GEOGRAPHIC INFORMATION SYSTEM OF VEGETABLE AND CROP PRODUCTIONS IN BENGUET

J. B. Lacea
Instructor I, College of Arts and Sciences

ABSTRACT

Commercial Geographic Information System(GIS) applications are expensive and difficult to understand because of their complex features, which are not always used or applicable in some research studies. Although there are open and free source GIS applications, they lack the most needed features in this undertaking. Customarily, application trims down the complexity features and contains proper solution to typical research study. This IT research tackled the prototype and framework for the development of GIS tool in gathering and presenting data that will direct solution to some problems of vegetable and crop production in Benguet. The methods and tools for data acquisition, analysis, and visualization are implemented in the software architecture model.

INTRODUCTION

The province of Benguet is one of the top producers of temperate vegetables and other crops like fruits and flowers. It produces the major bulk of the country's semi-temperate vegetables such as cabbage, potato, carrot, broccoli, chayote, and bell pepper as well as flowers like anthuriums, chrysanthemums, lilium, and callas. The quality and quantity of harvests are affected by several factors such as improved seeds, fertilizers, pests, soil chemical properties, plantation land area, temperature and humidity, and weather.

Keywords: Decision-Support System, Factor Analyses, GPS, Information System, Spatial Data Analysis, Software Architecture, UML

The local government units and other agricultural institutions have realized that there is immediate need to acquire information of possible solution to problems faced by farmers on their production of vegetables and crops in the different localities in Benguet.

The need for information exists in all fields of endeavor. Managers treat information as valuable resources like money, people, and other materials that should be managed accordingly in an all-out effort to meet the desired productivity level. Acquiring information is vital to research managers for decision-making that provides on-demand reports and inquiry capabilities. As to the brilliant quote by futurist and forecaster John Naisbitt "The new source of power is not money in the hands of the few, but information in the hands of the many."

One of the dilemmas facing today's manager is shortage of information needed to make vital decisions despite the seemingly information overload. Symptoms of overload are a growth of incoming information, an explosion in the volume of information sources. Symptoms of scarcity are the lack of vital information for decision making.

There is also the crucial problem of exploiting an organization's proprietary information as a strategic resource. Underlying these problems is that of having "the right information, for the right place, in the right format, at the right time" (Long, 1989).

Geographic Information System (GIS) is an automated system tool for the capture, storage, retrieval, analysis, and display of spatial data. It is a special case of information systems where the database consists of observations on spatially distributed features, activities or events, which are definable in space as points, lines, or areas. A GIS manipulates data about these points, lines, and areas to retrieve data for ad hoc queries and analyses. The database consists of a set of observations, which uses the scientific approach to measurement. Scientists take and record these measurements using a system to analyze the data scientifically/ statistically. The observations are spatially distributed; i.e. they occur over space across time and locations (Clarke, 1999).

One system made public is the Global Positioning System(GPS), which is a satellite-based system for determining accurate positions on or near Earth's surface. It was developed in the 1970s and 1980s by the U.S. Department of Defense. The system is based on a network of 24 high-

altitude satellites configured so that a minimum of four satellites are in view of any position on Earth. Each satellite continuously transmits both identification and positioning information that can be picked up by GPS receivers on Earth.In 1983, President Ronald Reagan made GPS accessible to the public(Mcknight and Hess, 2008).

GPS receivers can be located with high accuracy and can feed a database with the real-time location of a moving person/object(a field engineer, a car, a truck, a container, and so on). These feed the enterprise databases with the location of the mobile users or assets of an organization that allows planning, scheduling, and logistics improvements.

Once data is stored in appropriate form in a database, spatial analysis makes it possible to derive meaningful information from it.

Analysis of vector spatial data includes the following: Within-Distance, Contains, Nearest-Neighbor, Distance, Buffer, Overlay, and Visualization (Kothuri, Godfrind, and Beinat, 2004).

The study then explored and developed the use of GIS for the vegetable industry of Benguet.

Objectives of the Study

The main objective of this research is to develop a GIS software-enabled Decision Support System(DSS) for vegetable and other crop productions in Benguet. Specifically, the research study:

1. Designed and implemented user-friendly IT Framework for collection of reliable spatial data through information mapping;

2. Developed GIS software tool that monitors the changes, factors, and observations of crop production particularly on vegetables; and

3. Provided data analyses services including accurate and up-to-date information to local government authorities and agriculture scientists on volume of harvests, seeds, fertilizers, pests, soil chemical properties, agricultural land area, temperature, humidity, and weather of the different farming localities that produce different agricultural products.

Expected Output

The implications of the results and outputs will contribute a GIS software tool for our local government to use in the monitoring of crop production particularly vegetables. This will assist our expert authorities in agriculture for decision-support systems in providing solutions along food concerns (safety, quality, and sustainability) seeds, soil, fertilizer, pest, agricultural land area, temperature, humidity, and weather.

Conceptual Framework

Comprehensive and consummate data are the impetus for analyses and processes to have good judgment and decision-making in understanding the radical cause and solution to problems. The data resources such as vegetable production, soil properties, fertilizers, seeds, pests, raster map, and GPS location are collected from the 13 municipalities of Benguet. These data resources will encompass the Information System shown in Figure 1. As stated by O'Brien (2005), an Information System can in organized combination of people, hardware, software, communication networks, and data resources that collects, transforms, and disseminates information in an organization. The information gathered can be viewed through maps, charts, 3D contour data visualization, and report. The spatial data analysis generates annual reports on volume of harvest, soil, fertilizer, seed, pest, agricultural land area, temperature, humidity and weather along with statistical data and factor analyses results.

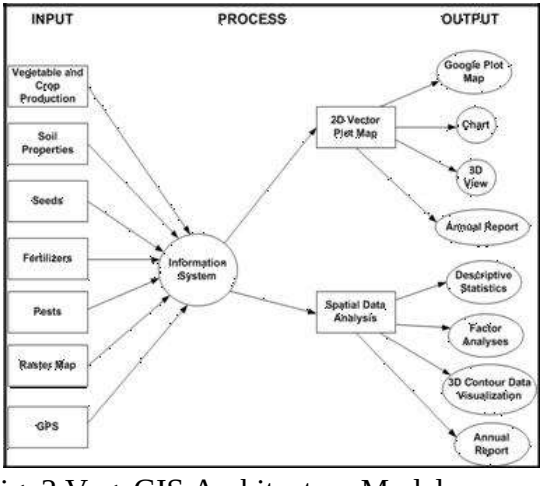


Fig. 2.VegeGIS Architecture Model

MATERIALS AND METHODS

This IT research study began its design and development from June 2010 to May 2012. Its scope consisted of the 13 municipalities of the province of Benguet and 23 selected various vegetables including strawberry as follows: Baguio beans, bell pepper, broccoli, cabbage, sweet potato, carrot, cauliflower, celery, chayote, cucumber, lettuce, mushroom, mustard, onion, pechay, potato, radish, rice, spinach, garden peas, tomato, and Chinese cabbage.

Software Architecture

Software architecture, a global form of an application, describes the strategic choices that determine software quality like reliability or the guarantee of performance while making room for tactical decisions made during development (Muller, 1997).

The name of the GIS software tool that is setup solely in the objectives of this IT research and development is VegeGIS (GIS of Vegetable and Crop Production in Benguet). The central core of the architecture model is the Server Process Execution Engine (SPEE).

The SPEE has complex and abstract operations consisting of datastore and retrieval, process, analyses and computation, and visualization for the services of the eight (8) clients as shown in Figure 2. The clients are the main features that assimilate into gestalt solutions. The Spatial Data are the definite location and place with related unique attributes. It represents farm lands that produce different vegetables and crops. A government institution like Department of Agriculture must assign agriculture field inspectors responsible in gathering these spatial data by visiting the 13 municipalities of Benguet and collecting samples, raw data, and interviewing the farmers. Likewise, more valuable information can be drawn in doing survey at the La Trinidad Vegetables Trading Post (LTVTP). The SPEE stores, retrieves, and transforms these spatial data, which are then subservient function to other clients. The Raster Map Overlay (RMO) is the placing of multiple thematic maps in precise registration, with the same scale, projections, and extent, so that a compound view is possible. It is a feature where one can visualize the place with various layers of themes such as type of soil, agriculture product distribution, zonification, and other related items.

The RMO adheres only on using raster images that contain rows and columns of pixels (tiny colored dots that made-up an image or picture). Sources of raster map can be taken from Google Map, Google Earth, digitized maps sold by the Department of Environment and Natural Resources, vector maps made from AutoCAD can still be used as long as possible though must already be converted into raster file format. Raster maps can be edited to suit its theme using image editing software application.

The SPEE stores, retrieves, and arranges these layers of raster images relative to the municipality and date of entry. The VegeGIS supports vector maps that enable to view AutoCAD map files. Vector map contains map that can show vegetable and crop farms drawn from its GPS decimal coordinates. It will show precise and accurate locations of the different farms in the province of Benguet.

The VCIS is one which manages the database of spatial data. It conglomerates the spatial data into groups or clusters of information such as production, soil, fertilizer, seed, pest, and meta-data. It purveys an opulent rationality in the vegetable and crop production that delivers answers on queries. The SPEE stores and retrieves this valuable information per municipality, agricultural product, and entry date. The 2D Vector Plot Map (2DVPM) is the mapping of farms that produces vegetables and crops which are taken from the VCIS database. It pinpoints the different places where plantations are located on the map. The user can manually estimate and plot the location of the farm based on its GPS Latitude and Longitude coordinates read from a GPS receiver device. However, using the Google Plot Map will automatically and precisely plot all the farm locations on a geo-referenced map. The Real-Time GPS Tracking serves in transferring the GPS coordinates from connected GPS receiver to the computer every 2 seconds and at the same time shows the current location on a map.

With the advent of GIS, a wide range of spatial analysis methods has been developed for carrying out data transformations between different spatial structures. These methods help to present the data in a more meaningful and consistent manner and enable different data sets, based on different geographic units, to be brought together and overlaid (PILZ, 2009).

Spatial Data Analysis is the quintessence design and feature of VegeGIS for one can understand the description of attribute data linked to map. It has 3 components like Descriptive Statistics, Factor Analyses, and 3D Contour Data Visualization. According to Triola(2002), when working with large data sets, it is generally helpful to organize and summarize the data by constructing a frequency table.

Samples of summary of the yearly vegetable and crop productions, frequency table, and histogram chart are shown in Figure 3. In addition, the computations for the average and standard deviation based from the frequency table are part of the summary as illustrated in Figures 4 and 5.

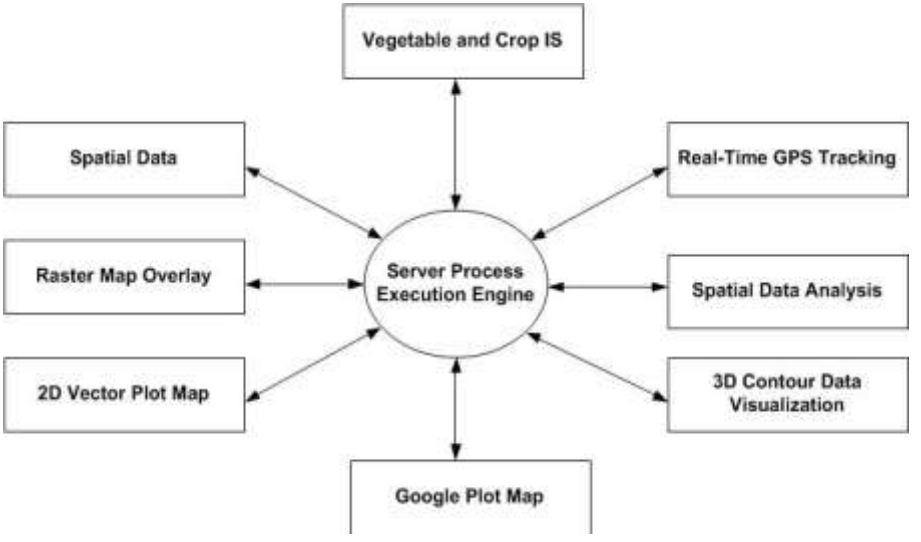


Fig. 2.VegeGIS Architecture Model

Fig. 3. Frequency Tables and Histogram Charts

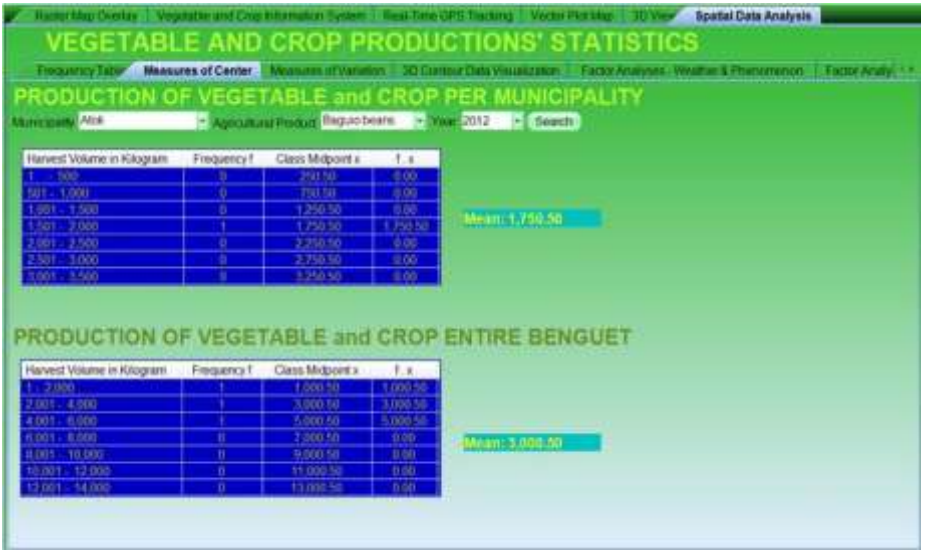


Fig. 4. Mean

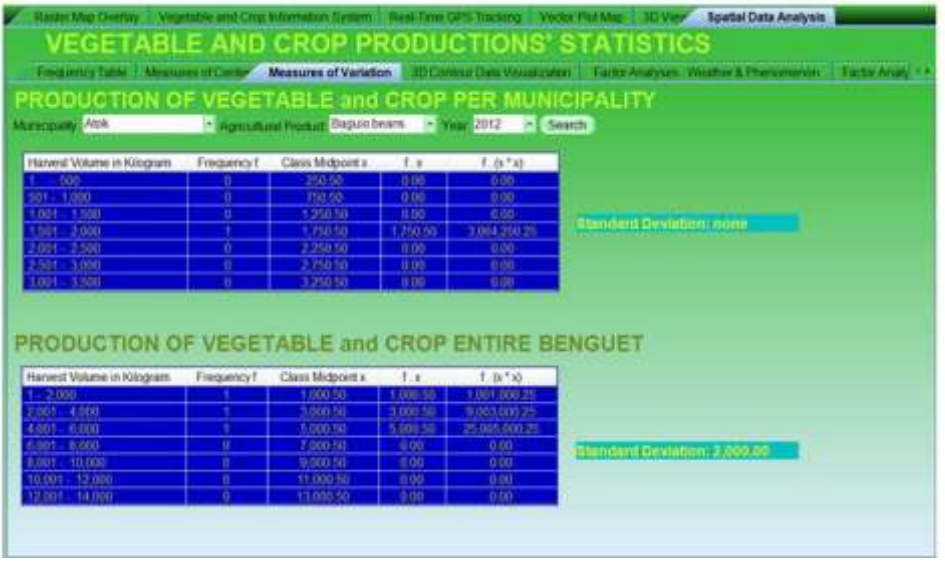


Fig. 5. Standard Deviation

According to Mcknight and Hess (2008), one of the most widespread devices for portraying the spatial distribution of some phenomenon is the isoline (from the Greek isos, "equal"), which is also called by a variety of related terms such as isarithm, isogram, isopleth, and isometric line, all of whichcan be considered as synonymous and used interchangeably. The word isoline is a generic term that refers to any line that joins points of equal value of something. Some isolines represent tangible surfaces, such as the elevation contour lines on a topographic map. Most, however, signify such tangible features as temperature and precipitation, and some express relative values like ratios or proportions.

The 3D Contour Data Visualization of VegeGIS projects, transforms, and renders the GPS locations along its volume of harvest of farm locations in 3D isoline view. The GPS longitude represents the x-axis and latitude represents the y-axis. The volume of harvest renders as the z-axis sample shown in Figure 6. Its purpose is to show how high and low the volume of harvest in its location. As stated by Spence (2001), the potential values of visualization are gaining insight and understanding. On the other hand, Chang (2002) used the term geographic visualization to describe the use of maps for setting up a context for visual information processing, which can then lead to formulation of research questions or hypotheses.

Fig. 6. 3D Contour Data Visualization

The Factor Analysis (FA) is independent variable that affects the dependent variable, volume of harvest. The independent variables comprise weather, temperature and humidity, seed, soil, fertilizer, pest, and agricultural land area. The FA compute the frequency, average, and total of the various factors that contribute to the yearly quantity of harvest sample (Figure 7).

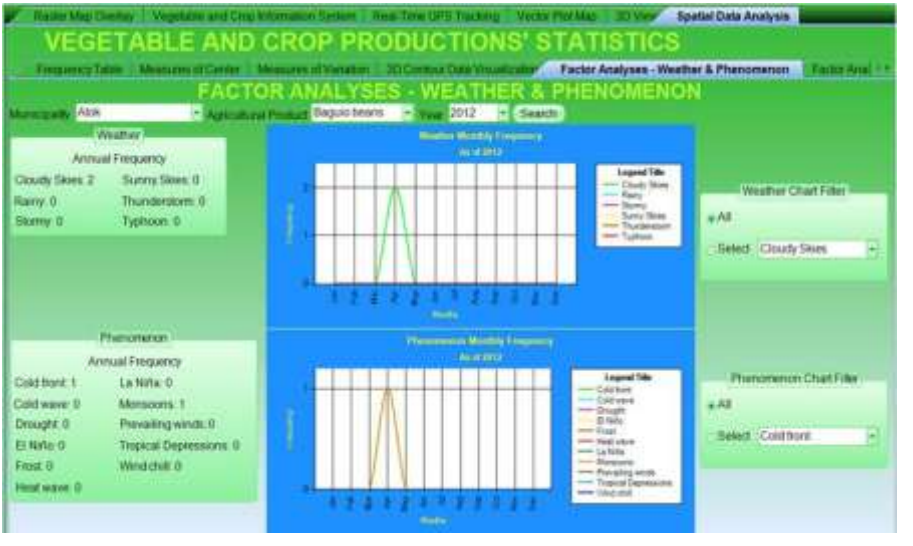


Fig. 7. Factor Analyses

UML Collaboration Diagram

The building and construction of VegeGIS were collaborative efforts of applying Object-Oriented Analysis and Programming. According to Jacobson et al. (1992), Object-Oriented Analysis can be characterized as iteration between analyzing the behavior and information of the system. It contains the following activities: finding, organizing, and describing how the objects interact; defining the operations of the object, and defining the objects internally. Moreover, Muller (1997) defined Unified Modelling Language (UML) as a standard notation for modeling object-oriented language applications. UML Collaboration Diagram illustrates interactions between objects using a static spatial structure that facilitates the illustration of the collaboration of a group of objects.

Based on the conceptual framework model of VegeGIS, the identified objects with their interactions to other objects are illustrated in Figure 8. The system becomes the repository of information about the vegetable and crop products and at the same time the server that collects and sends pertinent messages to other objects that becomes the Information System, which collects, transforms, and disseminates information. This diagram is the foundation of object-oriented programming for the creation of VegeGIS software tool.

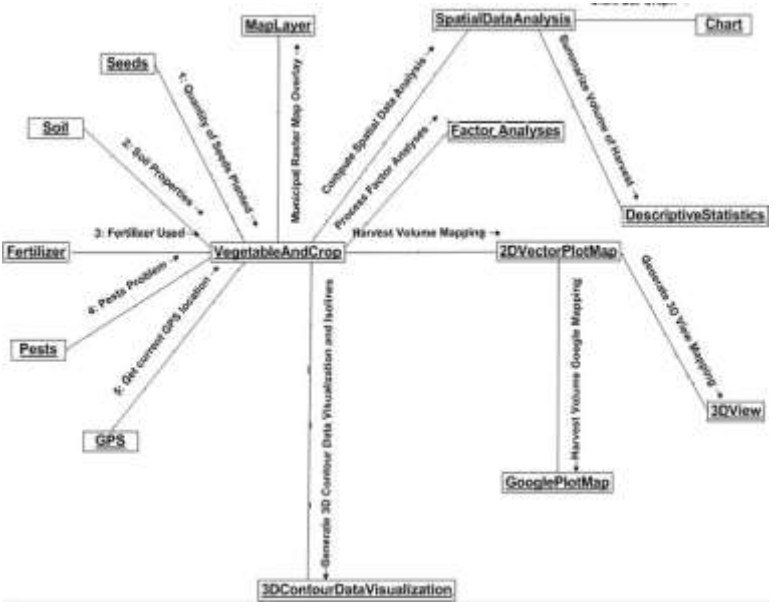


Fig. 8. UML Collaboration Diagram

Technologies Implemented

The building materials used for constructing VegeGIS software were acquired from readily available conventional technologies as follows:

1. C#.Net
2. ADO.Net
3. MySQL
4. MS Chart
5. Crystal Reports
6. OpenGL
7. GPS
8. Google Map
9. MS HTML Help Workshop
10. 3D Contour Data Visualization
11. GPSClientGate Express
12. Dot Net Bar
13. DWG True View 2013
14. Garmin GPSMap 62S
15. Globe Mobile Tattoo Flash Sonic 3G
16. Computer

Most of these materials are softwares that comprise environment framework, compiler, database engine, libraries, GUI, device driver, help builder, report generator, map API, chart, 3D engine, and hardwares such as computer, GPS receiver, and mobile internet. Figure 9 shows the mobile computing setup of VegeGIS.

RESULTS AND DISCUSSION

From conceptual framework, software architecture, UML collaboration diagram to implementation, the following content operations of VegeGIS are the results of software development, the features of which are described in the following paragraphs.

Fig. 9.VegeGIS setup

Spatial-Temporal Raster Map Overlay

The purpose of this feature is to provide compound view for the user to visualize farm locations that are associated by subject or theme. The first thing to do to apply this feature is to plan what subject or theme pertinent on place, time, and event. Secondly, gather raster images that contain maps, outlines, and or drawings make a uniform resolution (width and height measured in pixels) and recommended to all raster images but some may be larger or smaller provided the arrangements are done properly.

These raster images are to be stacked or layered (arranged one on top of each other). Some images to be stacked must be improved using image editing software. The imagemay contain opaque and transparent pixels. Transparent pixels will be hidden whereas opaque pixels are visible. The hidden transparent pixels will surface beneath layer image when overlapped.

AutoCAD Map File

This feature will open and view AutoCAD map file. Computer Aided-Design (CAD) is adrafting software that provides computation of precise dimensions in the product design.The CAD file contains vector

graphics, a method of creating pictures on a computer by telling it to draw lines in particular positions.An advantage of vector graphics is that picture can be enlarged or reduced without loss of sharpness, since the picture is not made of a fixed number of pixels. Thus, vector graphics is more precise than raster graphics which is made up of pixels. The locations of certain vegetable farms can be plotted with its GPS decimal coordinates in the map accurately.

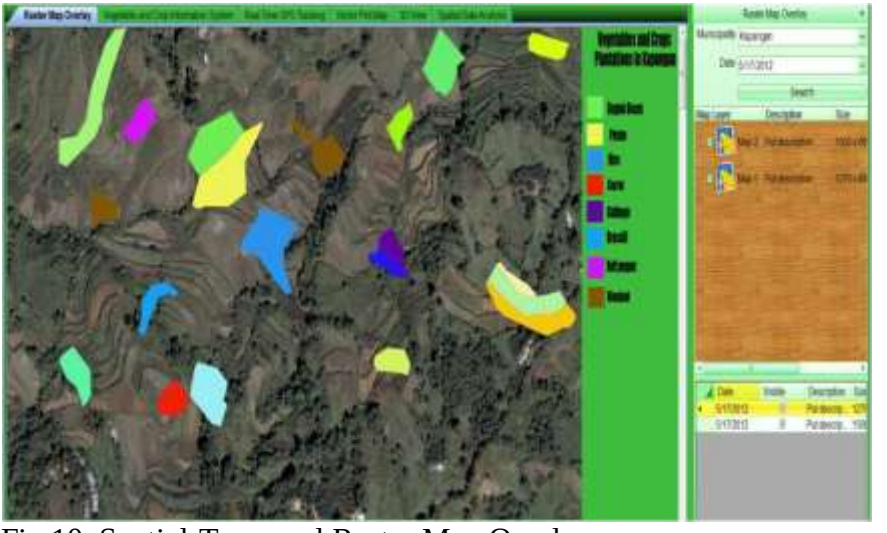


Fig.10. Spatial-Temporal Raster Map Overlay

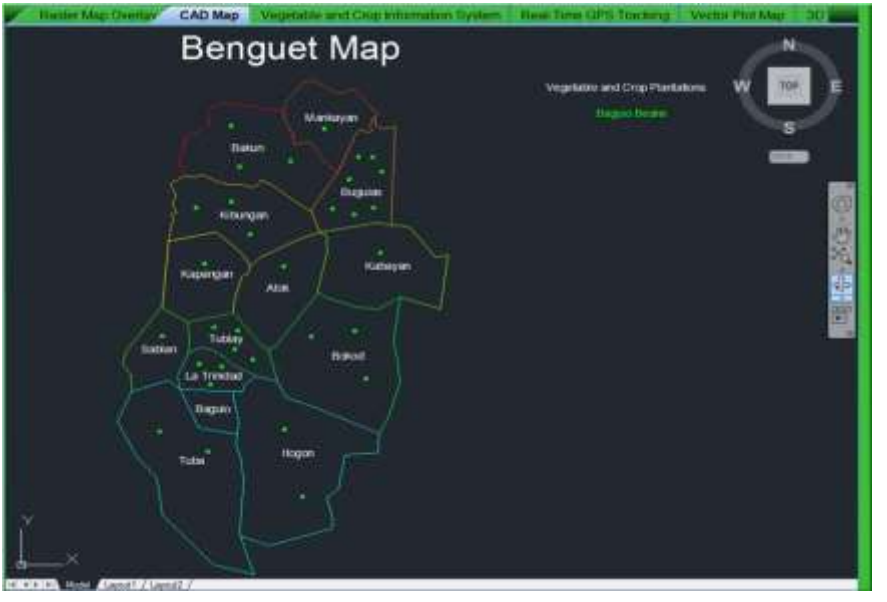


Fig. 11.AutoCAD Map File

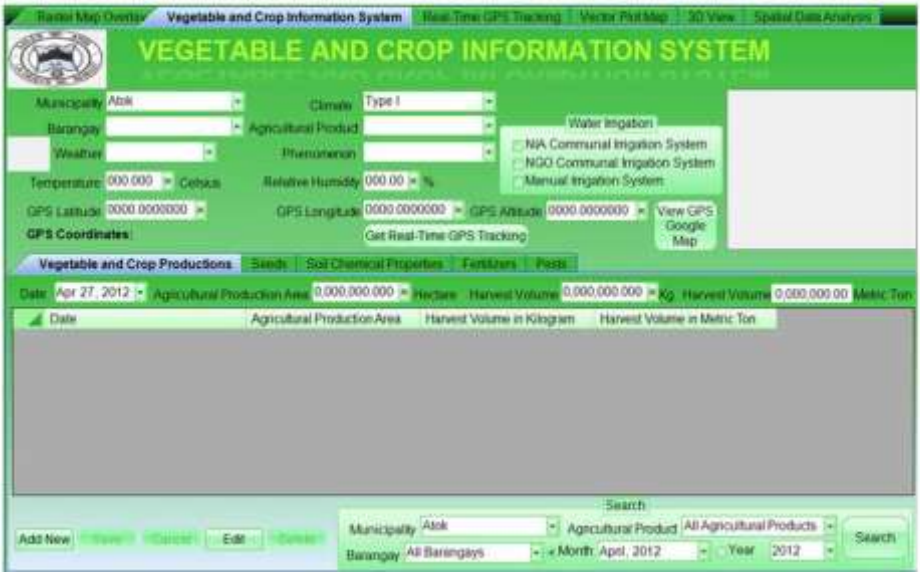


Fig.12. Vegetable and Crop Information System

Vegetable and Crop Information System

This feature is the intellectual mind of VegeGIS for it is the source and basis of procuring judgment, decision, and assessment. A comprehensive and reliable data on production, soil, seed, fertilizer, pest, physical geography, weather, temperature, and GPS must be gathered and collected. To implement, one simply fill-ups the necessary information and store into the database.

GPS Google Map

The GPS coordinates obtained from GPS receiver can show its linked geo-referenced map view that can be captured via Internet connection and courtesy of Google.

Real-Time GPS Tracking

This item is a supplementary feature that transfers the GPS coordinates' reading from the receiver to the computer and at the same time shows where in the map the current GPS location is in real-time. It keeps track the current location of the GPS receiver and the user. Mobile computing is possible to set up and work anywhere as long as there is enough power battery for laptop computer, GPS receiver, wireless Internet connection, and GPS signal.

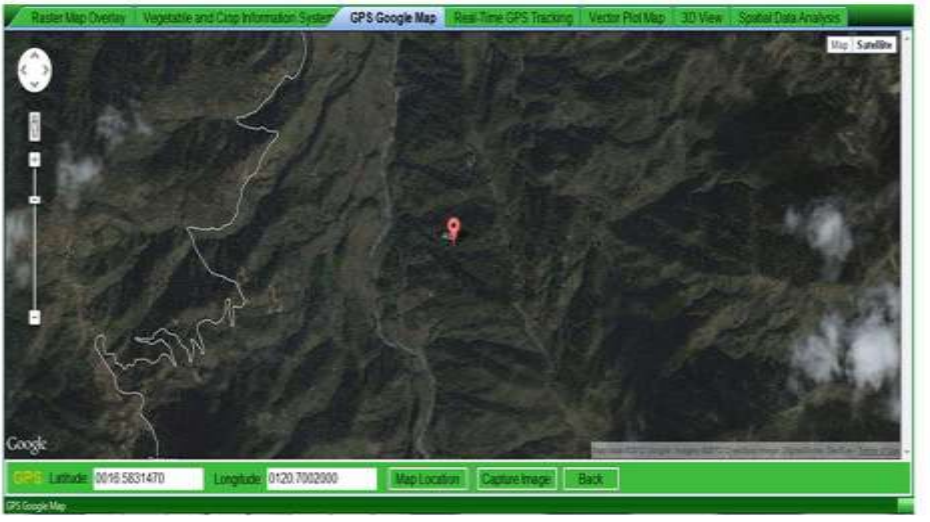


Fig. 13. GPS Google Map

Vector Plot Map

Identifying the different places in Benguet that propagate various vegetables and crops will instigate various government institutions for subsidy, aid, support to local government, and most especially the farmers to progress the agriculture economy at present and into the future. Mapping the farm locations brings statistical analyses that give answers to problems.

Fig. 14. Real-Time GPS Tracking

Fig. 15. Vector Plot Map

Google Plot Map

This feature is an automatic and precise plotting of farm locations on a georeference map using Google's satellite imagery and based on its GPS coordinates.

Fig. 16. Google Plot Map

3D View

This item is an extend feature that displays a transformed 2D Vector Plot Map into 3D perspective view. Things around us are mostly seen in 3D space rather than flat giving more depth of understanding and rationalizing.

Fig. 17. 3D View

Spatial Data Analysis

The purpose of VegeGIS is to examine the relationships between vegetable and crop Information System collectively and to use the relationships to describe the real-world phenomena that the map view represents.

- Frequency table.This item infers how low and high the supply of agriculture products. It manifests the yearly harvest volume distribution of vegetables and crops per municipality and entire province.
- Measures of center. It summarizes the data set by computing the middle value. This shows the yearly average of harvest volume of vegetables and crops per municipality and entire province.
- Measures of variation.This tool measures the degree to which the harvest volumes in the data set are spread out and to know as well if the degree is close to the mean or average or far away from the mean. Further, it shows the variation of values about the yearly average of harvest volume of vegetables and crops per municipality and entire province.

Fig. 18. Frequency Table

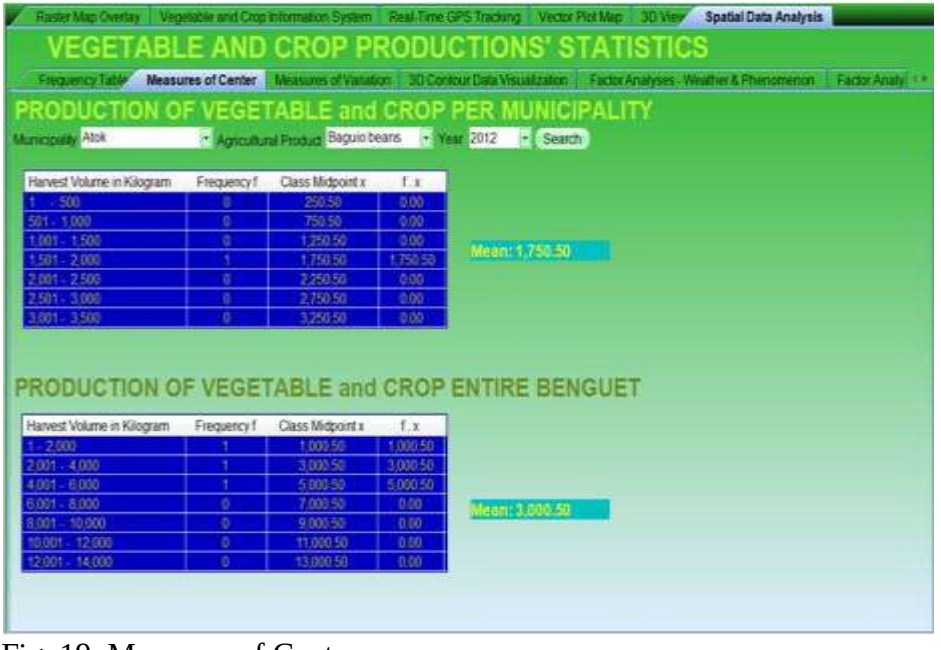


Fig. 19. Measures of Center

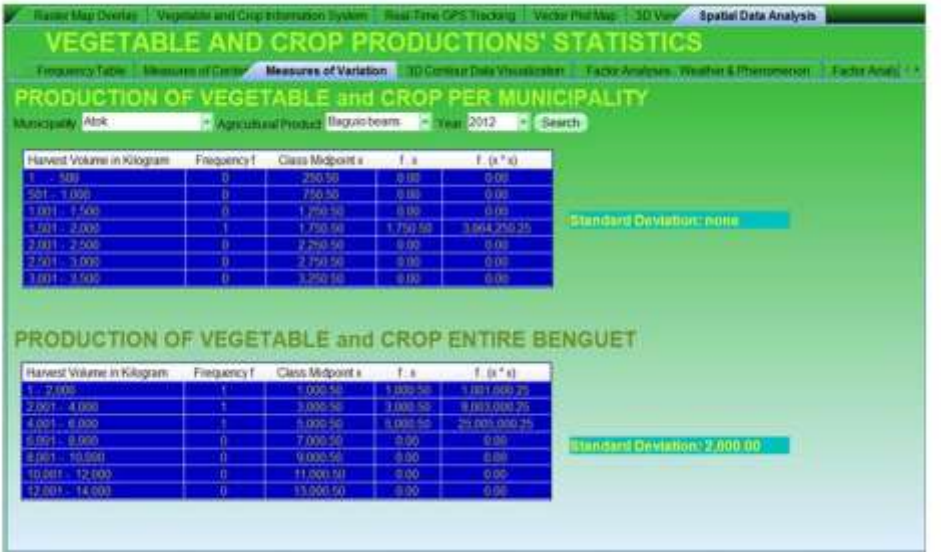


Fig.20. Measures of Variation

- Contour data visualization.This item provides visualization aspect between the GPS coordinates(x-y axes) location of farms and its harvest volume (z-axis) with isolines and contours. It yields additional perspective view to the user for deeper understanding and analyses.

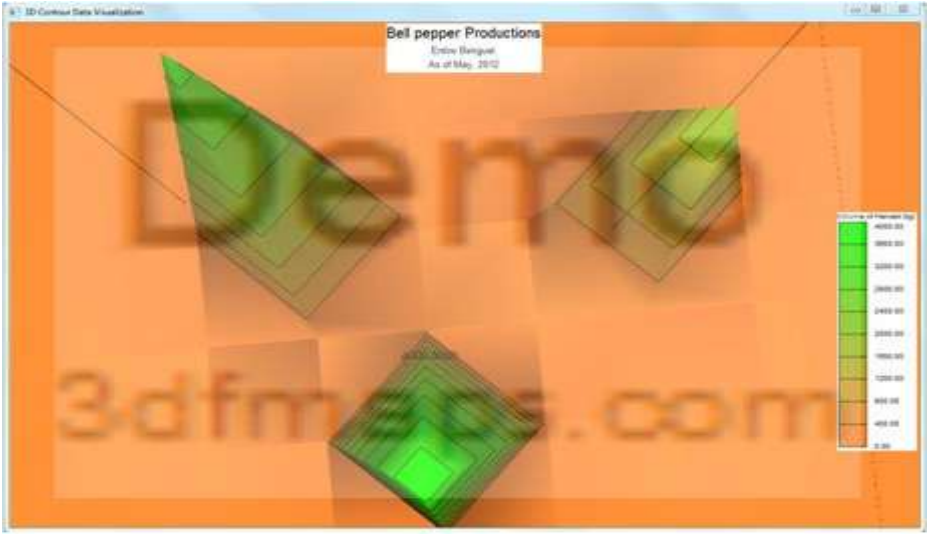


Figure 21. 3D Contour Data Visualization

Factor analyses.These tools evaluate the radical causality of the vegetable and crop production such quantity and quality of harvest, cost of product, agricultural problems etc. It assesses the monthly and yearly frequencies and average values of factors that cause, affect, contribute the quantity of harvest.

Weather and phenomenon.This instrument computes the monthly and yearly total frequency counts between weather and phenomenon on selected municipality and agricultural product.

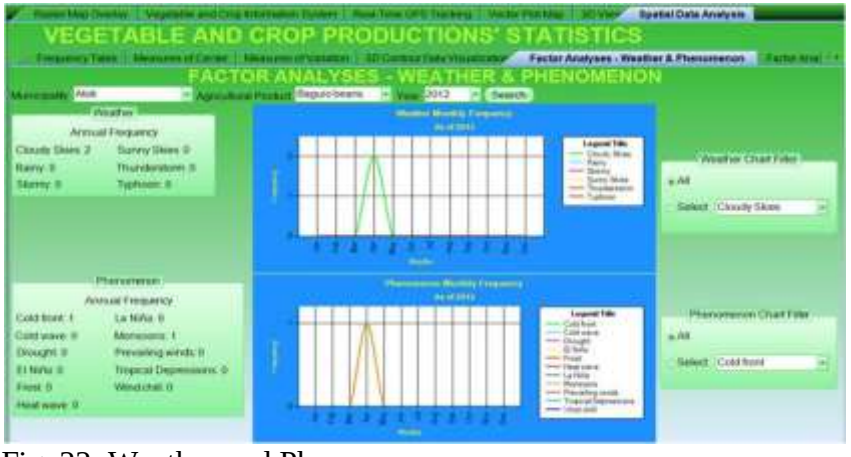


Fig. 22. Weather and Phenomenon

Temperature. The gadget computes the monthly and yearly average between temperature and relative humidity on selected municipality and agricultural product.

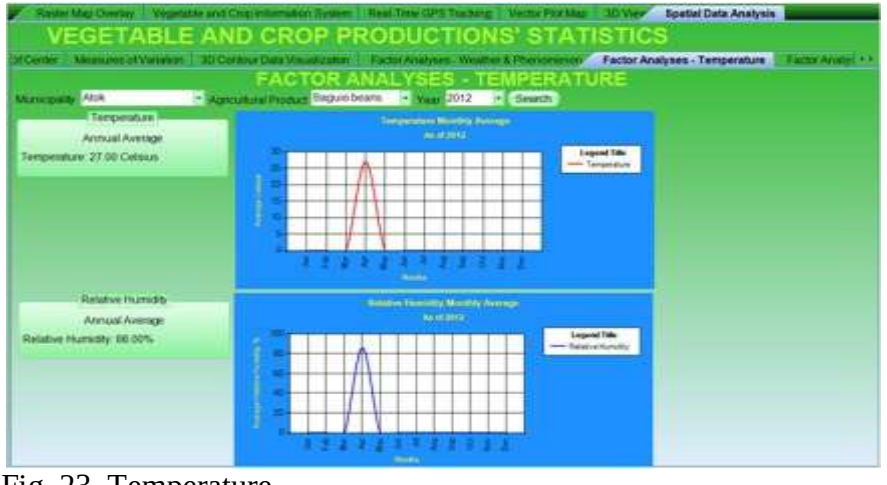


Fig. 23. Temperature

- Seeds and soil. The toolcomputes the monthly and yearly average between seed and soil chemical properties on selected municipality and agricultural product.

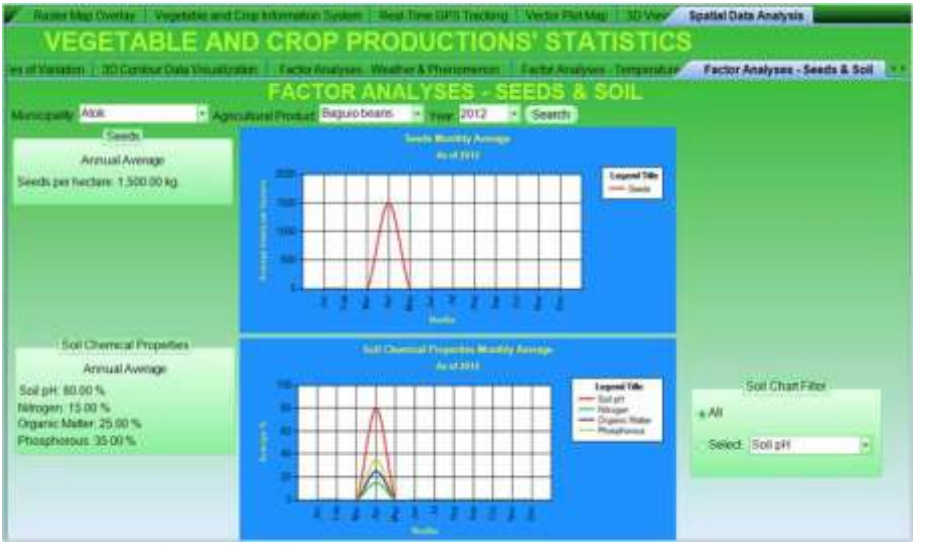


Fig. 24. Seeds and Soil

- Fertilizers and pests. The tool computes the monthly and yearly average between fertilizer and relative pest on selected municipalities and agricultural products.

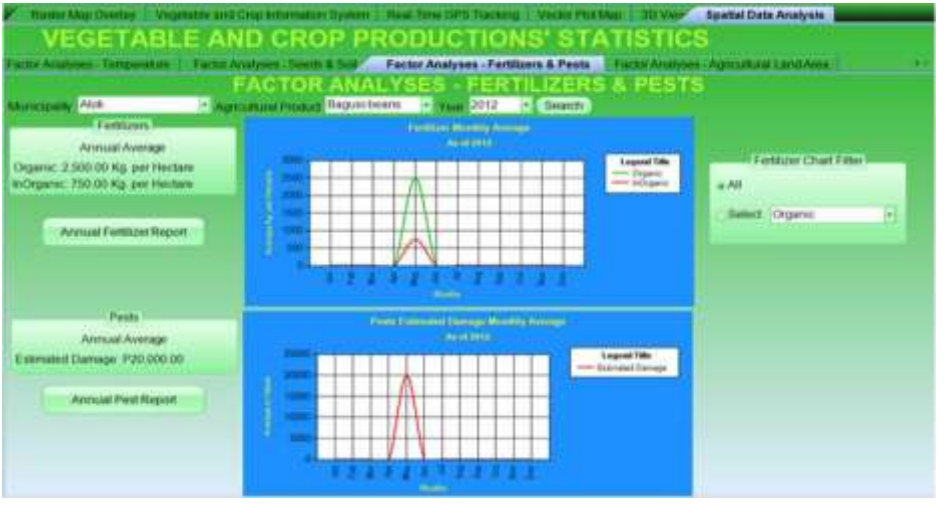


Fig. 25. Fertilizers and Pests

- Agricultural land area. It computes the total agricultural land area of a municipality and entire province on selectedagricultural products.

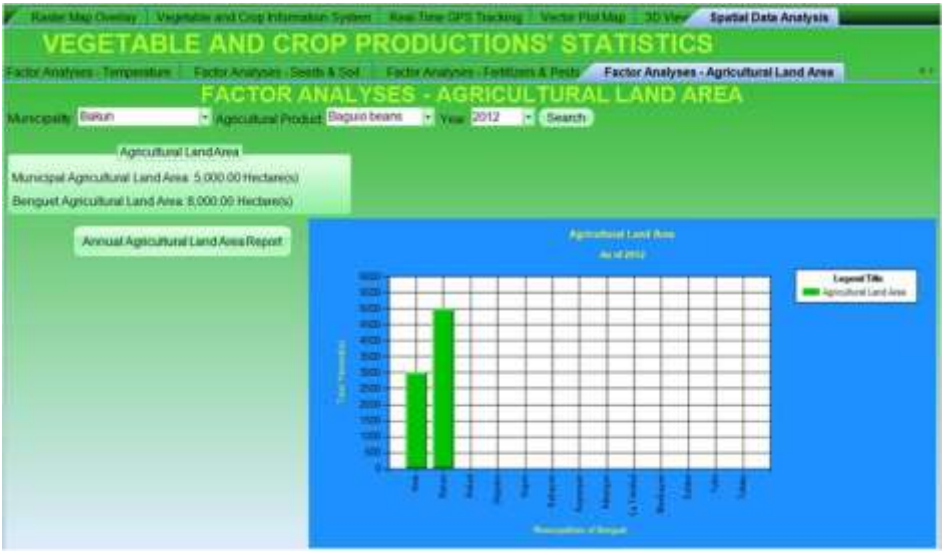


Fig. 26. Agricultural Land Area

- Report. This furnishes printed copy of annual reports for ad hoc public information dissemination and immediate actions.Such areas are:

1. *Benguet vegetable and crop production report.* It prints annual volume of harvest on selected agricultural product and all municipalities and barangays.

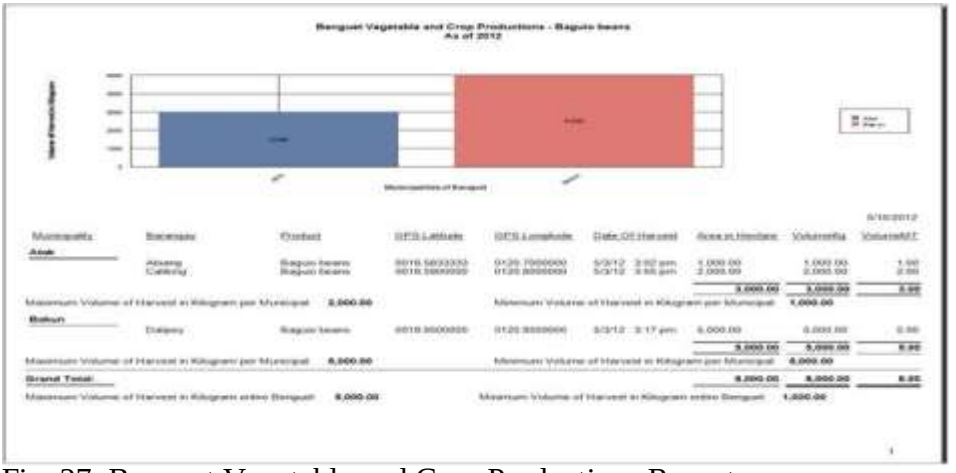


Fig. 27. Benguet Vegetable and Crop Productions Report

2. *Weather report.* It prints annual weather occurrences on selected agricultural product and all municipalities and barangays.

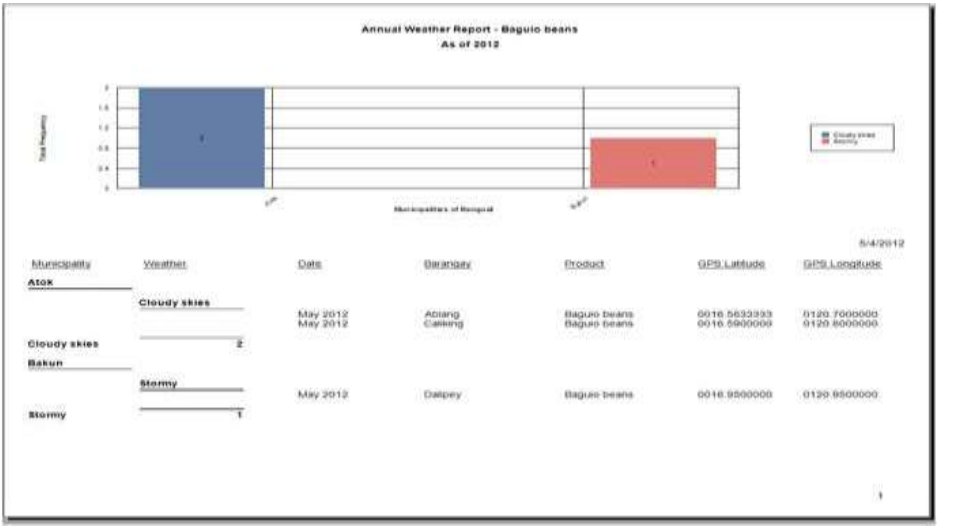


Fig. 28. Weather Report

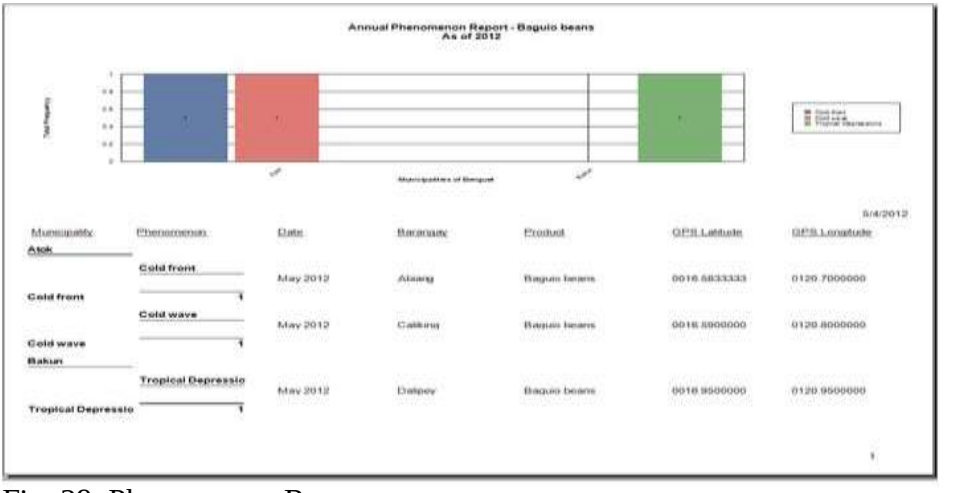


Fig. 29. Phenomenon Report

3. *Phenomenon report.* It prints annual phenomena occurrences on selected agricultural product and all municipalities and barangays.

4. *Temperature report.* It prints annual temperature measures on selected agricultural product and all municipalities and barangays.

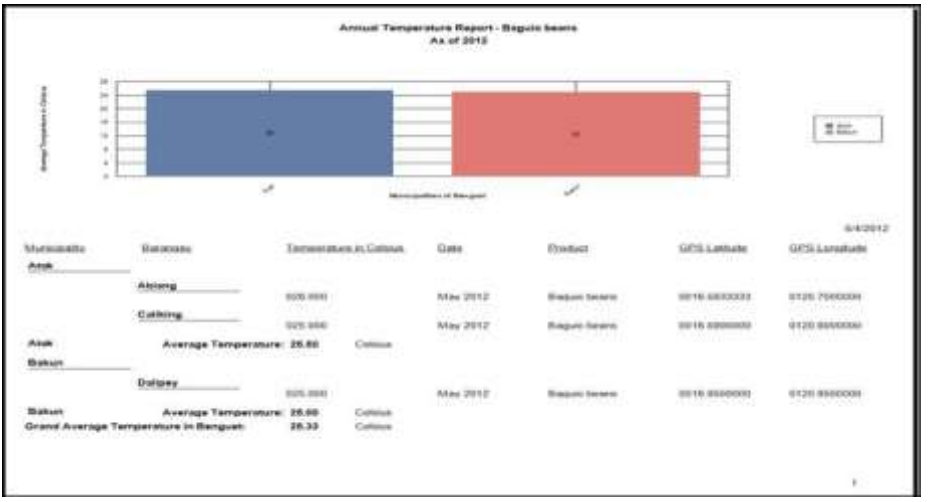
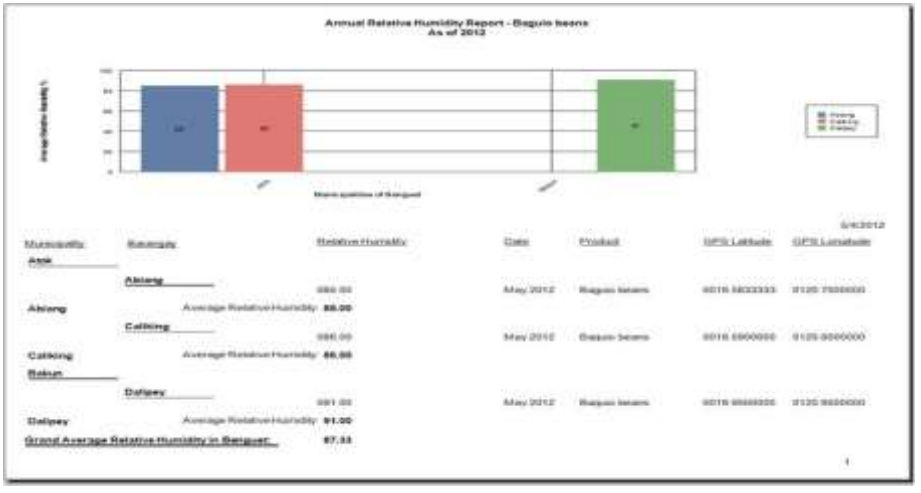


Fig.30. Temperature Report

5. *Relative humidity report.* It prints annual relative humidity measures on selected agricultural product and all municipalities and barangays.



6. *Seeds report.* It prints annual quantity of seeds planted on selected agricultural product and all municipalities and barangays.

7. *Soil report.* It prints annual soil chemical properties on selected agricultural product and all municipalities and barangaays.

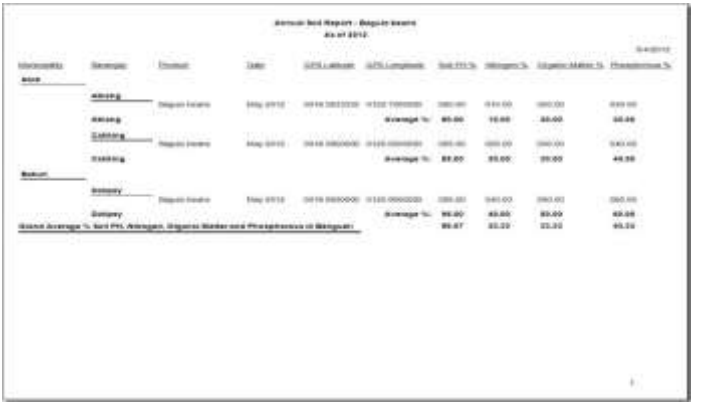
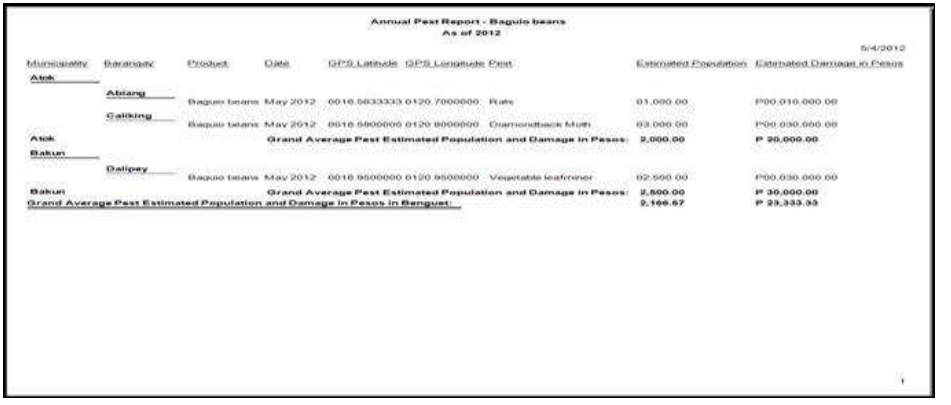


Fig. 33. Soil Report

8. *Fertilizer report.* It prints annual fertilizer usage on selected agricultural product and all municipalities and barangays.

Fig. 34. Fertilizer Report

9. *Pest report.* It prints annual pest problems on selected agricultural product and all municipalities and barangays.



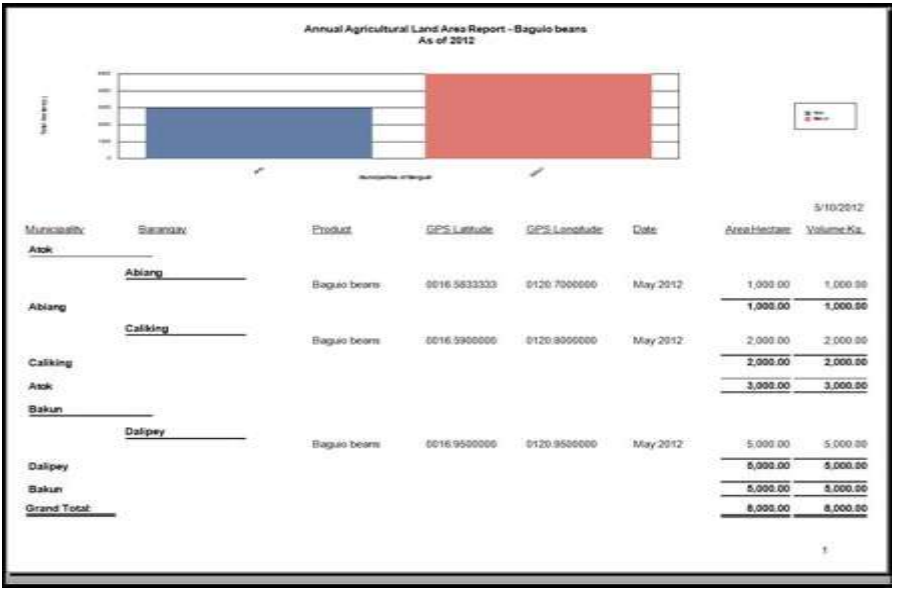
Annual Pest Report - Baguio beans
As of 2012

5/4/2012

Municipality	Barangay	Product	Date	GPS Latitude	GPS Longitude	Pest	Estimated Population	Estimated Damage in Pesos
Atok								
	Abiang	Baguio beans	May 2012	0016.5833333	0120.7000000	Rats	01,000.00	P00,010,000.00
	Caliking	Baguio beans	May 2012	0016.5900000	0120.8000000	Diamondback Moth	03,000.00	P00,030,000.00
Atok				Grand Average Pest Estimated Population and Damage in Pesos:			2,000.00	P 20,000.00
Bakun								
	Dalipey	Baguio beans	May 2012	0016.9500000	0120.9500000	Vegetable leafminer	02,500.00	P00,030,000.00
Bakun				Grand Average Pest Estimated Population and Damage in Pesos:			2,500.00	P 30,000.00
Grand Average Pest Estimated Population and Damage in Pesos in Benguet:							2,166.67	P 23,333.33

Fig. 35. Pest Report

10. *Agricultural land area report.* It prints annual measured agricultural land area plantation on selected agricultural product and all municipalities and barangays.



Annual Agricultural Land Area Report - Baguio beans
As of 2012

5/10/2012

Municipality	Barangay	Product	GPS Latitude	GPS Longitude	Date	Area Hectare	Volume Kg.
Atok							
	Abiang	Baguio beans	0016.5833333	0120.7000000	May 2012	1,000.00	1,000.00
Abiang						1,000.00	1,000.00
	Caliking	Baguio beans	0016.5900000	0120.8000000	May 2012	2,000.00	2,000.00
Caliking						2,000.00	2,000.00
Atok						3,000.00	3,000.00
Bakun							
	Dalipey	Baguio beans	0016.9500000	0120.9500000	May 2012	5,000.00	5,000.00
Dalipey						5,000.00	5,000.00
Bakun						5,000.00	5,000.00
Grand Total:						8,000.00	8,000.00

36. Agricultural Land Area Report

User Account and Maintenance

This item establishes legal authorization of users for security and reliability of information at hand. It manages the preservation, safeguarding, and renewal of computer data.

Fig. 37. User Account Databases

Fig. 38.Maintenance - Backup and Restore Databases

GPS Conversions

The VegeGIS abides decimal format for the GPS coordinates and offers conversion from other format.

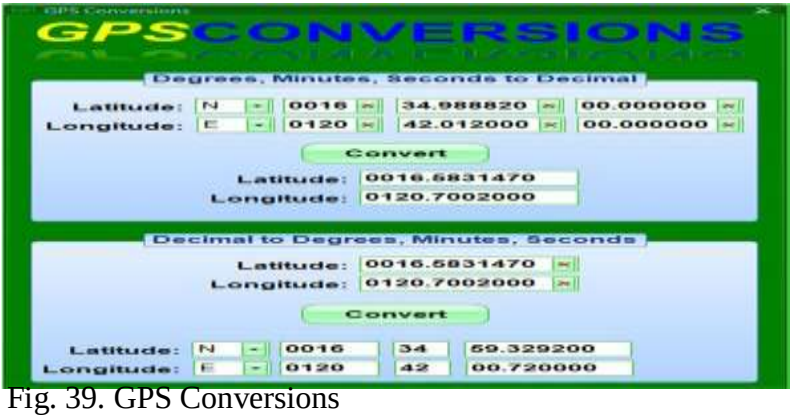


Fig. 39. GPS Conversions

SUMMARY AND AND CONCLUSIONS

The design and development of GIS software application as a tool has propensity contribution for decision-support system to authorities. The unified structures of vegetable and crop productions, soils, seeds, fertilizers, pests, maps, and GPS forming into an Information System provide the necessary extrapolation for obtaining solutions. The features of VegeGIS such as Spatial-Temporal Raster Map Overlay, AutoCAD Map File, Vegetable and Crop Information System, GPS Google Map, Real-Time GPS Tracking, Vector Plot Map, Google Plot Map, 3D View, Spatial Data Analysis, Reports, User Account, and Maintenance are adequate and suitable in achieving goals of this IT Research Project. This will serve as a catalyst for future standards in model and architecture of building customary GIS software applications. The necessity of adopting VegeGIS as one technological tool in monitoring, managing, and improving our agriculture economy will keep us away from problems such as food crisis, food sustainability, food maintenance, food security, seed, soil, fertilizer, pest, agricultural land area, temperature, humidity, and weather at present and into the future.

RECOMMENDATIONS

The patronage of deploying the VegeGIS software tool to the Department of Agriculture and other local institutions concerned for software testing and implementation is highly endorsed.

The designation of agriculture field inspectors per municipality who are responsible in gathering and collecting raw data for the information system of VegeGIS is recommended.

Procuring IT equipment such as computers, GPS receivers, Internet connection, and other materials to the agency advocating this IT Research Project must be fulfilled to utilize effectively the VegeGIS software tool.

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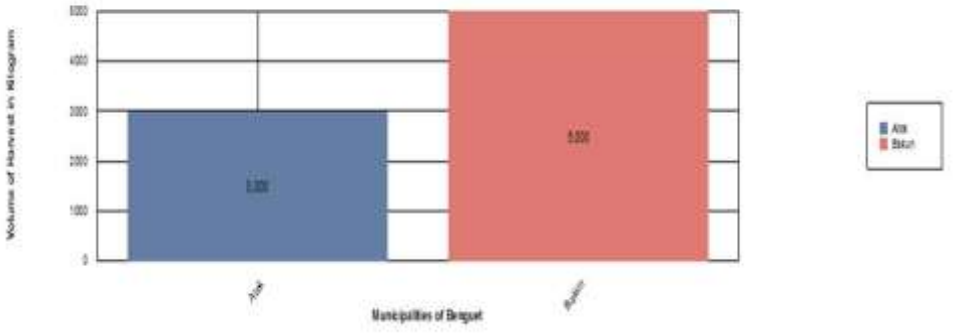
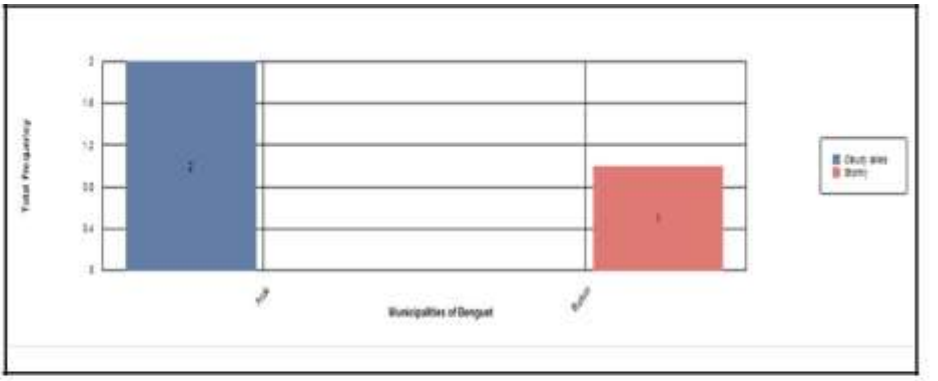
APPENDIX

Vege GIS Sample Generation of Reports



Municipality	Barangay	Product	GPSLatitude	GPSLongitude	DateOfHarvest	AreaInHectare	VolumeKg	VolumeMT
Atok								
	Abiang	Baguiobeans	0016.5833333	0120.7000000	5/3/12 3:02pm	1,000.00	1,000.00	1.00
	Calking	Baguiobeans	0016.5900000	0120.8000000	5/3/12 3:05pm	2,000.00	2,000.00	2.00
						3,000.00	3,000.00	3.00
Max. Volume of Harvest (kg/Municipality):		2,000.00		Min. Volume of Harvest (kg/Municipality):			1,000.00	
Bakun								
	Daliped	Baguiobeans	0016.9500000	0120.9500000	5/3/12 3:17pm	5,000.00	5,000.00	5.00
						5,000.00	5,000.00	5.00
Max. Volume of Harvest (kg/Municipality):		5,000.00		Min. Volume of Harvest (kg/Municipality):			5,000.00	
GRAND TOTAL:						8,000.00	8,000.00	8.00
MAXIMUM VOLUME:		5,000.00		MINIMUM VOLUME:			1,000.00	

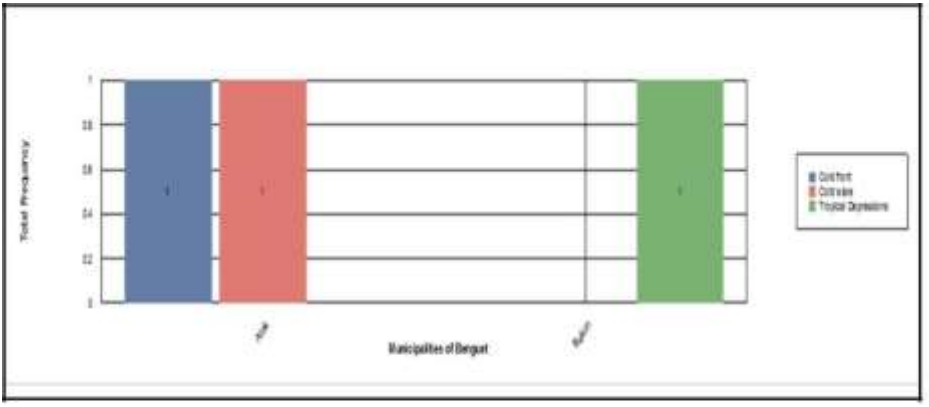
B. Annual WeatherReport-BaguioBeans (2012)



5/24/2012

Municipality	Weather	Date	Barangay	Product	GPSLatitude	GPSLongitude
Atok						
	Cloudyskies					
		May2012	Abiang	Baguiobeans	0016.5833333	0120.7000000
		May2012	Calking	Baguiobeans	0016.5900000	0120.8000000
Cloudyskies	2					
Bakun						
	Stormy					
		May2012	Dalipey	Baguiobeans	0016.9500000	0120.9500000
Stormy	1					

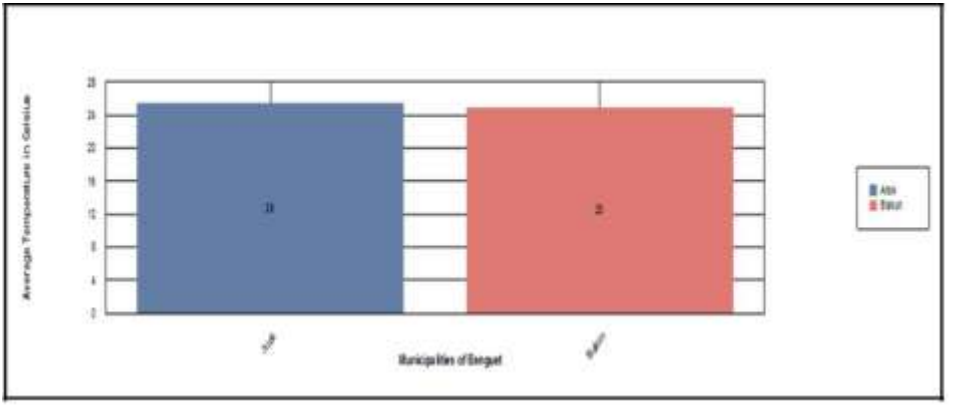
C. Annual Phenomenon Report - Baguio Beans, 2012



5/24/2012

Municipality	Phenomenon	Date	Barangay	Product	GPS Latitude	GPS Longitude
Atok						
	Cold front	May 2012	Abiang	Baguio beans	8016.5833333	0126.7833000
Cold front	1					
	Cold wave	May 2012	Calkiring	Baguio beans	8016.5500000	0126.0000000
Cold wave	1					
Bakun						
	Tropical	May 2012	Dalipey	Baguio beans	8016.9500000	0126.9500000
Tropical	1					

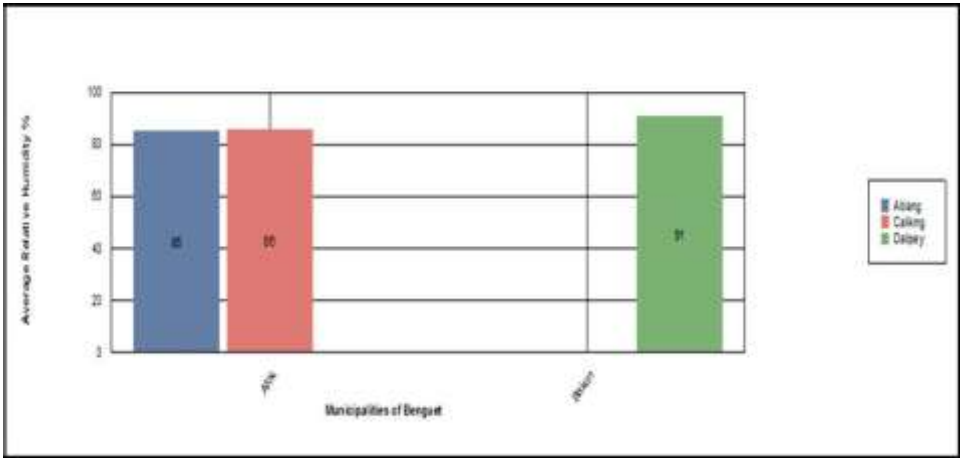
D. Annual Temperature Report - Baguio Beans, 2012



5/24/2012

Municipality	Barangay	Temperature in Celsius		Date	Product	GPS Latitude	GPS Longitude
Atok							
	Abiang	026.000		May 2012	Baguio beans	0016.983333	0120.700000
	Calikiing	025.000		May 2012	Baguio beans	0016.990000	0120.800000
Atok	Average Temperature:	25.50	Celcius				
Bakun							
	Dalipey	025.000		May 2012	Baguio beans	0016.950000	0120.550000
Bakun	Average Temperature:	25.00	Celcius				
GRAND AVERAGE:		25.33	Celcius				

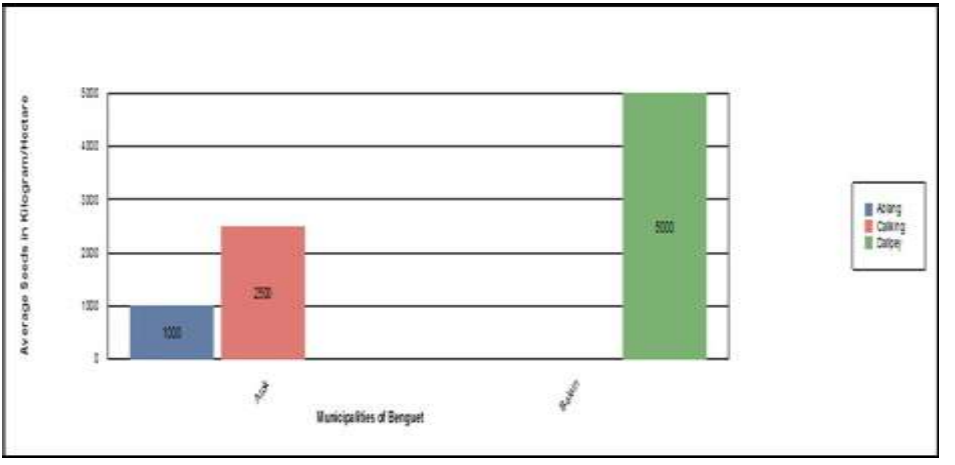
E. Annual Relative Humidity Report - Baguio Beans, 2012



5/24/2012

Municipality	Barangay	Relative Humidity	Date	Product	GPS Latitude	GPS Longitude
Atok						
	Abiang	085.00	May 2012	Baguio beans	0016.5833333	0120.7000000
Abiang	Average Relative Humidity: 85.00					
	Calking	086.00	May 2012	Baguio beans	0016.5800000	0120.8000000
Calking	Average Relative Humidity: 86.00					
Bakun						
	Delipey	091.00	May 2012	Baguio beans	0016.9500000	0120.9500000
Delipey	Average Relative Humidity: 91.00					
GRAND AVERAGE (%):		87.33				

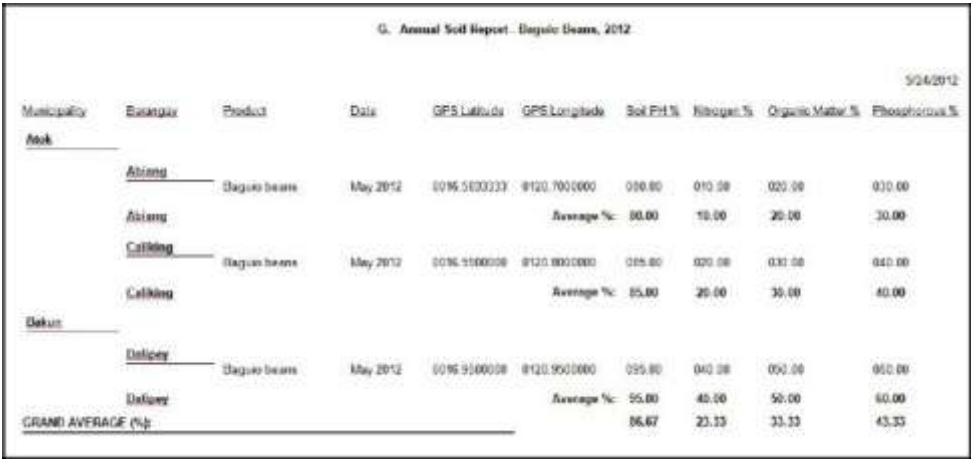
F. Annual Seeds Report - Baguio Beans, 2012



5/24/2012

Municipality	Barangay	Total Seeds (kg/ha)	Date	Product	GPS Latitude	GPS Longitude
AtoA						
Abiang		01,800.00	May 2012	Baguio beans	0016.5833333	0120.7000000
Abiang	Average Total Seeds in (kg/ha):	1,800.00				
Caliking		02,500.00	May 2012	Baguio beans	0016.5000000	0120.0000000
Caliking	Average Total Seeds (kg/ha):	2,500.00				
Bakun						
Daligey		05,800.00	May 2012	Baguio beans	0016.9000000	0120.9500000
Daligey	Average Total Seeds (kg/ha):	5,000.00				
GRAND AVERAGE:		2,833.33				

G. Annual Soil Report - Baguio Beans, 2012



G. Annual Soil Report - Baguio Beans, 2012

5/24/2012

Municipality	Barangay	Product	Date	GPS Latitude	GPS Longitude	Soil PH %	Nitrogen %	Organic Matter %	Phosphorous %
Atok									
	Abiang	Baguio beans	May 2012	0016.5833333	0120.7000000	000.00	010.00	020.00	030.00
	Abiang				Average %:	00.00	10.00	20.00	30.00
	Calliking	Baguio beans	May 2012	0016.5000000	0120.8000000	005.00	020.00	030.00	040.00
	Calliking				Average %:	05.00	20.00	30.00	40.00
Bakun									
	Dalipey	Baguio beans	May 2012	0016.9500000	0120.9500000	095.00	040.00	050.00	060.00
	Dalipey				Average %:	95.00	40.00	50.00	60.00
GRAND AVERAGE (%):						66.67	23.33	33.33	43.33

H. Annual Fertilizer Report - Baguio Beans, 2012

H. Annual Fertilizer Report - Baguio Beans, 2012

5/24/2012

Municipality	Barangay	Product	GPS Latitude	GPS Longitude	Date	Organic Fertilizer Kg/Hectare	In Organic Fertilizer Kg/Hectare
Atok							
	Abiang	Baguio beans	0016.5833333	0120.7000000	May 2012	02,800.00	00,500.00
	Calliking	Baguio beans	0016.5000000	0120.8000000	May 2012	03,800.00	01,000.00
Atok				Sub-Average Kilogram/Hectare		2,500.00	750.00
Bakun							
	Dalipey	Baguio beans	0016.9500000	0120.9500000	May 2012	06,800.00	00,900.00
Bakun				Sub-Average Kilogram/Hectare		4,800.00	800.00
GRAND AVERAGE (PHP):						3,666.67	766.67

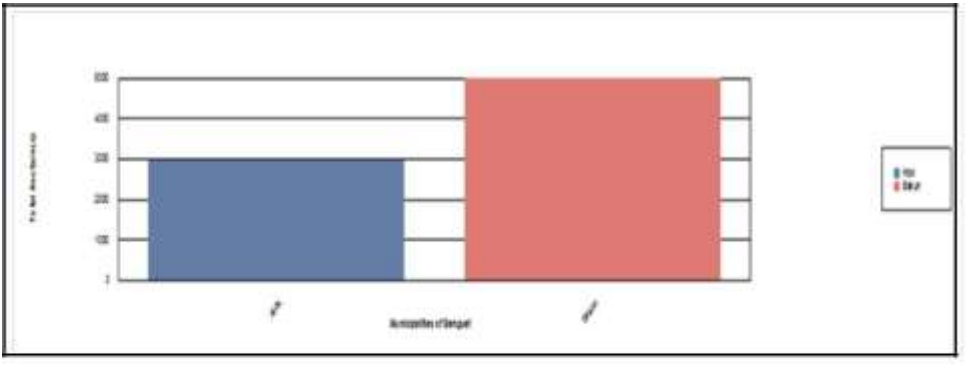
I. Annual Pest Report - Baguio Beans, 2012

I. Annual Pest Report - Baguio Beans, 2012

5/24/2012

Municipality	Barangay	Product	Date	GPS Latitude	GPS Longitude	Pest	Estimated Population	Estimated Damage in Pesos
Atok								
	Abiang							
		Baguio beans	May 2012	0816.5833333	0120.7500000	Rats	81,000.00	P90,000.00
	Calibiog							
		Baguio beans	May 2012	0816.9900000	0120.9500000	Diamondback Moth	83,000.00	P90,000.00
Atok		Sub- Average Pest Estimated Population and Damage in Pesos:					2,000.00	P20,000.00
Bakun								
	Dalipey							
		Baguio beans	May 2012	0816.9000000	0120.9500000	Vegetable leafminer	82,500.00	P90,000.00
Bakun		Sub- Average Pest Estimated Population and Damage in Pesos:					2,500.00	P30,000.00
GRAND AVERAGE (PHP):							2,166.67	P23,333.33

J. Annual Agricultural Land Area Report - Baguio Beans, 2012



5/24/2012

Municipality	Barangay	Product	GPS Latitude	GPS Longitude	Date	Area Hectares	Volume Kg.
Atok							
	Abiang						
		Baguio beans	0816.5833333	0120.7500000	May 2012	1,000.00	1,000.00
Abiang						1,000.00	1,000.00
	Calibiog						
		Baguio beans	0816.9900000	0120.9500000	May 2012	2,000.00	2,000.00
Calibiog						2,000.00	2,000.00
Atok						3,000.00	3,000.00
Bakun							
	Dalipey						
		Baguio beans	0816.9000000	0120.9500000	May 2012	5,000.00	5,000.00
Dalipey						5,000.00	5,000.00
Bakun						5,000.00	5,000.00
GRAND TOTAL (PHP):						8,000.00	8,000.00