

GIS Anchored Integrated Plantation Management: Tea

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Introduction:

Tea is one of the most important and highest foreign exchange earning agricultural product of India. The Indian states of Assam, Meghalaya, Tripura, North Bengal (Darjeeling) and Sikkim contribute significantly to the overall tea production in the country. Tea is also grown in Southern part of the country such as Tamilnadu, Karnataka and Kerala. Total Tea cultivation area is approximately 0.45 million ha. There are three major varieties of tea produced world wide such as Orthodox, CTC & Green Tea. India mainly produces Black Tea whereas Green Tea is very popular in Japan, Taiwan, China etc. India produces 850 million Kgs of Tea annually, which is 30% of world production (Annual world production 2800 million Kgs.). For last couple of years, due to rapid changes in global economic scenario, globalization of Indian economy, breaking of USSR and increasing presence of countries like Kenya, Indonesia, SriLanka etc. in global export market, Indian tea industry is under recession. Consequently average price realized per Kg. of Tea by Indian Industries decreasing steadily as described in Fig. 1.

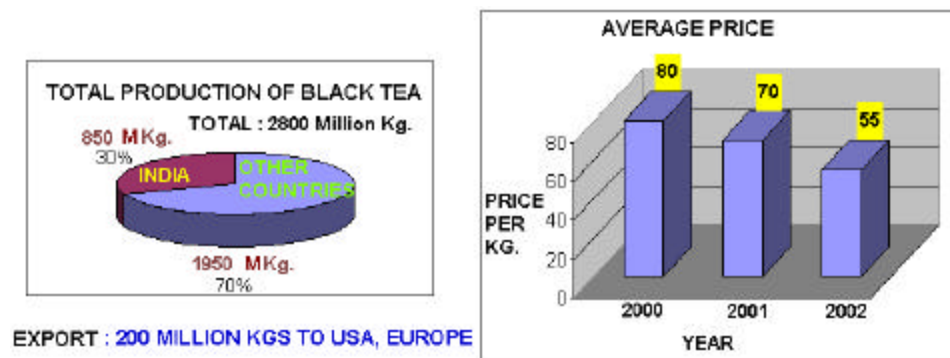


Fig. 1 : Statistics of Indian Tea Production and Prices

Industry and Government has realized that there is immediate need to modernize the tea production process to make it globally competitive. The major national objective of tea industry is to utilize available lands on estates towards sustainable development by ensuring land use efficiency with proper soil conservation measures and environment protection. In addition, producers' objective is to manage tea estates to maximize profits. Therefore, the overall objective of this proposed project is to identify suitable strategic land use development plan and to introduce precision farming with efficient planning & monitoring of plantation to maximize profitability. The strength of IT in the form of GIS & ERP solution is expected to give excellent result towards achieving this goal.

Objective:

The objective of this proposed work is summarized below:

- ?? To develop a GIS anchored web enabled Decision Support System (DSS) for Tea Enterprises.
- ?? Introduction of the concept of Precision farming.
- ?? User-friendly IT Framework for collection of reliable spatio-temporal data.
- ?? Efficient and smart ERP package for decision support at all levels for better management & profitability.

Description:

In order to make Indian Tea globally competitive, the need for proper planning and timely monitoring of Plantation-related data is a must. The estate managers should be able to see every corner of the field with all associated data for better productivity and to achieve consistent quality.

In this proposed work, we would like to emphasize the need of collection of reliable and timely Plantation-related data and to put them into state-of-the-art GIS & ERP framework for analysis and planning.

Data collection from the field with the help of field sensors and integration of these data to GIS and ERP package will lead to effective and efficient planning for better management.

The following areas will be addressed in this project :

(a) Generation of Digital Map of the Estate:

A digital map of the entire estate will be prepared from existing available paper maps and documents. Latest high resolution Satellite image will be used during this map generation to include up to date information of the estate.

(b) Land use & Land cover map :

The map is then classified in terms of land use and land cover.

The percentage of tea crop cover is a major indicator for crop yield. Therefore crop cover percentage is considered for land use categorization.

(c) Generation of DEM or Topography :

Based on the existing contour maps and/or stereo Satellite image, a Digital Elevation Model (DEM) of the entire terrain will be generated. From the generated DEM, slope and aspect maps will then be generated.

The Topographic factors, i.e., slope, elevation and aspect are having enormous importance to tea plants and also to soil conditions.

Hence, these DEM, slope and aspect maps will help the managers in decision-making.

(d) Generation of Soil map :

A classified soil and fertility map will be generated on the basis of existing soil survey data. Some sample soil data from specific field points will be collected and tested at Laboratory for crosschecking of the data.

(e) Generation of Drainage map :

The existing drainage and stream network map of the Tea estate will be prepared. This is very important in terms of irrigation and for draining of excess rainwater. Water logging is very harmful for the tea plants. This drainage map when analyzed in conjunction with the elevation map will give an idea about that. Modifications of the drainage system, if required, can then be planned for the betterment of the situation.

(f) Collection of other important attribute data :

Other important attribute data like average daily relative humidity, average daily sunshine hours and average daily temperature maps for the estate will be prepared. Tea plantation parameters concerning acreage, variety (clone), planting density, soil cover by the canopy, pruning cycle, planting date and yield will be collected.

(g) Socio-economic and other environmental data :

Socio-economic data of the area and other environmental data like soil erosion, deforestation, ground & surface water quality, etc. will be collected and mapped. Soil data like moisture content and pH value of soil will be measured periodically through sophisticated handheld instruments.

(h) ERP Integration :

All relevant attribute information will be stored in a database for ERP planning. All sorts of plantation information, scheduling information etc. will be stored in a centralized location, which would help the management to take effective managerial decisions. The web interface module will also help the officials to remotely monitor about the status of estate and take decisions remotely.

(i) Customisation of field instrumentation :

Proper interface electronics will be designed to collect and store data into Palm-top computers from the field instrumentation sensors.

Methodology:**(A) Generation of data from paper map and other records and survey data :**

- (a) Generation of Land use & Land cover map from Paper Map & Satellite imagery.
- (b) Generation of Soil map from records & field survey.
- (c) Generation of DEM from the Contour map and/or stereo Satellite imagery.
- (d) Generation of existing Drainage map.
- (e) Collection of field data through field sensors.
- (f) Collection of other important attribute data.
- (g) Socio-economic and other environmental data.

(B) Analysis of spatio-temporal and attribute data for planning :

- (a) Fertilizer scheduling
- (b) Scheduling of pesticide, fungicide, etc.
- (c) Pruning schedule
- (d) Plucking schedule
- (e) Replantation schedule
- (f) Irrigation planning
- (g) Drainage improvement planning

Thus this will lead to a Decision Support System (DSS) where record of almost every individual tea plant and all corners of the field will be documented and management will be able to take proper decision at proper time with the help of this package at the expense of a mouse click.

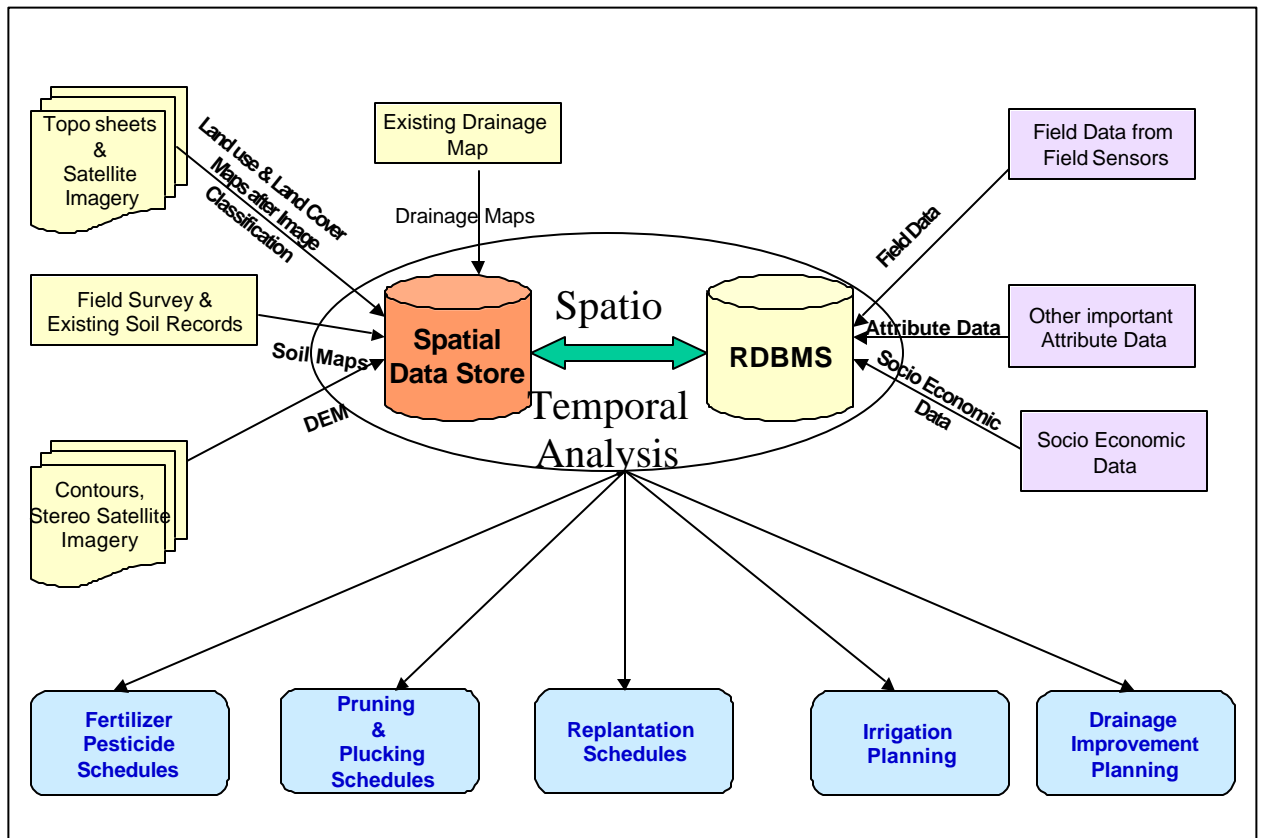


Fig 2 : Pictorial representation of the methodology of the proposed work

Proposed System Architecture:

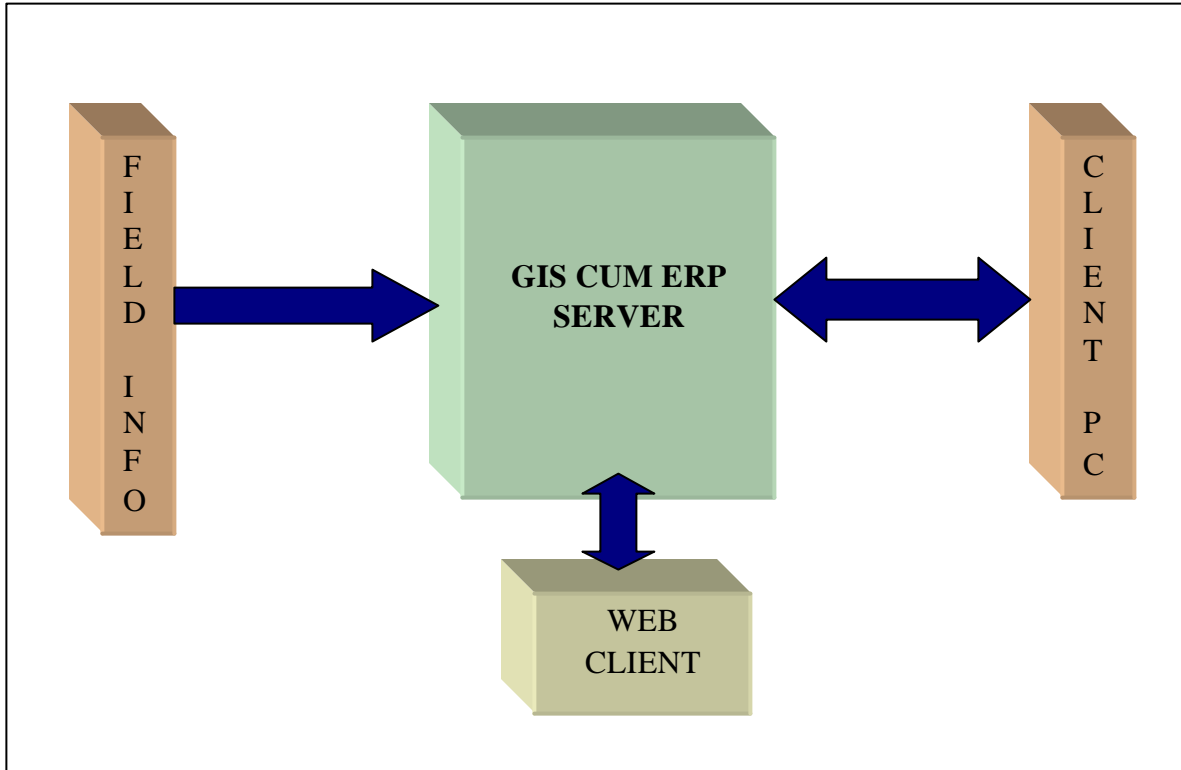


Fig 3 : Schematic Diagram of the Proposed System Architecture

The outcome of this proposed work can be envisaged as:

(a) A GIS anchored Integrated Plantation Management package tuned for the Tea Enterprises comprising of the followings :

- ✍✍ Detail map of the entire estate
- ✍✍ Thematic layer maps of the estate
- ✍✍ GIS based front-end
- ✍✍ Attribute ERP database
- ✍✍ Menu-based Spatial query builder
- ✍✍ Customised Plantation ERP
- ✍✍ Decision Support System with Web Connectivity

(b) An interface electronics will be designed & developed to send data from the field sensors to Palm-top devices.

Conclusion:

The following benefits are envisaged from the proposed work:

- ✍✍ A customized GIS based ERP package where all the spatial information of a Tea Estate like land use, land cover, soil, fertility, health of tea bushes etc. will be presented as thematic layer maps and all the associated attribute data will be stored in a database and linked with the Layer maps.
- ✍✍ The package will lead to a Decision Support System through which proper planning and actions can be taken for maximum profitability.
- ✍✍ Models will be developed for damage & loss assessments due to drought & flood and preventive measures and plans will be made accordingly.
- ✍✍ Scheduling of application of Fertilizer, Pesticide, etc. and scheduling of plucking will be generated.
- ✍✍ The Customized GIS package will lead to any type of user query (either spatial or non-spatial or both) related to the estate and that will in turn make management decisions easier.
- ✍✍ Although this package is proposed for Tea plantation, after successful completion of this project, this package can very easily be customized for all other plantation based industries.

References:

1. Prepare Sustainable Strategic Development Plans for a selected Tea Estate in Mid-country region in SriLanka using GIS - R.M.S.S. Rajapakse, J.A.A.M. Jayakody and M. Jayawardena (GISdevelopment.net)