

## **CHAPTER-1**

### **INTRODUCTION**

#### **1.1 WHAT IS CLOUD COMPUTING**

With the continuous and constant evolution of computer technology and network technology, enormous changes are occurring in the various arenas of the world. The application of information technology has impacted the social, economic and production development. Especially with the emergence of Cloud Computing technology and its application in various fields successfully, cloud computing is being considered as the third pillar or third IT wave after computer technology and Internet Technology. Currently, a lot of research in cloud computing and its implementation is being carried out in different and many developed countries. Research has shown outstanding results and achievements. Major and pioneer companies in IT such as Microsoft, HP, Google, IBM, Oracle, have realized potential opportunity in the field of cloud computing, and is being used in various areas. Cloud Computing has been successfully promoted in the fields of medicine, manufacturing, energy, financial services and other key areas. Cloud Computing would play a very critical role in the field of Agriculture if implemented effectively and efficiently. It can prove to be very beneficial if cloud technology promoted.

#### **1.2 AGRICULTURE AND CLOUD COMPUTING TECHNOLOGY**

India is one of the largest producers of foods, grains and other products, but still agriculture and its production process are decentralized, crude and obsolete methods being followed by the farmers, together with several constraints of the farmers and

modernization is very slow. This results in an obvious gap between the supply and demand chains of the agricultural products. This will have a negative impact on the farmer's economic conditions as well the national income of the country. This bottleneck can be eliminated with the implementation of Cloud in agricultural field. It can break the farmer's limitations in technical knowledge, improve the utilization of existing resources and can also overcome the strong dependence on natural climate in the specific geographical areas. By conveying important information related to agriculture through Cloud and other devices through Internet, the farmers can benefit hugely.



Fig-1:Farmer using laptop

### 1.3 OBJECTIVE

The objective of the paper is concerned with the concept of how Cloud Computing can be implemented effectively, and how can it be prominent in developing Indian Agricultural sectors and in other developing countries. It is concerned with how ICT (Information and Communication Technology) will be helpful in the agricultural sector and hence the economic development of the country.



Fig-2: A new age in agriculture

## 1.4 OVERVIEW

Cloud computing is a type of computing that depends on sharing computing resources rather than having local servers or personal devices to handle applications. In cloud computing, the word cloud (also phrased as “the cloud”) is used as a metaphor for “the Internet”, so the phrase cloud computing means a type of “Internet-based computing”, where different computing resources- such as servers, storage, and applications are provided to an organization through the Internet.

Cloud Computing is a term that describes the means of delivering any and all Information Technology from computing power to computing infrastructure, applications, business processes and personal collaboration- to end-users as a service wherever and whenever they need it, i.e. On-Demand services.

In 2009 the US National Institute of Standards and Technology (NIST) Information Technology Laboratory developed a considered and well written definition distilled from a number of perspectives.

## 1.5. NIST Definition of Cloud Computing

“Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage,

applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models. The emerging cloud abstracts infrastructure complexities of servers, applications, data, and heterogeneous platforms”.

### 1.6 Significant features of Cloud Computing Technology

#### **Five essential characteristics of cloud computing:**

**On demand self-provisioning of resources:** A consumer can individually provision computing capabilities and resources, such as additional systems (processing capability, software and storage) and network resources.

**Utilization of Internet technologies:** These services are delivered using Internet identifiers, formats and protocols, such as URLs, HTTP, and IP which give customers high benefits from this huge network. Users can use different thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

**Pool of resources:** Cloud computing is based on a business model in which resources are shared at the application, host, and network level. The resources are pooled to serve multiple consumers using a multitenant model. Different physical and virtual resources are dynamically assigned and reassigned depending on consumer demand.

**Massive scalability and elasticity:** Cloud computing gives customers the ability to increase the resources if the area of application grows or new functionality is needed. On the other hand if requirements become less, the user can request to reduce resources, taking into account that they are not paying for resources which they are

not utilizing. The resources available for provisioning often appear to be unlimited and can be delivered in any quantity at any time.

**Reduce costs:** Cloud customers do not buy the resources they need; they just need to pay per usage in terms of time, services, and storage needed. This approach saves the total cost and helps specially the small and medium companies to start their work with little money. Both the provider and customer can monitor, control, and report the usage of the resource.

Also, there are other characteristics which give more advantages for the cloud as:

**Green Technology:** Cloud computing is a green technology since it enables resource sharing among customers that minimize the number of data centers which save power and reduce pollution.

**High performance:** The performance is improved because the cloud is a large network of powerful computers resulting in high processing capability.

**Users not concerned with upgrading and maintenance:** Customers need not to upgrade or maintain the cloud infrastructure by themselves; cloud service providers who are responsible for maintenance and up-gradating all the time.

**Fast deployment:** The implementation of cloud for an application may be in days or sometimes in hours. It needs to just fill some registration and information forms to be able to use it.

**Pool of service providers:** Cloud computing vendors have various services that give the customer flexibility to choose among them.

**Virtualization:** Cloud computing relies on virtualization, which gives it the ability of separating the business services from the infrastructure needed to run these services.

## **1.7 Information and Communication Technology (ICT)**

### **1.7.1 What is ICT**

ICT (Information and Communication Technology) is a term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems . A new domain of ICT is emerging called Cloud that will maintain bulk but customized and updated databases with rapid connectivity with low investment cost. It provides real-time computation, data access, and storage to users without having the knowledge of physical location.

## **CHAPTER-2**

### **SYSTEM DESIGN**

#### **2.1RELATED WORK**

There are tremendous work done in the field of cloud computing and its implementation in agricultural sectors in various countries. The following are some of the observations made and studied by the authors and researchers.

##### **2.1.1 Cloud Computing and Agricultural Development of China: Theory and Practice**

In this paper, the author has discussed about the advantages and the status of China's agriculture development. A huge research is being carried out theoretically since long period and studies are also being done on its effects on China's agriculture and its various sectors. The concept of implementing Cloud is not yet matured in China. It suggests a cloud application system framework that can be implemented in China. Due to government constraints and challenges, the implementation is not very matured and effective.

##### **2.1.2 Application of Cloud Computing in Agricultural Development of Rural India**

Traditionally, agriculture or farming is an activity whose knowledge is passed down many generations together. The information on the methods and science of farming is confined only to the farming community. Another major problem in our country is rural-urban migration as unemployment ratio is constantly is increasing.

These two major problems can be efficiently resolved by the application of cloud computing technology in the field of farming. By collecting all the related information regarding farming techniques at a central cloud, that information can be accessed by the

users and other concerned people around the world. And migration problem will be solved as the cloud services are provided to the users however remote the location.

### **2.1.3 Cloud Computing: A New Era of Computing in the Field of Information Management.**

Sharing of information and knowledge is very critical for efficient and better productivity in agriculture. This information is maintained by farmers' communities. If Cloud computing is applied in the field of agriculture efficiently, then it will prove to increase overall productivity of the cultivation land. In addition to storing the information in cloud, information management of all sorts of data related to cultivated land, including location, land rights, area, and soil and land characteristics can be integrated.

### **2.1.4 Application of Cloud Computing in the Field of Agriculture and Prospects in Other Fields.**

In traditional farming, IT is very scarcely been introduced due to which it has affected the productivity. Introduction of IT and Cloud Computing in the field of farming, it will have efficient effect on the improvement of the production process and also on information sharing.



## 2.2 PROPOSED SYSTEM AND DESIGN

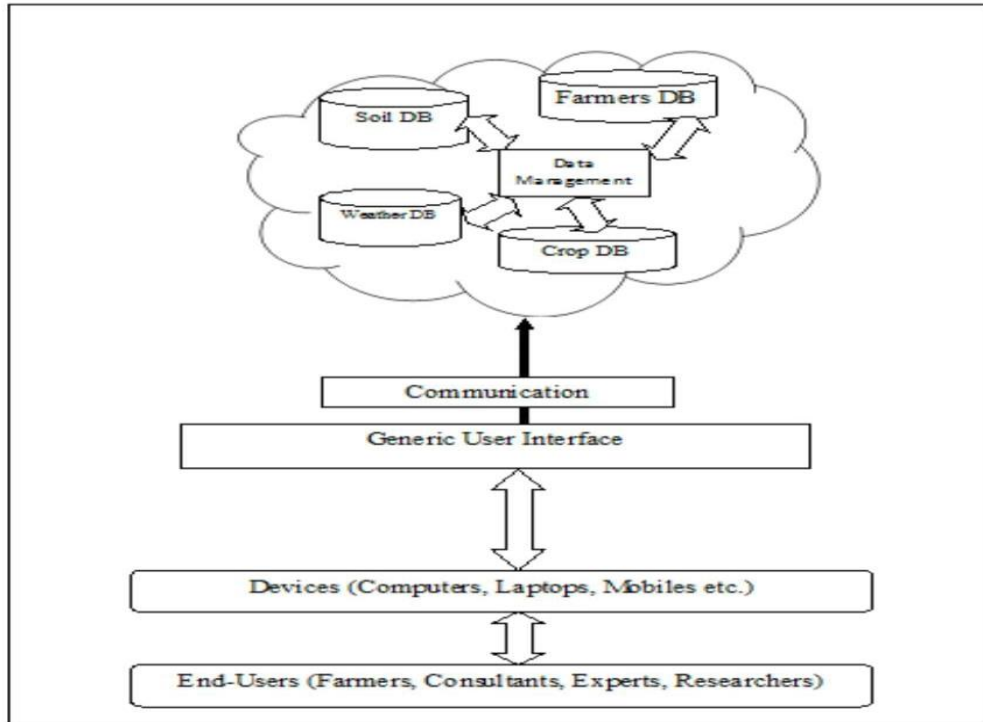


Fig: 3 System design

The proposed system as shown in Fig: 3, suggests that cloud can be implemented with a model with two core parts:

- (i) An approach that is user-friendly and fast to monitor and fulfill the user requests- Cloud system
- (ii) A centralized location to store all relevant data Cloud.

### 2.2.1 The Cloud System:

**Communication:** The literacy rate in rural areas and in smaller towns is much lower. This population of illiterate mostly comprises of farmer communities. They also form a population who are non-English speakers. Hence, this component or part of the system is most important as it allows the users access the users in the languages that are comprehensive to the users. It serves a messaging system to disseminate the information.

### **2.2.2 Cloud:**

It is the centralized location that has to be set up to store all the relevant data. It can include various and separate databases.

Soil-related, weather-related, Research, Crop, and Farmers-related Data can all be stored at a single location and data availability can be achieved.

This data can be accessed by the end-users such as farmers, experts, consultants, researchers etc., easily any time from any location through the devices that are connected to the Cloud system. A generic user interface can be used that aids in accessing the cloud system for communication with the system to access the information.

### **2.2.3 TYPES OF CLOUDS**

#### **a) Public cloud**

The cloud infrastructure applications, storage, and other resources are made available to the public for free or on pay-per-use model. It is owned by an organization selling cloud services. Example: Amazon, Google Apps, Windows Azure etc.

#### **b) Private cloud**

The cloud infrastructure is operated solely for a single organization. It may be owned, managed and operated by the organization or a third party, and may exist on-premises or off-premises.

#### **c) Hybrid cloud**

The cloud infrastructure is a composition of two or more clouds (private, community, or public that re-main unique entities but are bound together by standardized or proprietary technology that enables data and application portability.

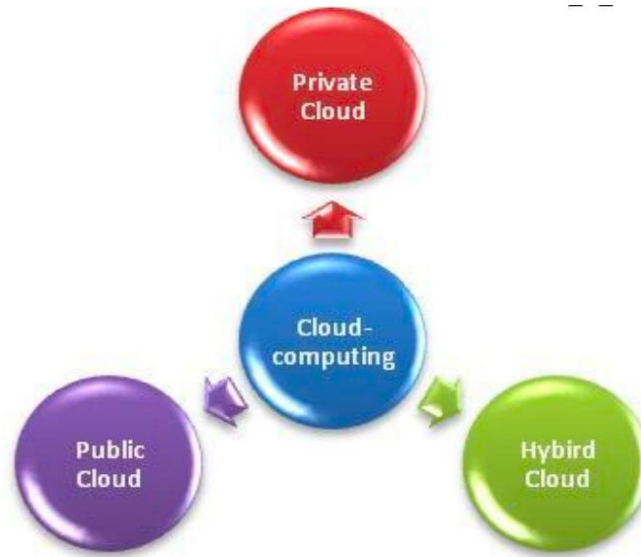


Fig 4: Model of cloud computing

### 2.3 NECESSITY OF PROPOSED SYSTEM IN AGRICULTURAL SECTORS

Cloud Computing technology is recently picking up the global market extensively covering almost all the prime sectors and areas but nothing is still done in the Indian Agro sector. The developed countries have already taken up this project but still in the infant state.

The effective use of Cloud in agro sector will bring positive changes by utilizing cloud's key features. The following benefits may serve as reasons as to why cloud technology is necessary to be implemented in the agricultural sector:

- It is an attractive technology from the point of view of cost of setting up. Low startup cost is affordable in rural India.
- Information management (related to crop, soil, and weather and production process) is easier as it will be managed by the service providers, a team of professionals.

- Promotes the circulation of agricultural products. Long supply chain and complex link between farmers and consumers makes it difficult for the farmers to derive benefits and value from the markets.
- Unemployment problem is resolved as services are provided to smallest of the place and however the place is remote.
- Data availability at any time and at any location.
- Urban rural migration can be reduced.
- Technical issues will be reduced as they are handled by service providers and professionals.

## CHAPTER-3

### WORKING

#### 3.1 HOW DOES CLOUD COMPUTING WORK

Let's say you're an executive at a large corporation. Your particular responsibilities include making sure that all of your employees have the right hardware and software they need to do their jobs. Buying computers for everyone isn't enough -- you also have to purchase software or software licenses to give employees the tools they require. Whenever you have a new hire, you have to buy more software or make sure your current software license allows another user. It's so stressful that you find it difficult to go to sleep on your huge pile of money every night.

Soon, there may be an alternative for executives like you. Instead of installing a suite of software for each computer, you'd only have to load one application. That application would allow workers to log into a Web-based service which hosts all the programs the user would need for his or her job. Remote machines owned by another company would run everything from e-mail to word processing to complex data analysis programs. It's called cloud computing, and it could change the entire computer industry. Cloud computing system, there's a significant workload shift. Local computers no longer have to do all the heavy lifting when it comes to running applications. The network of computers that make up the cloud handles them instead. Hardware and software demands on the user's side decrease. The only thing the user's computer needs to be able to run is the cloud computing system's interface software, which can be as simple as a Web browser, and the cloud's network takes care of the rest.

There's a good chance you've already used some form of cloud computing. If you have an e-mail account with a Web-based e-mail service like Hotmail, Yahoo! Mail or Gmail, then you've had some experience with cloud computing. Instead of running an e-mail program on your computer, you log in to a web e-mail account remotely. The software and storage for your account doesn't exist on your computer -- it's on the service's computer cloud.

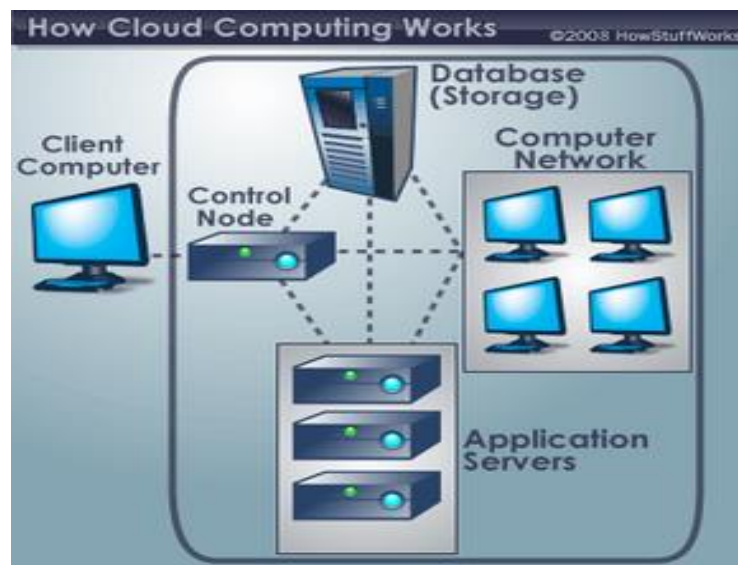


Fig-5: Cloud computing working

### 3.2 Basic Cloud Computing Models

**Software-As-A-Service (SAAS):** This model of cloud delivers services that includes software, web applications etc., to the users without buying/downloading and installing on specific machines . Instead of buying and paying for the full software or application, cloud charges the users based on whatever is used.

**Platform as a Service (PAAS):** It provides clients the computing platform for designing

and developing specific applications with minimum redundancy. It also takes care of hosting of those applications without concerning about hardware and data storage

requirement. It also guarantees the availability of most recent platforms and their security.

**Infrastructure as a Service (IAAS):** This model usually includes components used in availing services, such as virtual computers, traffic monitoring and re-directing, basic network components etc. As the organizations invest the most in establishing infrastructure and in the components, this is the most crucial and salient feature provided by the cloud.

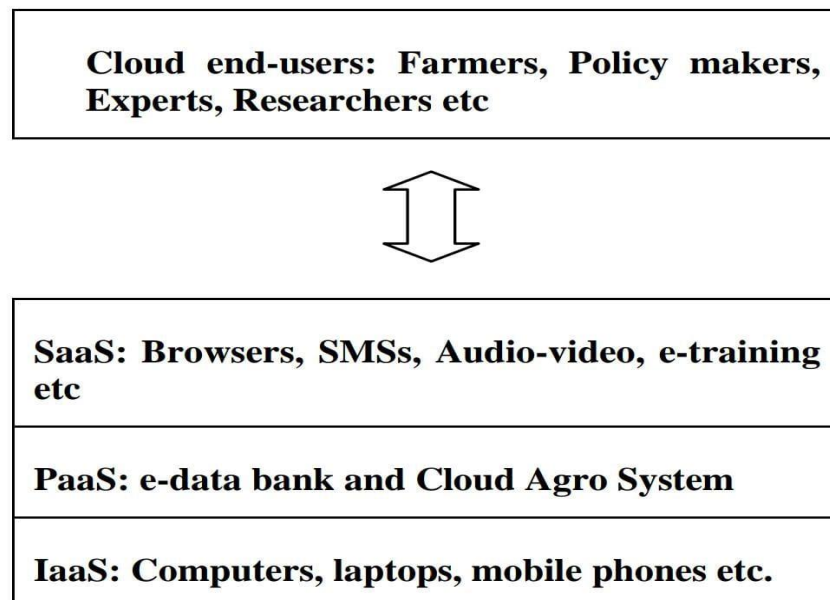


Fig 6: Basic Cloud Computing Structure

## CHAPTER-4

### ADVATAGES & IT'S IMPACTS

#### 4.1 ROLE OF CLOUD COMPUTING IN AGRICULTURE FIELD

- Agriculture information data bank (crop, weather, soil, growth progress, farmer data & expert consultation).
- Store all the agriculture related information in a centralized cloud, which will be available to all the users at anytime, anywhere.
- Management of all data related to land.
- Location, area; soil and land characteristics through centralized decision support systems.
- High integration & sharing of agricultural information.
- It can be eliminate the farmer's limitations of technical knowledge & resources Providing agricultural technology service & science.
- Improvement of the agricultural products marketing.
- Efficient use of agricultural resources.
- Promote the circulation of agricultural product and service in wider level.

#### 4.2 CHARACTERISTICS OF CLOUD COMPUTING

The special publication includes the five essential characteristics of cloud computing:

- **1. On-demand self-service:** A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.



- **2. Broad network access:** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops and workstations).
- **3. Resource pooling:** The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state or datacenter). Examples of resources include storage, processing, memory and network bandwidth.
- **4. Rapid elasticity:** Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.
- **5. Measured service:** Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth and active user accounts). Resource usage can be monitored, controlled and reported, providing transparency for the provider and consumer.

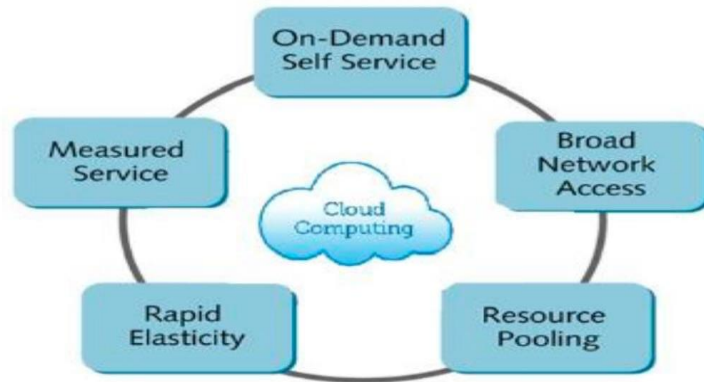


Fig 7: Cloud characteristics

#### 4.3 BENEFITS OF CLOUD COMPUTING IN AGRICULTURE

- Data Readiness any time & anywhere.
- Local and global communication.
- Improve economic condition of the Nation.
- Enhanced the GDP of the nation.
- Ensure food security level.
- Motivation of farmers and researchers.
- Reduction of technical issue.
- Rural-Urban movement.
- Data availability at any time and at any location without delay.
- Improve market price of Food, seeds, other product.

#### 4.4 CLOUD COMPUTING APPLICATIONS IN AGRICULTURE

##### High integration and sharing of agriculture information

Cloud computing offers a new management mechanism, which can integrate information resources in different regions and departments, build information sharing space and share infrastructure. In the Agriculture Information Resources Cloud

(AIRC) users are able to get agricultural information through a variety of terminal not just the computer, which promotes the information sharing significantly.

### **Real-time monitoring and guidance in agricultural production**

Currently, cloud computing technology already achieves real-time visual monitoring of crop growth, not only able to quickly get the surface information but also be able to detect the water and fertilizer content in the soil.

### **Construction and improvement of the agricultural products supply chain**

The cloud platform facilitates the information exchange and communication between farmers and agricultural enterprises, it has very important significance for constructing and improving agricultural products supply chain, ameliorating agricultural products sales, and increasing farmers' profits.

### **Tracking and monitoring of the agricultural products quality**

In the cloud computing platform, the animal can take advantage of advanced computer imaging technology to evaluate:

1. The animal meat,
2. Select and cultivate varieties,
3. Establish the database and animal nutrition demand model, and meet a number of animal's nutritional needs indicators and allow the maximum production of livestock and poultry.

## **4.5 CHALLENGES OF CLOUD COMPUTING IN AGRICULTURE**

- Maintenance & Supervision by third party, so data security is less.
- Indirect administrator accountability.

- Farmer is unknown for cloud computing technology.
- Less physical control.
- Attraction to hackers.
- Need on the network connectivity.
- Requires a constant Internet connection.
- It runs the risk of security.
- Farmers training necessary for this technology.
- Does not work well with low-speed connections.
- Platform facility is not easily available for farmers.

#### **4.6 CURRENT CHALLENGES IN INDIAN AGRICULTURE**

- Poor knowledge about the weather forecast, pests and diseases.
- Poor ICT infrastructure and ICT illiteracy.
- Non availability of timely and relevant content.
- Lack of awareness among farmers about the benefits of ICT in agriculture.
- Particular non availability of agricultural information kiosks/ knowledge center's at the grass root level.

#### **4.7 FUTURE SCOPE**

Future agriculture will use sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices and precision agriculture and robotic systems will allow farms to be more profitable, efficient, safe, and environmentally friendly.

## **CHAPTER-5**

### **PROBLEM SOLVING**

#### **5.1 STATEMENT**

By all the above discussion based on various papers, the following problem statement is derived that suggests, “To develop a messaging system that makes use of Cloud Computing technology and the devices that come in handy of all the end users. This can be utilized in the field of agriculture so that efficient information management, flexible knowledge and information sharing, local and global communication and production planning can be achieved. This ultimately results in overall increase and improvement in the productivity in agriculture and thus the economy”

#### **5.2 ROLE OF CLOUD COMPUTING IN SOLVING THESE CHALLENGES**

Using the applications of cloud the farmers have nothing to worry about hardware and software investment and also the technical knowledge required to learn them . The farmers will send the request for the specific cloud service using a user friendly device, and the cloud service provider will analyze and handle the request dynamically. And finally the results will be passed back to the client. They can get most up-to-date farming and propagation techniques, pest control knowledge, and can also track the whole process from production, distribution to consumption. They can also provide the systematic information collection like Supply chain management, Market forecasting and Business decision-making information.

## **CHAPTER-6**

### **CONCLUSION**

#### **6.1 SUMMARY**

India will definitely benefit if the proposed model is implemented effectively in the agricultural sector. An effective implementation of this model will encourage other sectors also, which will lead to optimal benefit of shifting towards cloud. This will bridge the gap between technology, information and farmers of India. This will have positive and tremendous impact on other fields also that will lead the nation towards technological development. Therefore, promotion and awareness of Cloud computing technology and its use, implementation will bring out new zenith in economic development in India.

#### **6.2 CONCLUSION**

Cloud computing is a newly introduced concept and most of the developing nations are not to acquire it and have a well-established information base for the nation. This will return to a well-connected world. Cloud computing has benefit to and entire economics, but substantial challenges stands in the way. Cloud computing will support the farmers access to application services at any wherever using various terminals. They request their resources from the cloud not from a fixed physical entity. The applications are run in the cloud, the farmers don't need to know and worry the specific location of the application. They only need to a laptop or a cell phone and they can achieve what they want. In the next three years, cloud computing in India will be more and more used by enterprise. India will definitely benefit if the proposed model is implemented effectively in the agricultural sector. An effective implementation of this model will encourage other sectors also, which will lead to optimal benefit of shifting towards cloud. This will bridge the gap between technology, information and farmers of India. This will have positive

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