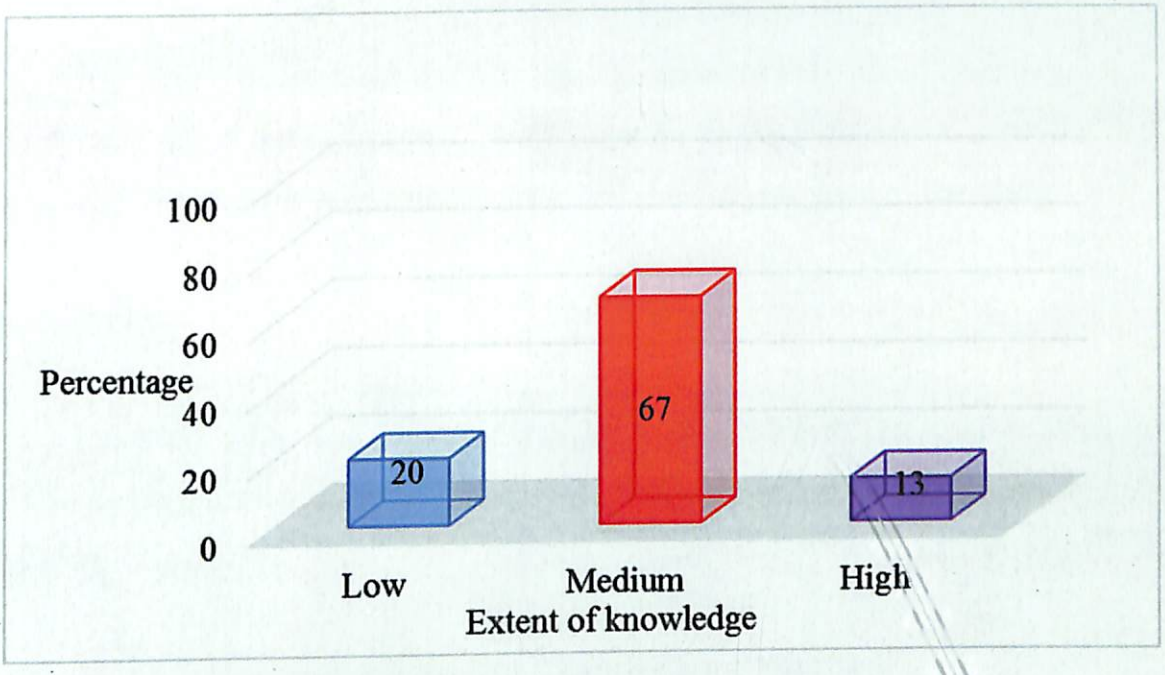

Figure 10. Distribution of farmers according to their extent of knowledge in organic farming

The modern communication technologies available, the information on organic farming disseminated was low. The recent positive support given in this field by the government and its agencies were not reaching up to the farmers efficiently. This finding is in opposition with the earlier studies of Jaganathan (2004) and Jayawardhana (2007).

4.3. PROFILE CHARACTERISTICS OF ORGANIC VEGETABLE FARMERS

A clear understanding of the socio-economic and psychological characteristics of the respondents would enable the investigator to interpret the data. For this purpose ten variables were selected and included in the study.

4.3.1. Age

From the table it is observed that more than 50% of the organic farmers (58%) belonged to old age category and 42% percent belonged to middle age category (Figure 11).

Table 16. Distribution of organic farmers according to their age

(n=100)

Sl No:	Category	Frequency	Percentage
1	Young Age(≤ 35 yrs)	0	0
2	Middle Age (36-55 yrs)	42	42
3	Old Age (≥ 55 yrs)	58	58

The distribution of the farmers were not in normal distribution, where great variation was observed from normal distribution because there were no farmers under the young age group.

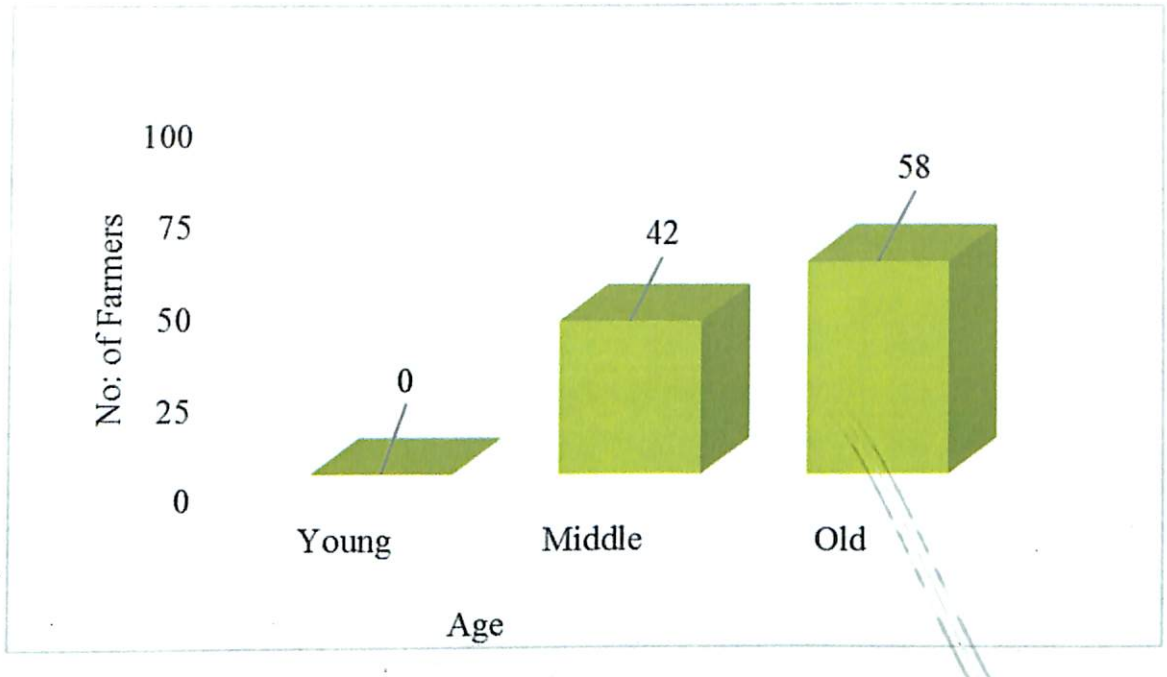

Figure 11. Distribution of farmers according to their age

It is clear that the farmers were all belonged to old age and middle aged category and implicated that the participation of young people in farming is quite low. The older farmers were more acquainted with organic cultivation practices than the middle aged farmers. They were having more indigenous knowledge on production practices as well as protection practices. It also reflects the situation in which younger generation is drifting away from farming. Measures should be taken by the government to encourage more young farmers to do organic farming.

A similar result was reported by Jaganathan (2004), Thamban *et al.* (2006), Jayawardhana (2007) and Hanjabam (2013).

4.3.2. Educational Status

The results of the study shows that 100% of the organic farmers were literate. Forty nine per cent of the farmers have attended high school and 25% of them had collegiate education (Figure 12).

Table 17. Distribution of organic farmers according to their educational status

(n = 100)

Sl No:	Category	Frequency	Percentage
1	Illiterate	0	0
2	Primary school	7	7
3	High school	49	49
4	Higher secondary school	19	19
5	College	25	25

This result reflects the higher literacy rate of the state and also implies that today's farmers are educationally forward. Similar results have been obtained by several researchers *viz.,* Jaganathan (2004), Jayawardhana (2007) and Hanjabam (2013).

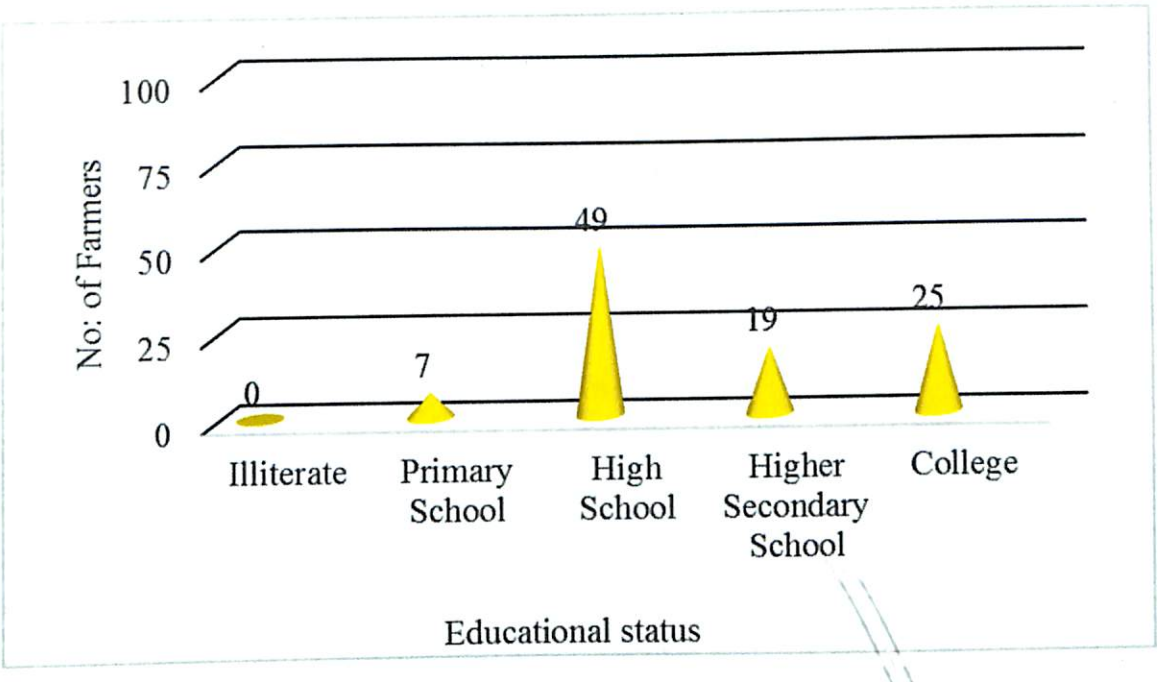

Figure 12. Distribution of farmers based on educational status

4.3.3. Farming Experience

From the table it was observed that the majority if the farmers (54%) were having high level of farming experience, i.e., more than 25 years, while 39 per cent of the respondents had experience between 11-25 years, 5 per cent had experience between 6-10 years and only 2 per cent had farming experience of less than 5 years, (Figure 13).

Table 18. Distribution of organic farmers according to their farming experience

(n= 100)

Sl. No:	Experience in years	Frequency	Percentage
1	Up to 5 years	2	2
2	6-10 years	5	5
3	11-25 years	39	39
4	More than 25	54	54

There were no young farmers among the respondents. Hence farmers having farming experience up to 10 years is few in number. Majority of the farmers have started following organic farming for more than 10 years. This result is line with the findings of Fayas (2003), Sasankan (2004) and Jayawardhana (2007).

4.3.4. Innovativeness

The score range for innovativeness was 1 – 4. The mean value of the scores obtained for the innovativeness was 2.81 and the standard deviation was 0.91. The organic farmers were classified according to cumulative frequency as low with a score range less than 1.89, medium with a score range of 1.89 – 3.72 and high with score range of more than 3.72 respectively.

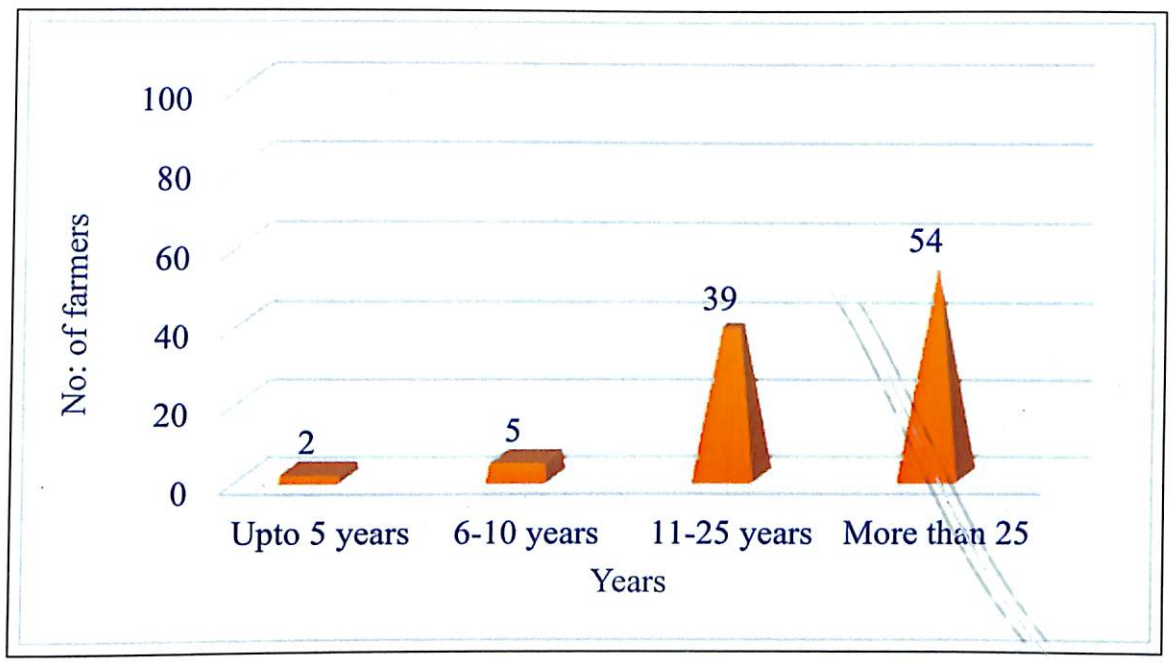

Figure 13. Distribution of farmers based on farming experience

Table 19. Distribution of organic farmers according to their innovativeness

(n= 100)

Category	Score range	Frequency	Percentage
Low	<1.89	12	12
Medium	1.89-3.72	66	66
High	>3.72	22	22
Mean = 2.81		SD = 0.91	

From the table it is clear that 66 per cent of the respondents were having medium, 22 % high and 12 % low levels of innovativeness in organic farming practices (Figure 14).

Government of India has launched several organic farming programmes to promote the export of organic products from India. Also, Government of Kerala is undertaking several schemes in organic farming. The innovative spirit of the farmers also increased due to their motivation for more information and extension agency contact. Organic farming is taken up by majority of the farmers due to the increasing awareness among the consumers on the deleterious effects of pesticides and hence, there has been a high demand for organically cultivated food produces.

Jaganathan (2004) and Jayawardhana (2007) also reported similar studies in their studies.

4.3.5. Information Seeking Behaviour

The score range for innovativeness was 10 – 50. The mean value of the scores obtained for the information seeking behaviour was 27.51 and the standard deviation was 3.83. The organic farmers were classified according to the cumulative frequency as low with a score range less than 23.67, medium with a score range of 23.67-31.35 and high with score range of more than 31.35 respectively.

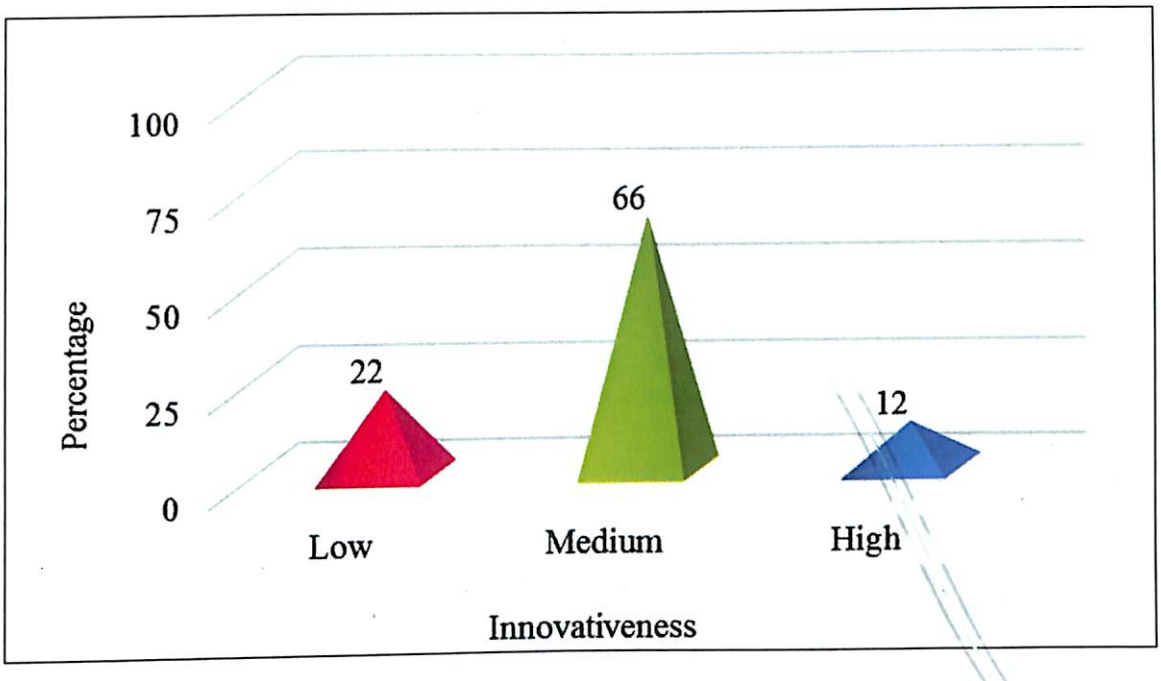

Figure 14. Distribution of farmers based on innovativeness

Table 20. Distribution of organic farmers according to their information seeking behaviour

(n= 100)

Category	Score range	Frequency	Percentage
Low	<23.67	11	11
Medium	23.67-31.35	72	72
High	>31.35	17	17
Mean = 27.51		SD = 3.83	

From the table 20 it is discerned that majority (72%) of the respondents belonged to medium category followed by high (17%) and low (11%) with respect to information seeking behaviour (Figure 15). This is because the farmers are having regular access to journals, television and contacts with fellow farmers. Similar results have been obtained by Beena (2002), Jayawardhana (2007) and Hanjabam (2013).

4.3.6. Extension Agency Contact

The score range for innovativeness was 9 – 27. The mean value of the scores obtained for the extension agency contact was 15.96 and the standard deviation was 3.26. The organic farmers were classified according to cumulative frequency as low with a score range less than 12.69, medium with a score range of 12.69-19.2 and high with score range of more than 19.2 respectively.

Table 21. Distribution of organic farmers according to their extension agency contact

(n=100)

Category	Score range	Frequency	Percentage
Low	<12.69	19	19
Medium	12.69-19.2	67	67
High	>19.2	14	14
Mean = 15.96		SD = 3.26	

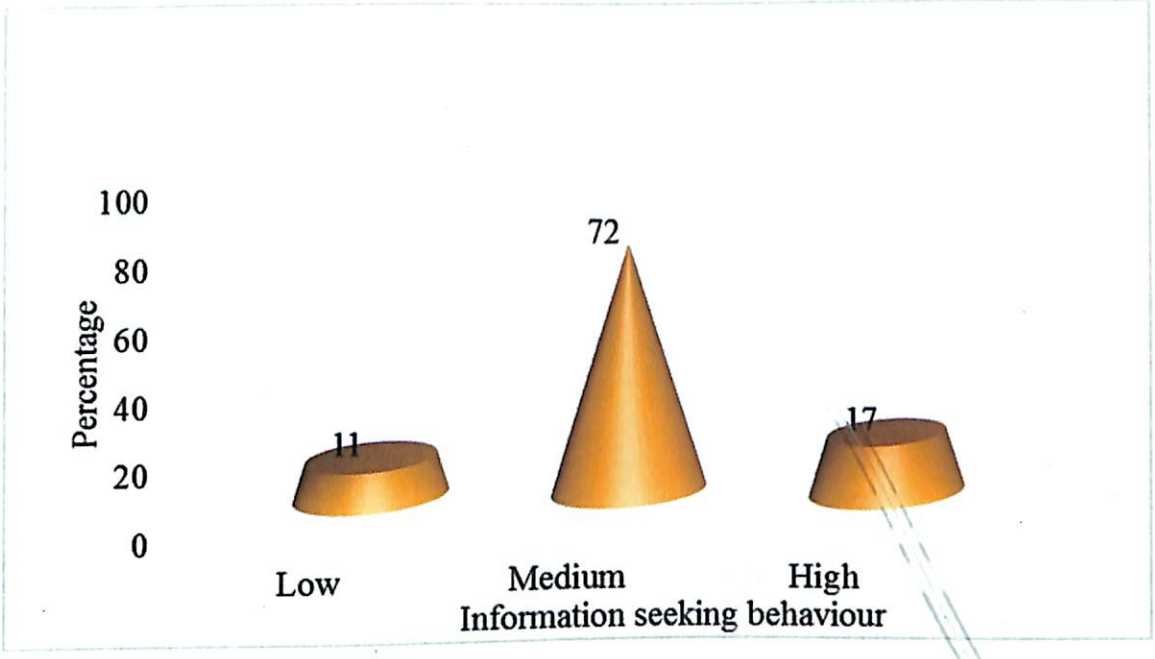

Figure 15. Distribution of farmers based on information seeking behaviour

The perusal of the table shows that majority (67%) of respondents had medium extension orientation, followed by low (19%) and high (11%) levels of extension orientation. (Figure 16)

It was because of the fact that the organic farmers had more contacts with the agricultural officers, and regular readers of different agricultural magazines. They used to attend regular training classes, demonstrations, farm visits, etc. This finding was in line with Sobha (2013).

4.3.7. Livestock Possession

The mean value of the scores obtained for the livestock possession was 3.26 and the standard deviation was 2.11. The organic farmers were classified according to cumulative frequency as low with a score range less than 1.15 medium with a score range of 1.15-5.37 and high with score range of more than 5.37 respectively.

Table 22. Distribution of organic farmers according to their livestock possession

(n= 100)

Category	Score range	Frequency	Percentage
Low	<1.15	30	30
Medium	1.15-5.37	70	70
High	>5.37	0	0
Mean = 3.26		SD = 2.11	

From the above table it can be observed that the majority (70%) of the farmers are having medium level of livestock component along with agriculture and 30 per cent of the respondents belonged to low category (Figure 17).

Livestock is a major component in organic farming and is inseparable. All respondents' households were having at least one cattle or goat and poultry. The

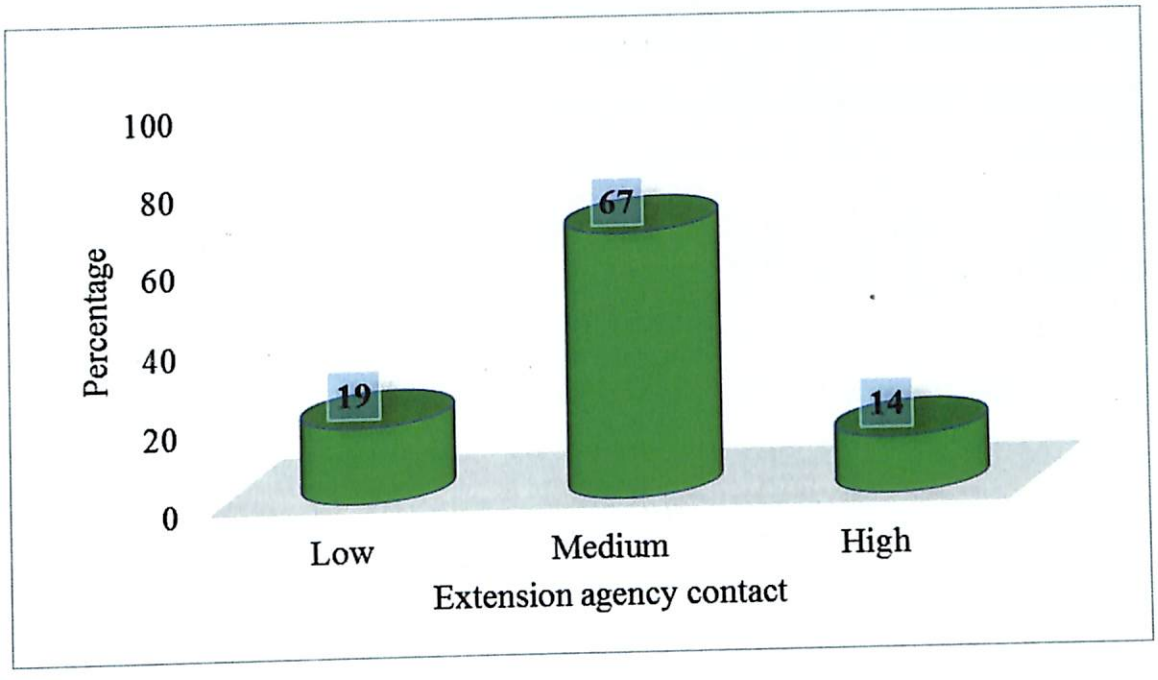

Figure 16. Distribution of farmers based on extension agency contact

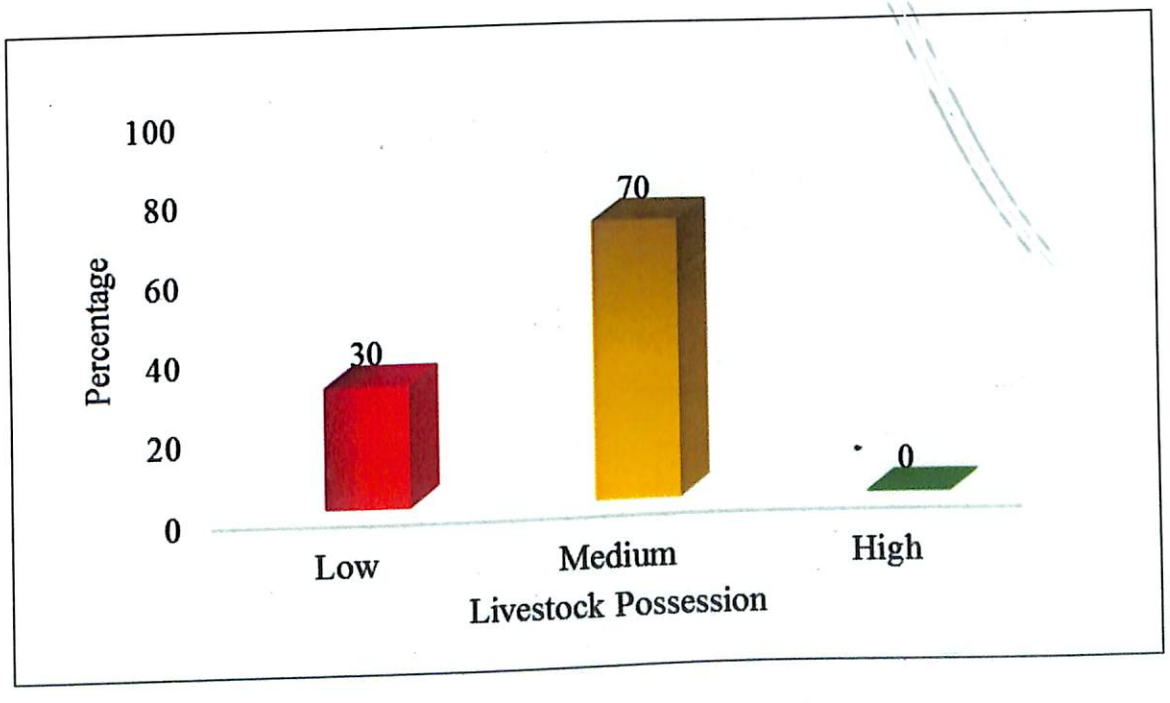

Figure 17. Distribution of farmers based on livestock possession

products were generally utilized for the domestic purposes. Also many of the respondents' households were having bio-gas tanks as well as compost pits in their premises. The result is in line with the finding of Jaganathan (2004) and Jayawardhana (2007).

4.3.8. Scientific Orientation

The score range for innovativeness was 6 – 30. The mean value of the scores obtained for the scientific orientation was 25.62 and the standard deviation was 1.99. The organic farmers were classified according to cumulative frequency as low with a score range less than 23.62 medium with a score range of 23.62-27.61 and high with score range of more than 27.61 respectively.

Table 23. Distribution of organic farmers according to their scientific orientation

(n= 100)

Category	Score range	Frequency	Percentage
Low	<23.62	11	11
Medium	23.62-27.61	73	73
High	>27.61	16	16
Mean = 25.62		SD = 1.99	

The table given below clearly shows that 73% organic farmers had medium level of scientific orientation followed by high (16%) and low (11%) level, (Figure 18).

It may be concluded that the respondents were moderately to highly scientific in their approach to take up organic farming practices. The reason for high to medium level of scientific orientation might be due to their increased research agency contact. This helped the respondents to gain adequate knowledge

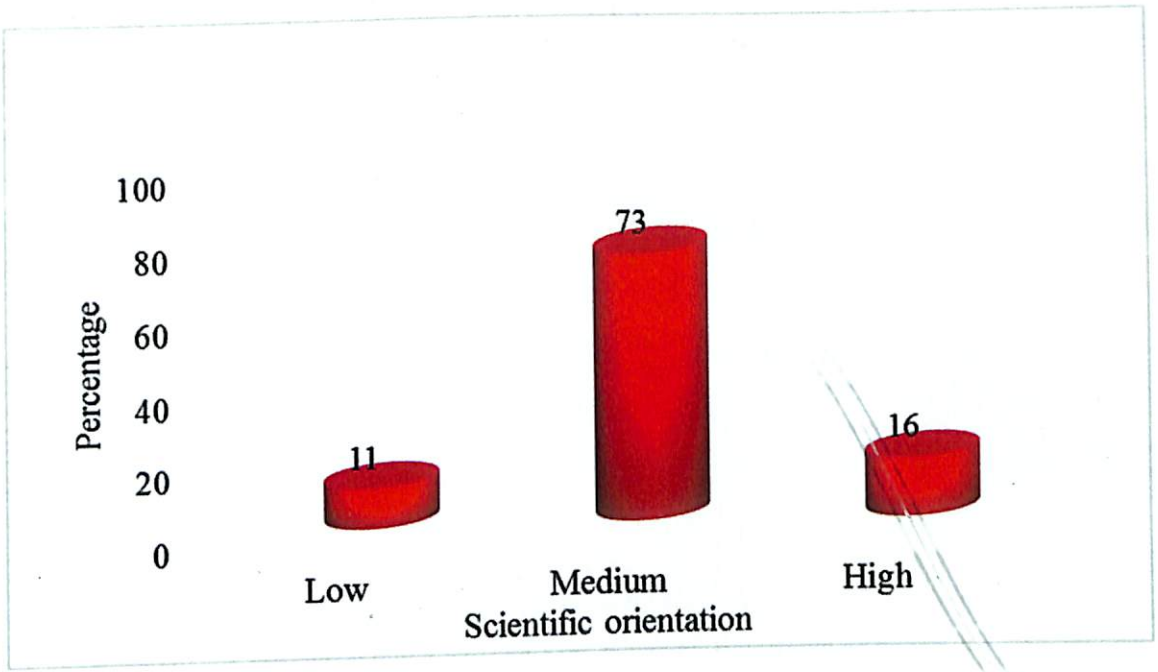

Figure 18. Distribution of farmers based on scientific orientation

on organic farming practices. This finding is in line with the findings of Oommen (2007), Shobha (2013) and Hanjabam (2013).

4.3.9. Economic Motivation

The score range for innovativeness was 6 – 30. The mean value of the scores obtained for the economic motivation was 18.75 and the standard deviation was 1.99. The organic farmers were classified according to cumulative frequency as low with a score range less than 23.62 medium with a score range of 18.75-23.15 and high with score range of more than 23.15 respectively

From table 24, it was inferred that a higher percentage of the respondents had high level of economic motivation. This was due to the fact that the cost of production of organic cultivation is much lesser compared to the conventional farming since the inputs for organic cultivation can be generated from the available farm resources.

Table 24. Distribution of organic farmers according to their economic motivation

(n= 100)

Category	Score range	Frequency	Percentage
Low	<18.75	10	10
Medium	18.75-23.15	12	12
High	>23.15	78	78
Mean = 20.95		SD = 2.199	

78 % of the organic farmers were highly economically motivated (Figure 19). So their main motive was to harvest good quality produce from their available land utilizing organic farming practices. A similar trend was also emphasized by Fayas (2003).

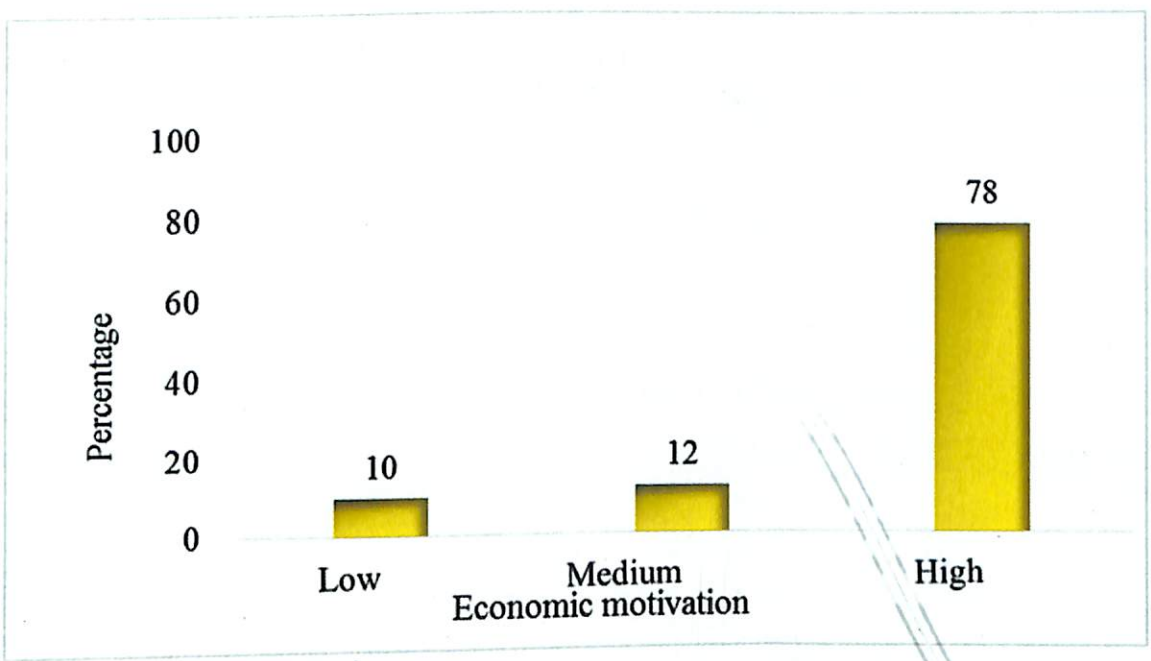

Figure 19. Distribution of farmers based on economic motivation

4.3.10. Market Perception

The mean value of the scores obtained for the extent of knowledge variable was 4.52 and the standard deviation was 1.07. The organic farmers were classified according to cumulative frequency as low with a score range less than 3.44 medium with a score range of 3.44-5.59 and high with score range of more than 5.59 respectively

Table 25. Distribution of organic farmers according to their market perception

(n=100)

Category	Score range	Frequency	Percentage
Low	<3.44	16	16
Medium	3.44-5.59	73	73
High	>5.59	11	11
Mean = 4.52		SD = 1.07	

Table 25 clearly indicates that 73 per cent of the respondents had medium level of market perception followed by low (16%) and high (11%) levels of market perception (Figure 20).

Only a limited number of farmers are aware of the markets where the organic produce can fetch high price than the conventionally produced vegetables. A medium percentage of the farmers were aware that there are such markets where the organic produce could get maximum price, but they were not having access to such kind of markets. Also a limited number of farmers are unaware of the availability of such markets where their produce could fetch higher price than the conventionally grown organic produce.

Due to the increase of food related health issues, people are willing to pay more for agricultural produce that are devoid of harmful chemical substances. Hence organic farmers can perceive that their produce will fetch more price in the market with an increasing demand for it. The major problem while marketing the

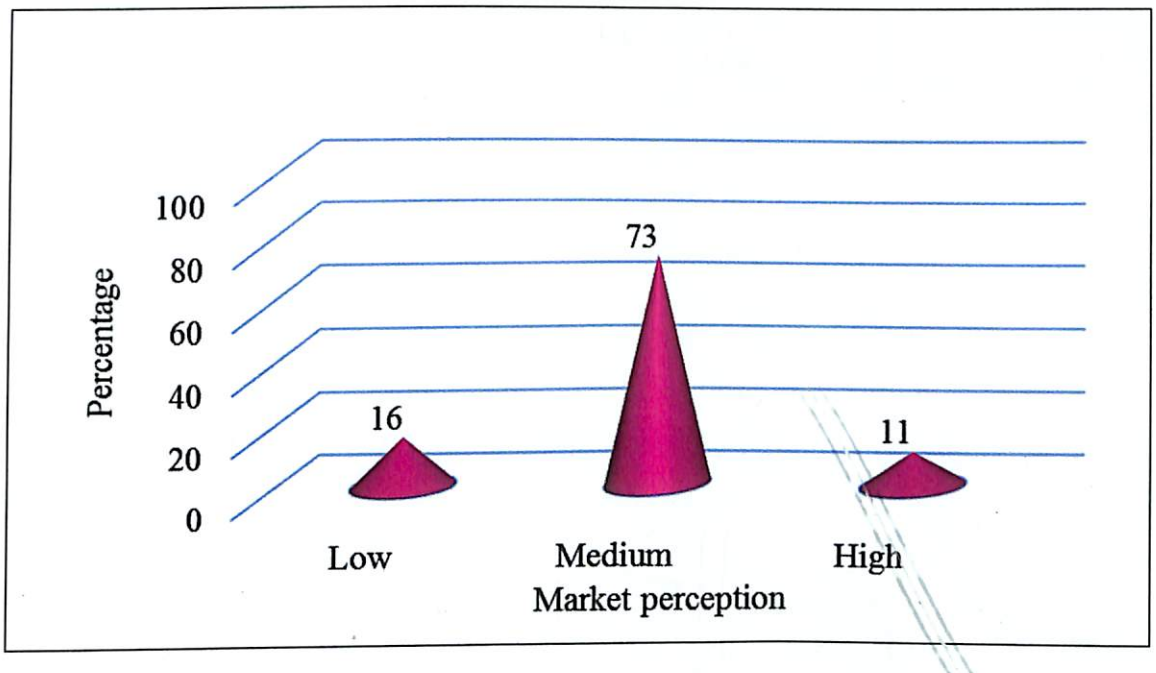

Figure 20. Distribution of farmers based on market perception

organic vegetables are that the supply of the produce can never meet with the demand for it. This finding is in accordance with the results of Suthan (2003), Jaganathan (2004), Jayawardhana (2007) and Hanjabam (2013).

4.4. RELATIONSHIP BETWEEN THE CHARACTERISTICS OF THE ORGANIC FARMERS WITH THE EXTENT OF KNOWLEDGE

Table 26. Relationship between the characteristics of organic vegetable cultivators and knowledge on organic farming practices

(n=100)

Sl. No:	Independent variables	Correlation coefficient (r)
1	Age	0.096
2	Educational Status	0.16
3	Farming Experience	-0.050
4	Livestock Possession	0.118
5	Innovativeness	-0.034
6	Extension Agency Contact	0.332**
7	Information Seeking Behaviour	0.027
8	Scientific Orientation	-0.056
9	Economic Motivation	-0.242*
10	Market Perception	-0.115

* Significant at 5 per cent level ** Significant at 1 per cent level

Knowledge about organic vegetable cultivation by the organic farmers had a positive and significant relationship with extension agency contact where as it showed a negative significance with the economic motivation level as presented in the Table 26.

Sixty seven percent of the respondents are having medium level of extension agency contact, implicating that the majority farmers are contacting extension agents on a regular basis which might have contributed in acquirement of knowledge related to organic farming.

The extent of knowledge about organic farming practices are having a positive and significant relationship with the extension agency contact, whereas, it is showing a negative correlation with economic motivation. Extension agency contact enables farmers to attend a number of training programmes conducted by a number of organizations and facilitates to have discussion with organic experts, who visit successful farmers' fields, conduct group discussion, conduct study tour to other states, etc. A similar result was reported in another study conducted by Jaganathan *et al.,* (2012).

Though 78% of the farmers show a high level of economic motivation, it is negatively related to the extent of knowledge. It is because, the farmers believed in the fact that practicing organic farming is for the amelioration of soil, water and environment health which will in turn results in the production of safe food for consumption. The high level of economic motivation is also because of the fact that organic produces fetch more price than conventionally produced vegetables.

Majority of the farmers were practicing organic farming by default, *i.e.* they were cultivating vegetables organically prior to certification. Majority of them were also having high level of economic motivation, since the cost of production was less compared to the conventional vegetable cultivation. They were aware of the fact that organic produce can fetch more price than the conventional produce but are not able to sell as the markets are not available exclusively for organic products.

4.5. CONTENT DEVELOPMENT

The development of the content for an expert system on organic vegetable cultivation was done by analysing the information need on organic vegetable cultivation through the disparities between the information available to the farmers and the information required for the farmers. It was found out through the gap in extent of knowledge of the certified organic farmers. The information

thus collected were inventorized in a systematic way, categorizing them broadly into three, *viz*., crop production, crop protection and organic certification and marketing practices

4.5.1. Stages of Content Development

The content development was done in four stages (Figure 21) as

1. Review of available information for content development
2. Rating of the collected information
3. Formulation of database
4. Knowledge test

4.5.1.1. Stage. 1:- Review of available information for content development

In the first stage, collection of information available from different sources including national and international journals, research studies, package of practice, authentic/scientific records, scientific publications, proceedings, books and success stories of established farmers, was done.

4.5.1.2. Stage. 2:- Rating of the Collected Information

In the second stage, the information thus collected was given for further verification for its authenticity including scientific validity and practical applicability. A judges' rating was conducted to ascertain the relevant information so as to form the database of the expert system. This was done by field extension workers (agricultural officers and agricultural assistants) and farmers (both certified organic farmers and organic farmers by default).

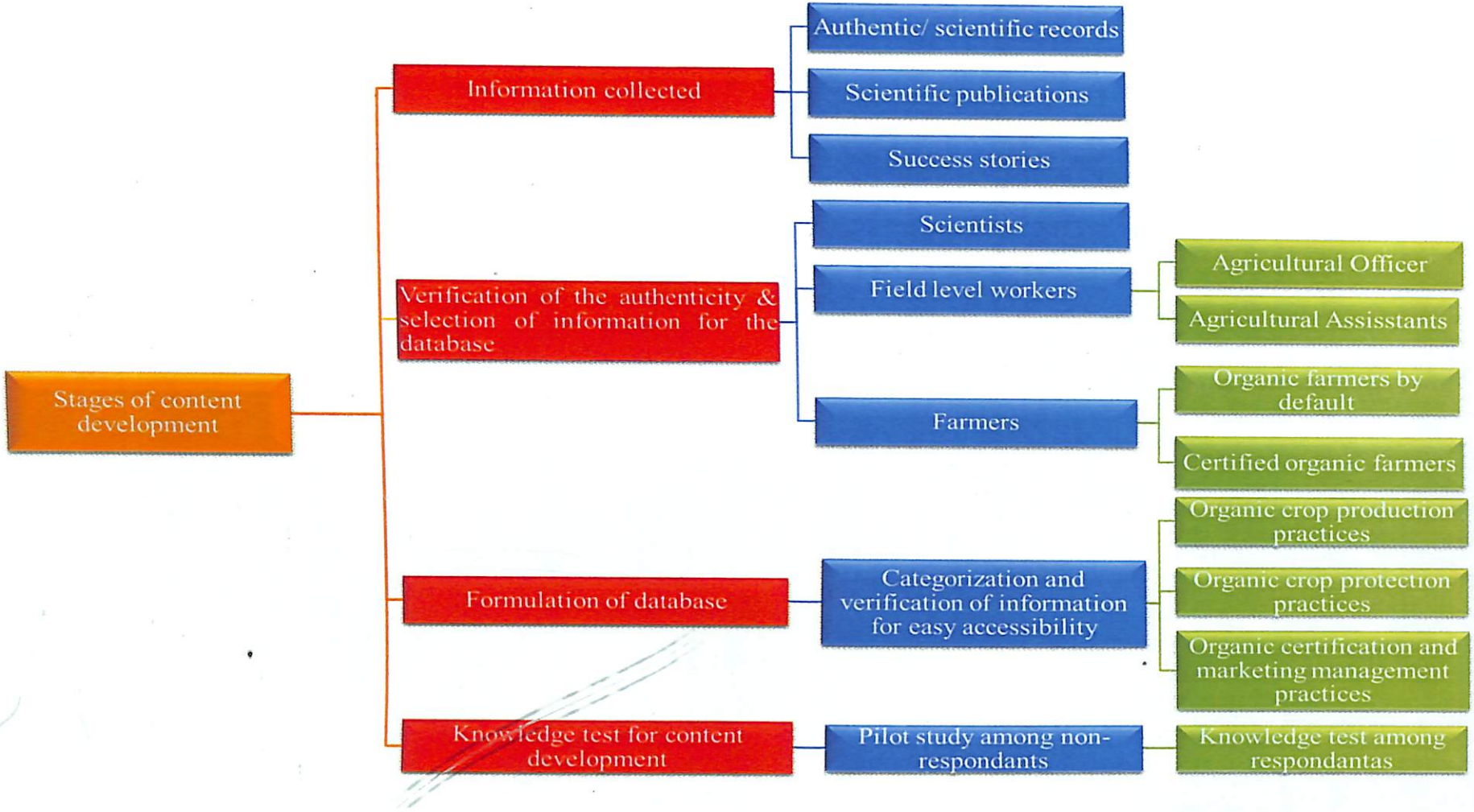

Figure 21. Stages of content development

4.5.1.3. Stage. 3:- Formulation of Database

In the third stage, formulation of database was done. After the judges' rating, the information collected was sorted to the most relevant and distinct farming practices. These practices were given to scientists and extension personell for judging the relevancy of the selected practices, as well as to classify those practices into three categories *viz.,* crop production practices, crop protection practices and organic certification and marketing practices for easy accessibility. Questions were formulated according to the practices on each category which was given during the next stage.

4.5.1.4. Stage. 4:- Knowledge Test

In the final stage, a knowledge test for was done. The practices were sorted out to most relevant ones, according to their rank obtained on judges' rating. A pilot study was conducted in the non- sampling area for narrowing down to the practices on which the farmers need more information. These practices was given to respondents in the sampling area to test their extent of knowledge.

4.5.2. Conceptual Framework of the Expert System

The organic vegetable cultivation practices identified were grouped broadly into three, *viz*., crop production, crop protection and organic certification and marketing practices (Figure 22). Under crop production category, aspects such as season, varieties, planting materials, cultivation practices, inputs were included. Input aspect was again divided into on farm which included, green manure, composting and botanicals and off farm which includes fertilizers and soil conditioning products, bio-pesticides, bio-control agents and bio fertilizers, both neem based as well as others.

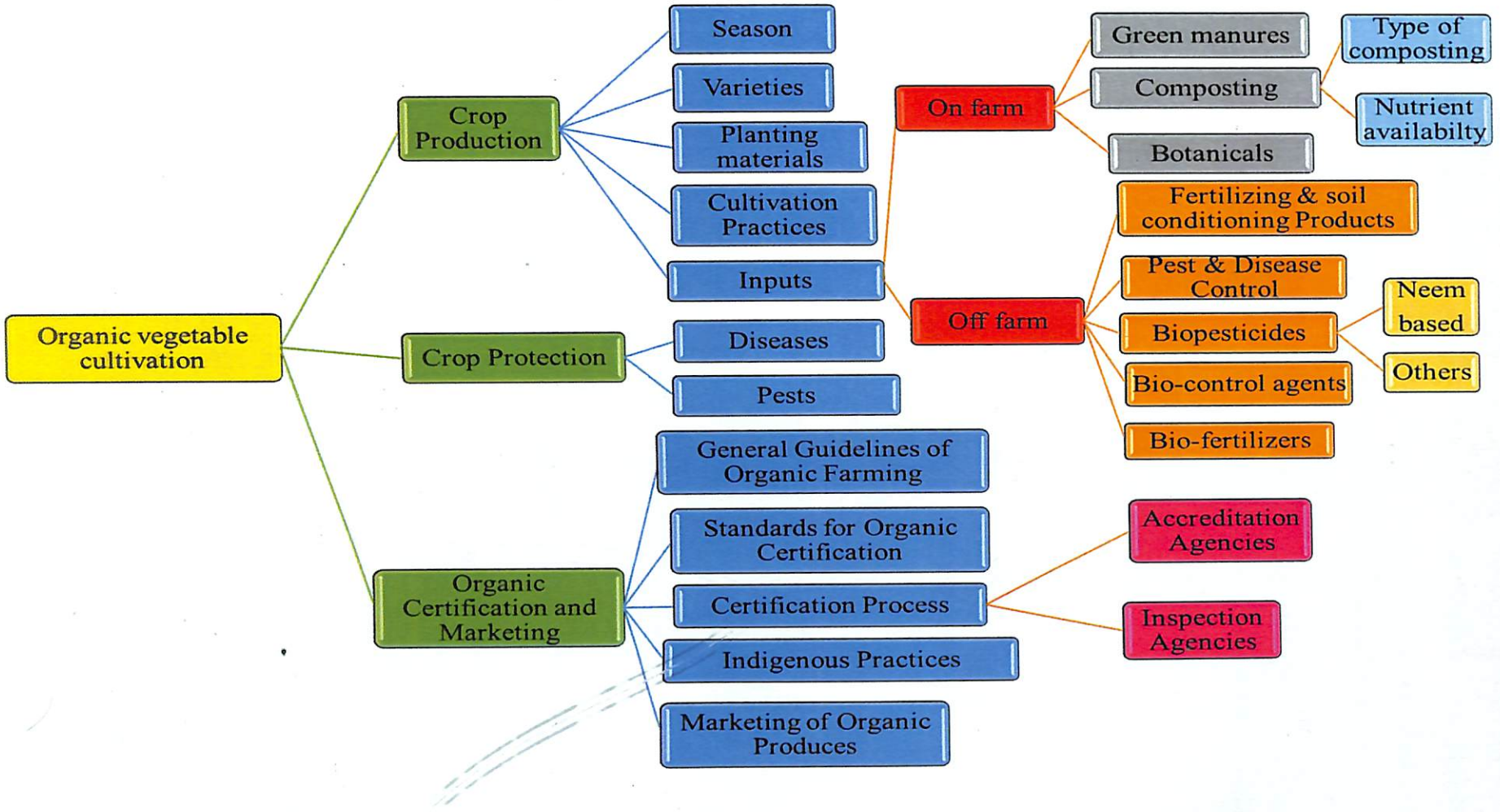

Figure 22. Conceptual framework of the expert system

Under crop protection category, pictorial description of pests and diseases of the crops can be included along with the illustrations of the symptoms caused by them. Also this aspect included the pest and disease control measures.

Under the organic certification and marketing category, general guidelines of organic farming, standards for organic certification, certification process (including list of accreditation agencies and inspection agencies), indigenous practices and marketing of the organic produces was included.

4.5.3. Model of an Expert System on Organic Vegetable Cultivation

The home (first) screen shows the list of vegetables available in the expert system (Figure 23). On clicking any of the vegetables' names, (in the figure it is amaranthus) next window will show up with the categories under it. In the new window, the three categories, *viz.,* crop production, crop protection and organic certification and marketing (Figure 24). On clicking any of the categories, the window opened will show the sub-categories, *i.e.* the seven practices which are recognized as important. In the model given, on clicking, crop production, the window opened will show, season, varieties, cultivation practices etc. (Figure 25)

On clicking, the crop protection link, the new window (Figure 26) opened will show the links to major pests, major diseases, botanical preparations, biological agents etc. Clicking on the major pest link, list of the pests attacking the crop will be shown (Figure 27). Each name shall be hyperlinked to open new windows which will contain the illustrated description of the symptoms caused, identification of pest as well as the management measure for the pest (Figure 28).

Clicking on the organic certification and marketing category, the link opened will show, sub categories such as accreditation agencies, certification agencies, marketing of the produce etc. (Figure 29). In the example (Figure 30) given, clicking on the sub category, accreditation agencies, the link opened will

Model of an Expert System on Organic Vegetable Cultivation

Figure 23. Front screen of the expert system

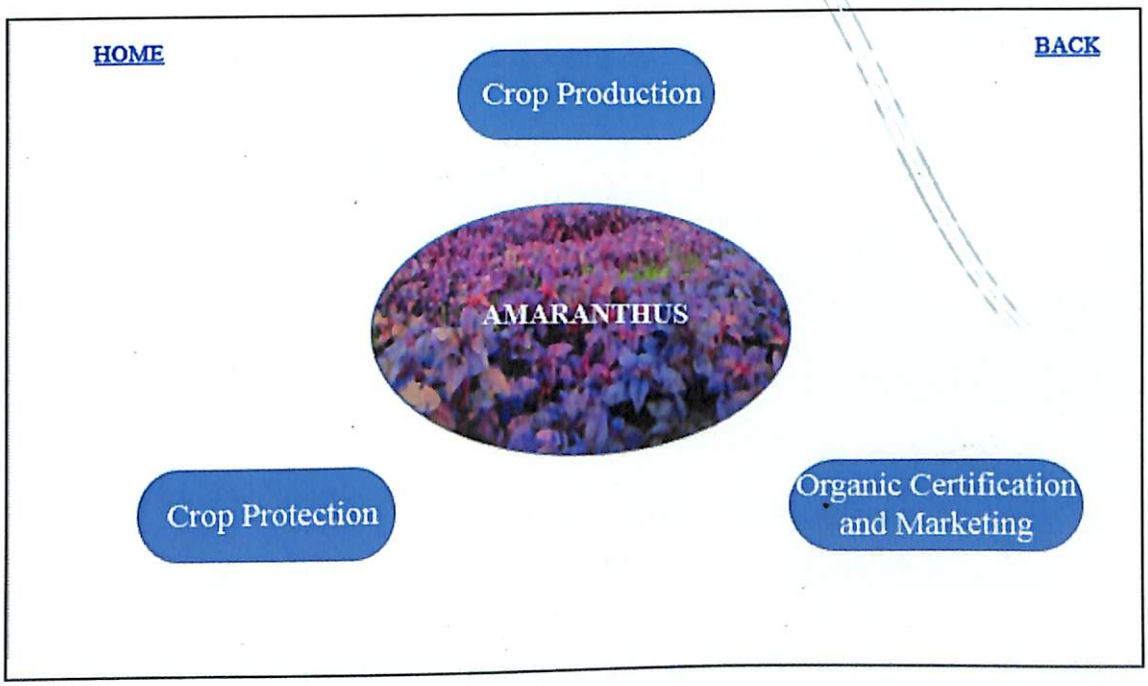

Figure 24. Crop-wise category in the expert system

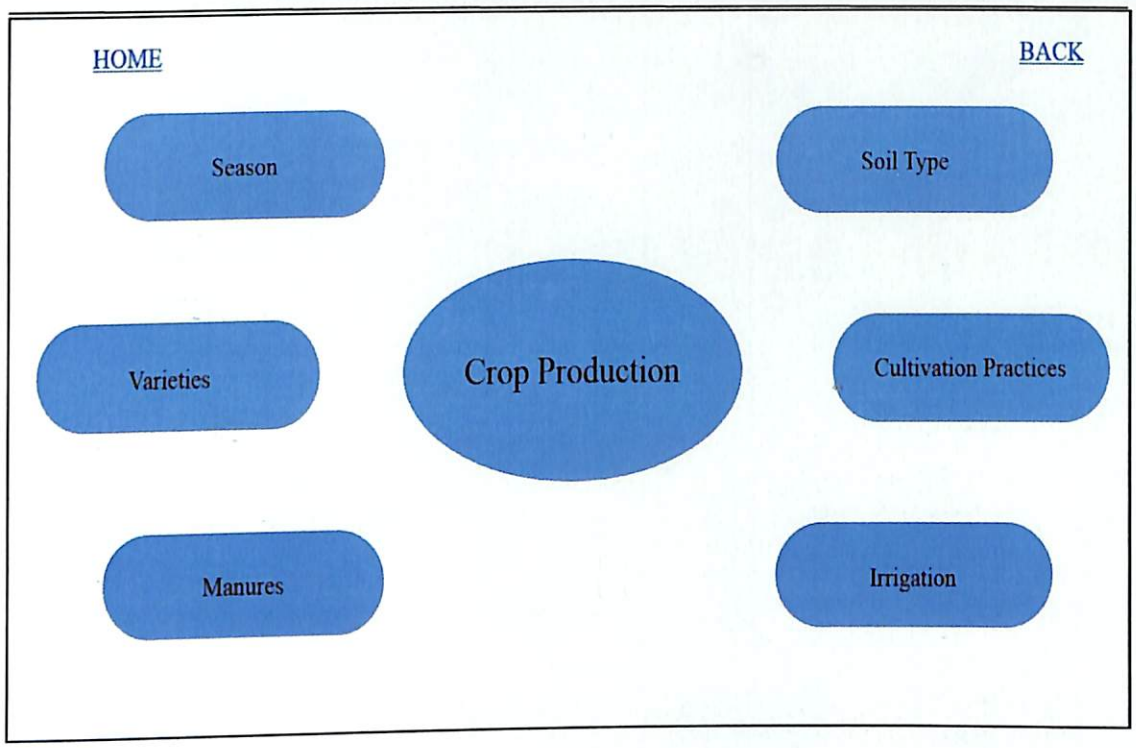

Figure 25. Crop production category in the expert system

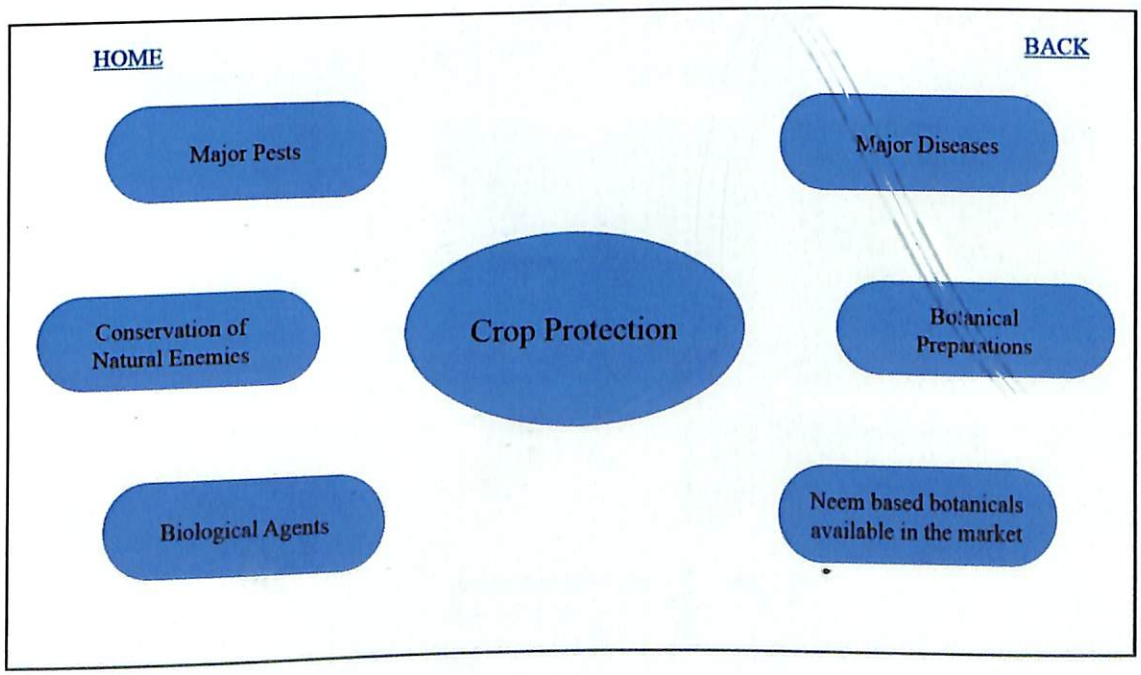

Figure 26. Crop protection category in the expert system

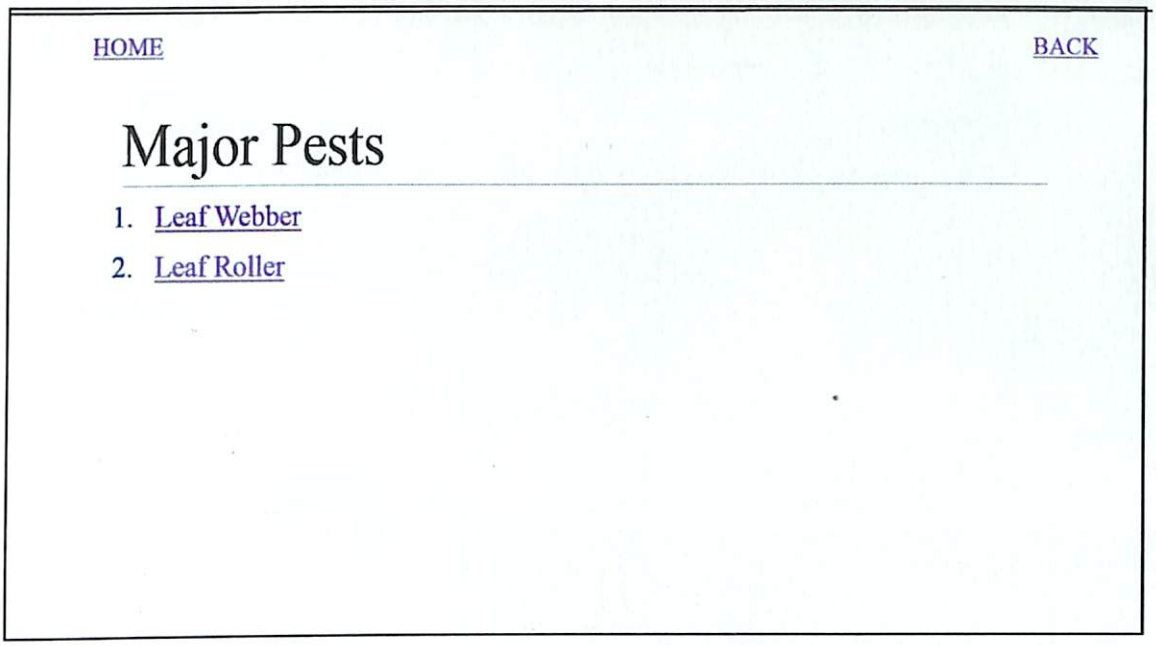

Figure 27. Sub category under the crop protection category the expert system

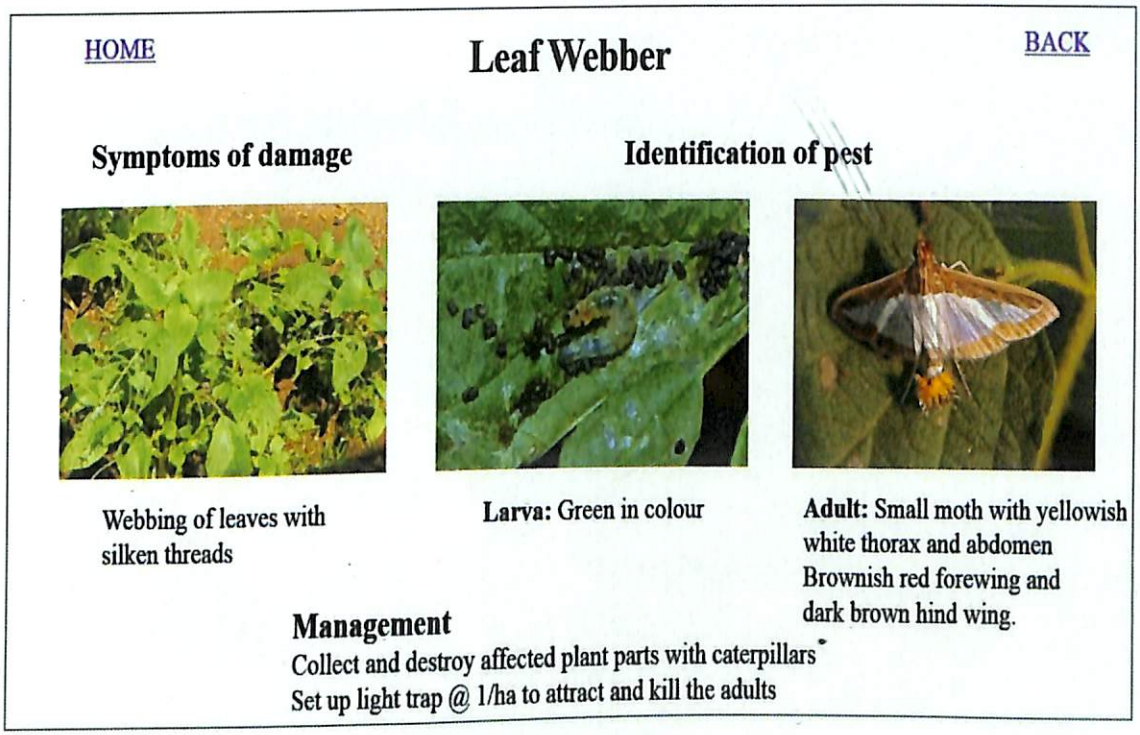

Figure 28. Description of pest and its management in the expert system

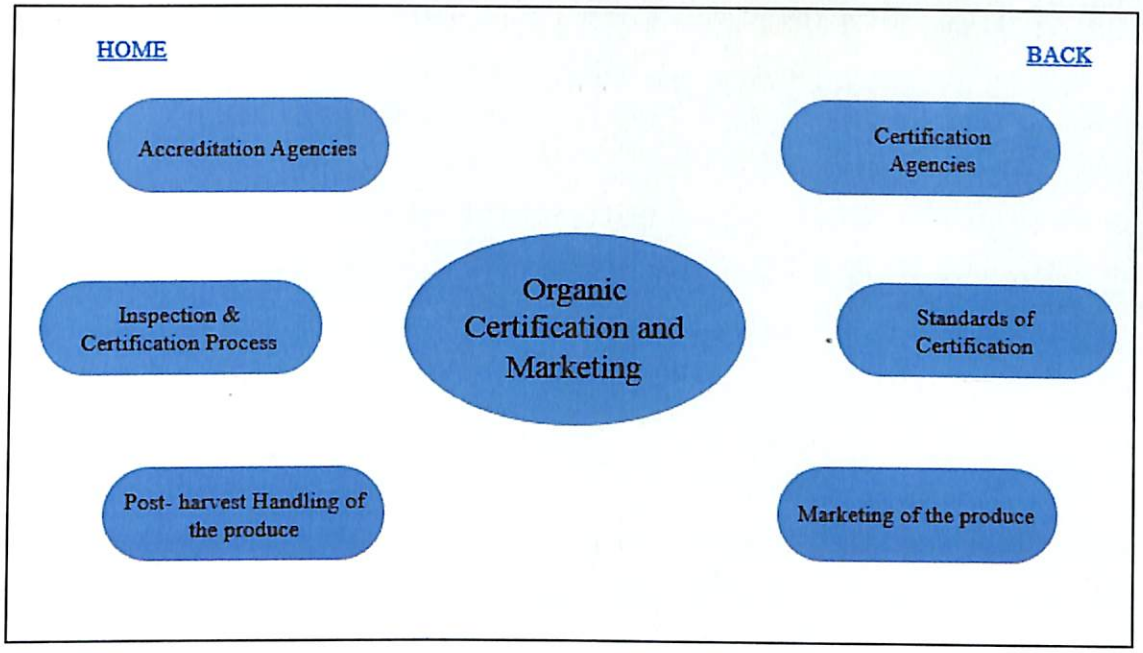

Figure 29. Organic certification and marketing category in the expert system

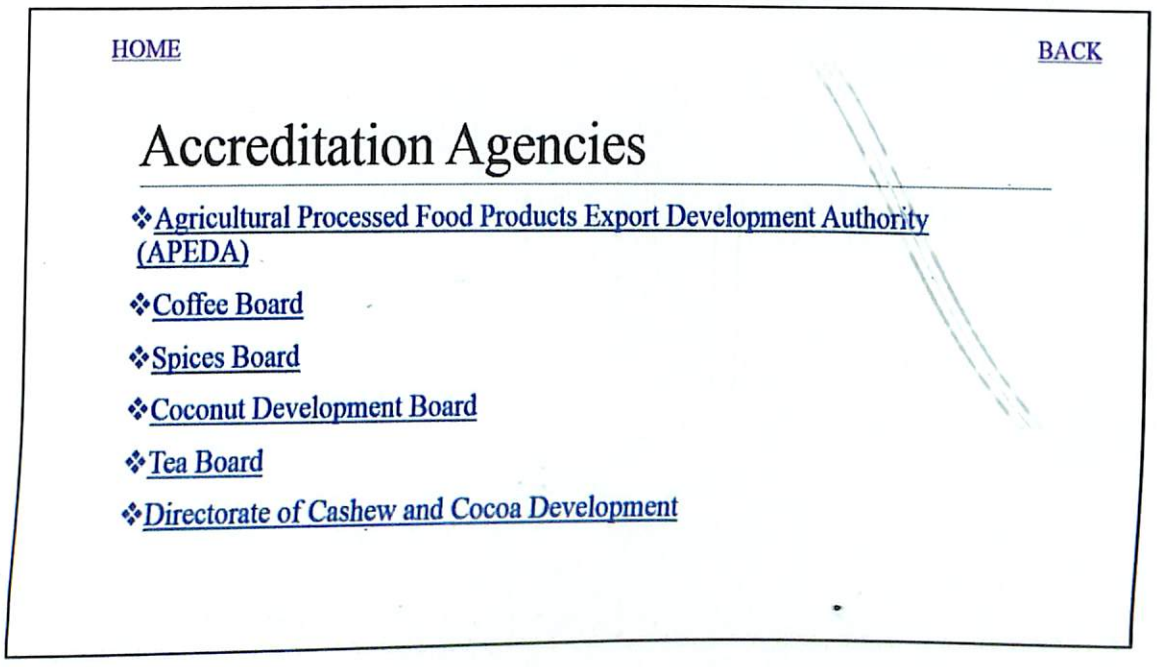

Figure 30. Sub category under the organic certification and marketing category in the expert system

show the list of agencies in India. It can be hyperlinked further in such a way that on clicking each link will display the details of that agency.

The model described is only an archetype and is not complete. Experts can further develop it into a fully functioning expert system. This study shows how to develop content for an expert system, with special reference to organic vegetable cultivation, so that a person who is intending to develop one shall do it quickly and easily.

Also, all the screen can have links to go directly to home screen as well as the previous screen. The given model has been prepared using the software MS Office 2013 Power Point Presentation and MS Office 2013 Word Document by giving hyperlinks to each of the category.

SUMMARY

5. SUMMARY

There is an increasing awareness among the consumers on the deleterious effects of pesticides and hence, there has been a high demand for organically cultivated food produces. Hence the farmers are shifting from conventional mode of agriculture to organic agricultural practices. One of the major impediment faced by the farmers during this shifting is the lack of proper knowledge on the organic farming practices. Though expert systems are the most popular information dissemination technology available, there is none especially for organic farming practices in vegetable cultivation.

The number of expert systems available for farmers on organic farming practices is very minimum. The user friendly interfaces available are also lacking information which farmers are often seeking for. In this regard the study entitled **"Content development for an agricultural expert system on organic vegetable cultivation"** was taken up with the major objectives as follows:

1. To analyse the information need on organic vegetable cultivation.
2. To inventorize information for the different systems in Kerala, in order to develop content for farmer- friendly interactive multimedia aid.
3. To assess the extent of knowledge on organic vegetable cultivation practices.
4. To study the profile characteristics of the respondents.

Kannur and Wayanad districts were purposively selected for conducting the study. From both districts 50 farmers were selected by employing simple random sampling technique. This study was conducted and carried out with well-structured pre-tested interview schedule and ex-post facto research design employed with appropriate statistical analysis.

Salient findings of the study are presented below:-

5.1 INFORMATION NEED ANALYSIS AND INVENTORIZATION OF ORGANIC FARMING PRACTICES IN VEGETABLE CULTIVATION

1. Information need analysis and inventorization of information on organic farming practices enabled in the formulation of a quick and easiest method to develop content for an expert system for organic vegetable cultivation.

2. Sixty five organic farming practices were identified for the purpose of information need analysis, of which forty five practices were recorded as these for which the respondents needed more information.

3. Inventorization of information on organic vegetable farming revealed that 89% of the organic farmers needed information on organic production practices, 82% required information regarding crop protection practices and 93% of the organic farmers needed information on organic crop certification management practices.

5.2. EXTENT OF KNOWLEDGE ON ORGANIC FARMING PRACTICES AMONG THE RESPONDENTS

1. Majority of the respondents (67%) of the farmers had medium level of knowledge followed by low (20%) level of knowledge and high (13%) level of knowledge about organic farming practices in vegetable cultivation. That is 87 % of the respondents were lacking scientific knowledge on organic vegetable farming practices.

2. Lack of proper scientific knowledge on organic farming, revealed higher need for inventorizing scientific aspects of organic farming.

5.3. PROFILE CHARACTERISTICS OF THE RESPONDENTS

1. More than 50% of the organic farmers (58%) belonged to old age category and 42% percent belonged to middle age category.

2. The results of the study showed all of the organic farmers were literate, out of which 49% of the farmers had attended high school and 25% of them had collegiate education.

3. Majority of the farmers (54%) were more experienced farmers, *i.e*., more than 25 years, while 39 per cent of the respondents had experience between 11-25 years, 5 per cent had experience between 6-10 years and only 2 per cent had farming experience of less than 5 years. For more than 10 years, majority of the farmers were involved in organic farming.

4. Majority (66%) of the respondents had medium innovativeness, followed by high (22 %) and low (12 %) levels.

5. Majority (72%) of the respondents belonged to medium category followed by high (17%) and low (11%) with respect to information seeking behaviour.

6. Majority (67%) of respondents had medium extension orientation, followed by low (19%) and high (14%) levels of extension orientation.

7. Majority (70%) of the farmers had medium level of livestock component along with agriculture and 30 per cent of the respondents' belonged to low category.

8. The organic farmers were more scientifically oriented, *i.e*., 73% of them have medium level of scientific orientation followed by high level (16%) and low level (11%).

9. A higher percentage of the respondents had high level (78%) of economic motivation, followed by medium (12%) and low level (10%).

10. Seventy three per cent of the respondents had medium level of market perception followed by low (16%) and high (11%) levels of market perception.

5.4. RELATIONSHIP BETWEEN THE CHARACTERISTICS OF THE RESPONDENTS WITH THE EXTENT OF KNOWLEDGE ON ORGANIC FARMING PRACTICES

Knowledge about organic vegetable cultivation by the organic farmers had a positive and significant relationship with extension agency contact where as it showed a negative significance with the economic motivation level.

Conclusion

The available knowledge on the organic farming practices prevailing in use by the farmers were either inherited from their ancestors or by their own inventions. Majority of the farmers of Kerala, in general were practicing organic farming by default. The efforts taken by the Department of Agriculture, in order to promote organic farming were reaching to a limited number of farmers in the State. Similarly a large number of vegetable farmers practicing organic cultivation were lacking scientific knowledge on production practices, plant protection practices and organic certification and marketing aspects.

Information dissemination on organic agriculture through digital devices are yet to get popularized among the farming community. User friendly digital interfaces, currently available for farmer usage are having only a limited content on organic agriculture practices. Besides, most of these devices are not even reaching the farming community. Though Kerala Agricultural University had

come out with an ad-hoc package of practices on organic farming, a digital device like an expert system solely dedicated to organic farming is yet to be developed.

Information need analysis and content development undertaken under the present study entitled “Content development for an agricultural expert system on organic vegetable cultivation” could address the above issues to a greater extent by bridging the gap between the information available to the farmers and what is being required by them. Apart from analysing the gap in extent of knowledge of the certified organic farmers and inventorizing the information for content development for a farmer friendly multi-media aid, the study could also come out with a methodology for information need analysis and a procedure for content development of an expert system on organic vegetable cultivation for different farming systems of Kerala. This methodology can be adapted by different agencies involved in popularizing organic farming among the farmers of Kerala for developing an expert system on organic vegetable farming.

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APPENDICES

APPENDIX- I

KERALA AGRICULTURAL UNIVERSITY

College of Agriculture, Vellayani, Thiruvananthapuram. 695 522

DEPARTMENT OF AGRICULTURAL EXTENSION

Dr. A. K. Sherief

Professor and Chairman

Sir/Madam,

Greetings.

Miss. **Anupama. S (Ad. No. 2012-11-163)**, one of the M.Sc. Scholar, Department of Agricultural Extension, College of Agriculture, Vellayani is undertaking a research study entitled: "Content development for an agriculture expert system on organic vegetable farming." as part of her PG research work.

For the selection of dependent variables for studying the certification and inspection process of organic agriculture, some dependent variables needs to be selected.

Considering your vast experience and professional expertise you have been selected as a judge to rate the relevancy of the variables. I request you to kindly spare some of your valuable time for examining the questionnaire critically. Kindly return the list duly filled at the earliest.

Thanking you.

Yours sincerely,

(Dr. A. K. Sherief)

Operationalized Definitions

a. **Crop production practices:** Crop production practices are those practices/activities that are undertaken in the farm to bring maximum yield/returns for the farmer in an eco-friendly and environmentally safe way.

b. **Crop protection practices:** Crop protection practices are those practices/activities undertaken by the farmer in the farm to protect the plants from pest and disease incidences in an eco-friendly and environmentally safe way.

c. **Crop certification and management practices:** Crop certification and management practices are those information or management practices followed by the farmer to maintain his field as an organic farm, required for obtaining an organic certification.

Sl no:	Crop Practices	Production	Protection	Certification &Management
1	Planting material procurement			
2	Indigenous local varieties			
3	Locally adaptable varieties			
4	Method of planting			
5	Season			
6	Soil type			
7	Timely irrigation			
8	Knowledge about farm scaping			
9	Resistant/ tolerant varieties			
10	Correct depth of planting			
11	Sole cropping			
12	Keeping buffer zones/			

	isolation distance			
13	Crop rotation			
14	Multi cropping			
15	Intercropping			
16	Knowledge about indigenous practices			
17	Burning of crop residues			
18	Summer ploughing			
19	Raising of green manure crops			
20	Incorporation of green manure crops			
21	Raising of green leaf manures			
22	Cattle rearing			
23	Rearing of poultry			
24	Goat rearing			
25	Rearing of ducks			
26	Incorporation of green leaf manures			
27	In-situ incorporation of crop residues			
28	Mulching the manure circle			
29	In-situ vermi-composting			
30	Coir pith composting			
31	Application of oil cakes			
32	Monitoring of pests and diseases			
33	Introduction of biological agents			

34	Application of FYM			
35	Use of soil amendments			
36	Use of animal repellents			
37	Soil solarisation			
38	Soil sterilization			
39	Biological processing of the produce			
40	Filtration and extraction of produce			
41	Mechanical and physical processing			
42	Smoking			
43	Field sanitation			
44	Application of poultry manure			
45	Conservation of natural enemies			
46	Application of ash			
47	Application of cow dung slurry			
48	Application of bio-fertilizers			
49	Use of traps			
50	Hand/mechanical weeding			
51	Use of botanical pesticides			
52	Inspection and certification process			
53	Knowledge about average nutrient content of common manures			
54	Knowledge about conversion			

	period			
55	Knowledge about products available in market for use in soil conditioning and fertilizing			
56	Knowledge about products available in market for pest control			
57	Knowledge about products available in market for disease control			
58	Keeping a farm diary for recording daily activities			
59	On-farm processing of produce			
60	Harvesting measures			
61	Method of handling, packaging and storage of organic produce			
62	Knowledge about soil testing			
63	Marketing of organic produces			
64	Sufficient quantity of organic manures available in the market			
65	Problems in marketing organic produces			

Any other suggestions:

APPENDIX- II

Classification of the practices into three categories *viz.* organic crop production practices, organic crop protection practices and crop certification and management practices.

Sl no:	Organic Practices	Score
Organic Crop Production Practices		
1	Application of ash	17
2	Sole cropping	19
3	Crop rotation	19
4	Application of oil cakes	19
5	Application of cow dung slurry	20
6	Raising of green leaf manures	21
7	Use of soil amendments	21
8	Application of poultry manure	21
9	Incorporation of green leaf manures	22
10	In-situ incorporation of crop residues	22
11	Mulching the manure circle	22
12	In-situ vermi-composting	22
13	Indigenous local varieties	23
14	Correct depth of planting	23
15	Locally adaptable varieties	24
16	Raising of green manure crops	24
17	Timely irrigation	25

18	Intercropping	25
19	Incorporation of green manure crops	25
20	Application of FYM	25
21	Method of planting	26
22	Multi cropping	26
23	Planting material procurement	28
24	Season	28
25	Soil type	28
26	Rearing of ducks	25
27	Goat rearing	28
28	Cattle rearing	30
29	Rearing of poultry	30
Organic Crop Protection Practices		
1	Summer ploughing	15
2	Hand/mechanical weeding	16
3	Keeping buffer zones/ isolation distance	17
4	Use of insect repellents	19
5	Resistant/ tolerant varieties	21
6	Burning of crop residues	22
7	Monitoring of pests and diseases	24
8	Introduction of biological agents	24
9	Use of botanical pesticides	24
10	Soil solarisation	26

APPENDIX - III

Selected practices 45 practices

Sl No:	Practices
1	Correct depth of planting
2	Locally adaptable varieties
3	Raising of green manure crops
4	Timely irrigation
5	Intercropping
6	Incorporation of green manure crops
7	Application of FYM
8	Method of planting
9	Multi cropping
10	Planting material procurement
11	Season
12	Soil type
13	Rearing of ducks
14	Goat rearing
15	Cattle rearing
16	Rearing of poultry
17	Hand/mechanical weeding
18	Keeping buffer zones/ isolation distance
19	Use of insect repellents
20	Resistant/ tolerant varieties
21	Burning of crop residues
22	Monitoring of pests and diseases
23	Introduction of biological agents
24	Use of botanical pesticides
25	Soil solarisation
26	Smoking

27	Use of traps
28	Field sanitation
29	Conservation of natural enemies
30	Knowledge about organic products available in market for disease control
31	Knowledge about indigenous practices
32	Knowledge about organic products available in market for pest control
33	Knowledge about soil testing
34	Biological processing of the produce
35	Mechanical and physical processing
36	Harvesting measures
37	In-situ vermi-composting
38	Inspection and certification process
39	Knowledge about conversion period for organic farming
40	On-farm processing of organic produce
41	Marketing of organic produces
42	Sufficient quantity of organic manures available in the market
43	Problems in marketing organic produces
44	Method of handling, packaging and storage of organic produce
45	Keeping a farm diary for recording daily activities

APPENDIX- IV

36 questions formulated for pilot study

1. Which one of the following is a cover crop (**production**)
    a. Calapagonium
    b. Mimosa
    c. None of the above
2. Name two fungicides permitted in organic farming(**management**)
3. Burning of crop residues are a useful practice for prevention of pests and diseases (true/false) (**protection**)
4. Which one of the following comes under green manure? (**production**)
    a. Glyricidia
    b. Sunhemp
    c. a and b
5. Name two certification agencies in Kerala (**management)**
6. Selection of resistant varieties is a better method than treating the pest/disease infested crops (true/ false) (**protection**)
7. Vermicomposting improve soil health (true/false)(**management**)
8. Mulching is done to (**production**)
    a. Conserve soil moisture
    b. Reduce weed growth
    c. Improve soil fertility
    d. All of the above
9. Name two botanicals used for pest and disease control (**protection**)
10. Organic manures supply (**production)**
    a. Only N, P and K

b. Only Ca, Mg and S

c. All of the above

d. None of the above

11. Name two neem based products used for pests and diseases control (**protection**)

12. Which one of the following is called as nature plough (**management**)

    a. Butterfly

    b. Earth worm

    c. Honey bee

    d. None of the above

13. Commonly used weed control practice in organic vegetable cultivation (**protection)**

    a. Hand weeding

    b. Mechanical weeding

    c. Chemical weeding

    d. A and B

14. Name two soil amendments (**production)**

15. Advantage of crop rotation with legume is (**management**)

    a. To fix atmospheric nitrogen

    b. To fix atmospheric oxygen

    c. To fix atmospheric carbon dioxide

    d. None of the above

16. Light traps are used to (**protection**)

    a. Control of vectors of pests

    b. Monitor of population of pests

c. Both a and b

d. None of the above

17. Animal husbandry is an important practice in organic farming (true/false) (**production**)

18. How many years it will take to be converted conventional farm to organic farm (**management**)

    a. 1-2 years

    b. 3-4 years

    c. More than 10 years

19. Name two natural enemies (**protection**)

20. Every year re-inspection of farm is not necessary to maintain certification status (true/false) (**management**)

21. Planting materials from any farm can be used in organic farming (true/false) (**production**)

22. Which of the following is not an organic farming practice? (**protection)**

    a. Light trap

    b. Furadan application

    c. Tricho cards

    d. Tobacco decoction

23. Intercropping is used to (**production**)

    a. Minimize weed growth

    b. Reduce pest population

    c. Increase the income

    d. All of the above

24. Soil solarisation is an effective method for preventing soil borne pests and diseases (true/false) (**protection)**
25. Which of the following cannot be used in organic farming? (**production)**
    a. Farm yard manure
    b. Vermicomposting
    c. Urea
    d. All the above
26. Agencies like INDOCERT provides certification to the organic farms and products (true/ false) (**management**)
27. Advantage of summer ploughing is (**protection**)
    a. To reduce the water requirement of next season crop
    b. Pupa of pests are exposed and killed
    c. Improve soil structure
    d. All of the above
28. Harvest and post-harvest measures for organic products require additional care than conventional farming (true/false) (**management**)
29. Use of chemical pesticides are useful for natural enemies (true/false) (**protection**)
30. Benefit of selecting quality planting materials (**production**)
    a. Early germination
    b. Vigorous growth
    c. All the above
31. Which of the following species of mushroom spawn is used in coir pith composting? (**management)**
    a. Oyster mushroom

b. Button mushroom

c. All the above

d. None of the above

32. Quantity of water required in organic farming is greater than conventional farming (true/false) (**production**)

33. Distance to keep between conventional farming and organic farming is (**protection**)

    a. 15 m

    b. 20 m

    c. 25 m

    d. 30 m

34. Name two traps which can be used in vegetable fields (**management)**

35. Which of the following earthworm species is used for vermicomposting in Kerala? (**production)**

    a. Eudrillus eugineae

    b. Lumbricus terrestris

    c. All the above

    d. None of the above

36. Which of the following material is not permitted in organic farming? (**management**)

    a. Calcium chloride

    b. Potassium sulphate

    c. Magnesium sulphate

    d. Sodium chloride

APPENDIX- V

21 questions selected for the knowledge test

1. Organic manures supply
    a. Only N, P and K
    b. Only Ca, Mg and S
    c. All of the above
    d. None of the above

2. Name two traps which can be used in vegetable fields

3. Benefit of selecting quality planting materials
    a. Early germination
    b. Vigorous growth
    c. All the above

4. Quantity of water required in organic farming is greater than conventional farming (true/false)

5. Which of the following cannot be used in organic farming?
    a. Farm yard manure
    b. Vermicomposting
    c. Urea
    d. All the above

6. Harvest and post-harvest measures for organic products require additional care than conventional farming (true/false)

7. Use of chemical pesticides are useful for natural enemies (true/false)

8. Soil solarisation is an effective method for preventing soil borne pests and diseases (true/false)

9. Agencies like INDOCERT provides certification to the organic farms and products (true/ false)

10. Every year re-inspection of farm is not necessary to maintain certification status (true/false)

11. Light traps are used to
    a. Control of vectors of pests
    b. Monitor of population of pests
    c. Both a and b
    d. None of the above

12. Animal husbandry is an important practice in organic farming (true/false)

13. How many years it will take to be converted conventional farm to organic farm
    a. 1-2 years
    b. 3-4 years
    c. More than 10 years

14. Name two soil amendments

15. Name two botanicals used for pest and disease control

16. Name two neem based products used for pests and diseases control

17. Which one of the following is called as nature plough
    a. Butterfly
    b. Earth worm
    c. Honey bee

d. None of the above

18. Burning of crop residues are a useful practice for prevention of pests and diseases (true/false)

19. Planting materials from any farm can be used in organic farming (true/false)

20. Advantage of summer ploughing is
    a. To reduce the water requirement of next season crop
    b. Pupa of pests are exposed and killed
    c. Improve soil structure
    d. All of the above

21. Distance to keep between conventional farming and organic farming is
    a. 15 m
    b. 20 m
    c. 25 m
    d. 30 m

APPENDIX- VI

Inventorization of Information on Content development

Sl No:	Farming Practices
A. Content on Organic Production Practices	
1	Selection of planting materials
2	Season
3	Varieties
4	Different types of composting
5	Animal husbandry components in organic farming
6	Availability of organic manures in the market
7	Knowledge about soil conditioning and fertilizing products available in market
B. Content on Organic Protection Practices	
8	Use of traps
9	Conservation of natural enemies
10	Introduction of biological agents
11	Soil solarisation
12	Botanical preparations used for pest and disease control
13	Neem based botanicals available in the market
14	Knowledge about products available in market for pest and disease

	control
C. Content on Organic Management Practices	
15	Knowledge about conversion period
16	Knowledge about buffer zones/isolation distance
17	Inspection and certification process
18	Certification agencies
19	Different standards while considering for organic certification
20	Method of handling, packaging and storage of organic produce
21	Marketing of organic produces

APPENDIX VII

KERALA AGRICULTURE UNIVERSITY

College of Agriculture, Vellayani

INTERVIEW SCHEDULE

Title: Content Development for an Agriculture Expert System on Organic Vegetable Farming.

1. Name & Phone no :

2. Age (in completed years)
3. Education:

Sl No:	Category	Response
1.	Illiterate	
2.	Primary school	
3.	High school	
4.	Higher secondary school	
5.	College education	

4. Farming experience (in years) :

5. Extension agency contact:

Category	**Frequency**		
	Regularly	**Occasionally**	**Rarely**
Agricultural scientist			
Agricultural officer			

Agriculture assistant			
Gram sevaks			
Group farming meetings			
Seminars			
Exhibition			
Study tours			
Demonstrations			
Any others			

6. Information seeking behavior:

Sl. No:	Sources	Most frequently	Frequently	Less frequently	Occasionally	Rarely
A. Media sources						
1	Radio					
2	Television					
3	Newspapers					
4	Agriculture literatures					
B. Formal sources						
5	Scientists of KAU					
6	Agriculture Extension workers					
7	Gram sevak					
C. Informal sources						
8	Friends/Relatives					
9	Fellow growers					

10	Any other					

7. Livestock possession

Category	**No:**	**Value (Rs)**
Buffalo		
Bullock		
Cow		
Calf		
Goat		
Poultry		
Others please specify		

8. Innovativeness(please tick the appropriate): When would you like to adopt organic farming practices?

1) As soon as it is brought to my knowledge
2) After I have seen other farmers try it successfully in their farms
3) I prefer to wait and take my own time
4) I am not interested in adopting organic farming

9. Scientific orientation:

Sl No:	**Statements**	**SD**	**A**	**UD**	**DA**	**SDA**
1.	Organic farming give better results to a farmer than the conventional farming					
2.	The way of farming by our forefathers is still the best way to farm					

3.	Even a farmer with a lot of experience should use new methods of farming					
4.	A good farmer experiments with new ideas in farming					
5.	Though it takes for a farmer to learn new methods in farming it is worth the effort					
6.	Traditional methods of farming have to be changed in order to raise the standard of living of the farmer					

10. Economic motivation

Sl No:	**Statements**	**SD**	**A**	**UD**	**DA**	**SDA**
1.	A farmer should work towards larger yields and economic returns					
2.	The most successful farmer is the one who makes the most profit					
3.	A farmer should try any new farming idea which may earn him more income					
4.	A farmer should grow cash crops to increased monetary profit in comparison to growing of food crops for home consumption					
5.	It is difficult for the farmers children to make a good start unless he provides them					

	with economic assistance					
6.	A farmer must earn his living, but the most important thing in life cannot be defined in economic terms					

11. Market perception

Statement	**Response**			
Do you think the farmer will be able to sell vegetables at higher price/demand if he adopts organic farming practices?	Yes		No	
Do you find it difficult to sell the produce in the local market?	Very difficult	Difficult	Easy	Very easy
How much price the organic produce will fetch compared to those produced under conventional methods?	Low	Same		High

12. 21 questions **7** each under production, protection and management aspects

1. Organic manures supply
    i. Only N, P and K
    ii. Only Ca, Mg and S
    iii. All of the above
    iv. None of the above
2. Name two traps which can be used in vegetable fields
3. Benefit of selecting quality planting materials
    i. Early germination
    ii. Vigorous growth
    iii. All the above

4. Quantity of water required in organic farming is greater than conventional farming (true/false)

5. Which of the following cannot be used in organic farming?

i. Farm yard manure

ii. Vermicomposting

iii. Urea

iv. All the above

6. Harvest and post-harvest measures for organic products require additional care than conventional farming (true/false)

7. Use of chemical pesticides are useful for natural enemies (true/false)

8. Soil solarisation is an effective method for preventing soil borne pests and diseases (true/false)

9. Agencies like INDOCERT provides certification to the organic farms and products (true/ false)

10. Every year re-inspection of farm is not necessary to maintain certification status (true/false)

11. Light traps are used to

i. Control of vectors of pests

ii. Monitor of population of pests

iii. Both a and b

iv. None of the above

12. Animal husbandry is an important practice in organic farming (true/false)

13. How many years it will take to be converted conventional farm to organic farm

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14. Name two soil amendments

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16. Name two neem based products used for pests and diseases control

17. Which one of the following is called as nature plough

i. Butterfly

ii. Earth worm

iii. Honey bee

iv. None of the above

18. Burning of crop residues are a useful practice for prevention of pests and diseases (true/false)

19. Planting materials from any farm can be used in organic farming (true/false)

20. Advantage of summer ploughing is

i. To reduce the water requirement of next season crop

ii. Pupa of pests are exposed and killed

iii. Improve soil structure

iv. All of the above

21. Distance to keep between conventional farming and organic farming is

i. 15 m

ii. 20 m

iii. 25 m

iv. 30 m

APPENDIX VIII

KERALA AGRICULTURAL UNIVERSITY

College of Agriculture, Vellayani, Thiruvananthapuram. 695 522

DEPARTMENT OF AGRICULTURAL EXTENSION

Dr. A. K. Sherief

Professor and Chairman

Sir/Madam,

Greetings.

Miss. **Anupama. S (Ad. No. 2012-11-163)**, one of the M.Sc. Scholar, Department of Agricultural Extension, College of Agriculture, Vellayani is undertaking a research study entitled: "Content development for an agriculture expert system on organic vegetable farming." as part of her PG research work.

After extensive review of the available literature and discussion with extension scientists and other experts, variables supposed to have close association with the study have been identified.

Considering your vast experience and professional expertise you have been selected as a judge to rate the relevancy of the variables. I request you to kindly spare some of your valuable time for examining the questionnaire critically. Kindly return the list duly filled at the earliest.

Thanking you.

Yours sincerely,

(Dr. A. K. Sherief)

OBJECTIVES OF THE STUDY

In Kerala, the application of ICT is finding its place in every sector including the wide spread application in agriculture also. The services are offered by Kerala Agriculture University as well as other public- private enterprises.

The objective of the study is to analyse the profile characteristics of the organic vegetable farmers, their extent of knowledge about organic farming and identifying and inventorizing need based information on organic farming in vegetables.

Please rate the independent variables to be included in the study based on its relevancy from the most relevant to the least relevant by ticking against each variable under the respective rating scale.

Sl. No:	Variables	Most Relevant	Relevant	Less Relevant
1	**Age-** number of calendar years completed by the respondent at the time of investigation			
2	**Gender-** It refers to the male and female farmers in the study area			
3	**Educational Status-** It refers to highest academic qualification possessed by the farmer.			
4	**Occupation-** The main vocation and other additional vocations that the respondents were possessing at the time of interview			
5	**Mass Media Exposure-** It is the extent of exposure of respondent to mass media such as Radio, Television, Newspapers, Farm magazines on agriculture and others.			
6	**Social Participation-** refers to the extent to which the respondent is socially active			

7	**Extension Agency Contact-** It is the degree to which the respondents meet the extension agents for agricultural information.			
8	**Farming Experience-** It is the number of completed years in farming.			
9	**Annual Income-** It is defined as the total income a respondent derived from agriculture, allied and other occupation in an year			
10	**Area Under Crops-** It was operationalised as the number of standard acres possessed by the farmer at the time of enquiry which is under cultivation			
11	**Productivity-** It refers to the output per unit area cultivated.			
12	**Possession of ICT Tools-** It is the availability of facilitation and opportunities to the respondents for updating of information regarding farming activities.			
13	**Scientific Orientation-** It is defined as the degree to which a farmer was oriented towards the use of scientific methods in farming.			
14	**Innovativeness-** It is the degree to which an individual is relatively earlier in adopting new ideas.			
15	**Economic Motivation-** It is defined as occupational in terms of profit maximisation and relative value the farmer places on monetary gains.			
16	**Market Perception-** defined as organization wide generation of market intelligence pertaining to			

	current and future customer needs, dissemination of intelligence across departments, and organization wide responsiveness to it			
17	**Physical Compatibility-** It is the degree to which the technology is perceived as consistent with the infrastructural availability, past experience and needs of the respondent.			
18	**Desirability-** Degree to which the technology is desired and perceived as worth.			
19	**Social Acceptability-** It is the degree to which a technology is considered useful, practical and feasible by majority of the social system.			
20	**Credibility-** It meant the extent to which a communication source was preferred as trustworthy and important by receivers of the information			
21	**Usefulness-** It meant the extent to which a communication source was preferred as useful by receivers of the information			
22	**Simplicity-** It is the degree to which the technology is simple to be adopted by the farmers.			
23	**Accuracy-** any inaccurate information leads to faulty It is the degree to which an individual is relatively earlier in adopting new ideas. decisions, so accurate information is needed for successful decision making.			
24	**Availability-** It is operationalised as information offered with			

	reasonable proximity and appropriate hardware and software			
25	**Reliability-** It is defined as information free from errors and biases at acceptable degrees of confidence.			
26	**Relevance-** any information disseminated by expert system related to the information needs of a specific recipient for a situation			
27	**Adequacy-** It is defined as report or information delivered covers all related aspects about a particular event or situation with respect to the expert system.			
28	**Explicitness-** refers to content of the expert system that does not need clarification.			
29	**Information Seeking Behaviour-** It is referred to as the sources or channels from which the respondents get technological information regarding agriculture and the related areas.			
30	**Information Storing Behaviour-** The information storage refers to how the respondent received the message and how he stored the content in his local language			
31	**Information Dissemination Behaviour-** refers to information exchange the respondent has within his community and among other communities and how he shared the message among the fellow members and or groups			
32	**Knowledge Requirement-** It meant the need of knowledge on improved practices and other information as realised by the			

	respondent.			
33	**Skill Requirement-** It means that the skill farmer realises as his requirement to use the ICT for improving his /her work efficiency.			
34	**Beliefs about Organic Farming:** It is defined as the beliefs occurring among the farmers about organic farming			
35	**Awareness regarding Organic Farming**: It is the degree of knowledge about organic farming			

Suggestions if any:

APPENDIX IX

Sl No:	Variables	Operationalized Definition
1	Age	Number of calendar years completed by the respondent at the time of investigation
2	Educational status	It refers to highest academic qualification possessed by the farmer.
3	Farming experience	It is the number of completed years in farming.
4	Innovativeness	It is the degree to which an individual is relatively earlier in adopting new ideas.
5	Information seeking behaviour	It is referred to as the sources or channels from which the respondents get technological information regarding agriculture and the related areas.
6	Extension agency contact	It is the degree to which the respondents meet the extension agents for agricultural information.
7	Livestock possession	Referred to the number of animals by an individual
8	Economic motivation	It is defined as occupational in terms of profit maximisation and relative value the farmer places on monetary gains
9	Scientific orientation	It is defined as the degree to which a farmer was oriented towards the use of scientific methods in farming.
10	Market perception	It is defined as organization wide generation of market intelligence pertaining to current and future customer needs, dissemination of intelligence across departments, and organization wide responsiveness to it

Content Development for an Agricultural Expert System on Organic Vegetable Cultivation

by

ANUPAMA S.
(2012-11-163)

THESIS
Submitted in partial fulfillment of the
requirement for the degree of

Master of Science in Agriculture
Faculty of Agriculture
Kerala Agricultural University, Thrissur

DEPARTMENT OF AGRICULTURAL EXTENSION
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2014

ABSTRACT

The present study entitled "Content development for an agricultural expert system on organic vegetable cultivation" was taken with a purpose of exploring a methodology for an Expert system. The objectives studied were analysis of information on organic vegetable cultivation, inventorization of the selected information for the different systems in Kerala, and development of a methodology for content development for farmer- friendly interactive multimedia aid suiting the Expert system.

One hundred farmers who were having organic certification were selected through simple random sampling procedure from Kannur and Wayanad districts. One dependent variable and ten independent variables were studied and analysed with the help of different scales and techniques.

On analysis of the data it was found that most of the respondents (58%) belonged to old age group and all the respondents were literate. Fifty four percent of the respondents were having experience in farming for more than 25 years. Majority (70%) of the farmers belongs to medium category when comes to the possession of livestock. Majority of the respondents belonged to the medium category with respect to extension agency contact (72%), information seeking behaviour (73%), innovativeness (66 %) scientific orientation (73%), and market perception (73%). Seventy eight percent of the respondents were having high level of economic motivation.

Extent of knowledge was categorized into three, *viz*., organic crop production practices, organic crop protection practices and organic crop certification and management practices for the purpose of identifying and inventorizing need based information on organic farming in vegetables. Majority of the respondents were having medium level of knowledge about organic farming. On analysing these three categories separately, 89% of the organic farmers need information on organic production practices, 82% requires

information regarding crop protection practices and 93% of the organic farmers need information on organic crop certification and management practices.

Extent of knowledge of organic farmers is having a positive and significant correlation with their extension agency contact and a negative correlation with economic motivation. The majority of the famers were having organic certification for more than ten years. The farmers were giving importance to the quality rather than the quantity of the vegetable produced.

The number of expert systems available for farmers on organic farming practices is very minimum. The user friendly interfaces available are also lacking in information which farmers are often seeking. The majority vegetable farmers practicing organic farming were also lacking scientific knowledge. Hence the present study entitled “Content development for an agricultural expert system on organic vegetable cultivation” analysed the information need on organic vegetable cultivation and inventorized those information to develop content for a farmer friendly multi-media aid.

The study also came out with a methodology for information need analysis and a procedure for content development of an expert system on organic vegetable cultivation for different farming systems in Kerala. This methodology could be adopted by different agencies involved in popularizing organic farming among the farmers in Kerala for developing an expert system on organic vegetable farming.