Coffee zone updating: contribution to the Agricultural Sector

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Abstract

As a need, and in order to generate inputs for the Coffee Sector, the Costa Rica Coffee Institute, ICAFE, proposes and fosters a Costa Rica coffee coverage updating as a tool for planning and development in the area of research.

Therefore, it is of utmost importance to carry out a systematic approach with the six coffee Regions to update the nationwide coffee coverage, through Geographic Information Systems, GIS.

Keywords: GIS, Coffee, Agricultural, Costa Rica

1. Introduction

The Costa Rica Coffee Institute (ICAFE) poses, as a need, the coffee coverage updating, because since 2006, last update, coffee acreage has undergone major changes as a result of housing developing, mainly in the Central y and West Valleys.

So, updating the national coffee area is extremely important because is a valuable information tool for decision-making from the different areas of research, planning and development of the coffee activity.

This is in order to properly orient the Coffee Sector in decision-making, production strategies and productivity at the coffee farms.

Therefore, updating the coffee coverage becomes an indispensable tool in decision making in the short and medium term for the Coffee Sector, within the Agricultural Sector.

The combination of a participatory methodology, with Coffee Regions doing the field task, in combination with a proper computer processing system both software-based geographic information systems (GIS) and an appropriate hardware for processing information, with ICAFE as a coordinator and project developer, in order to generate a

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farms digital cartographic data base for the implementation of a flexible and reliable system for collecting and updating information of coffee, are vital aspects for Sector planning taking differing scales of planning into account.

Combining mapping with matching coffee information enables using coffee farms coverage as a tool for planning and research for different areas of research at the Center for Coffee Research (CICAFE), which would be also past on to coffee Producers.

The information from the different research areas would remain referenced in an identifiable area, and deployed and displayed on maps and manipulated according to specific purposes of each researcher.

2. Objectives

2.1. Overall Objective

Updating the national coffee coverage in order to generate a strategic planning tool as a significant development of the research area, and be reflected in the contribution to the Coffee Sector input on a different scale.

3. Working Methodology

In upgrading this coffee area we used the geographic areas framework contained in the SIG, and established in the previous agricultural census.

The framework consists of a set of compact coffee land areas, called polygons.

Thanks to cooperation efforts achieved by the SIG program with FONAFIFO, new aerial photographs, updated to 2005, were acquired.

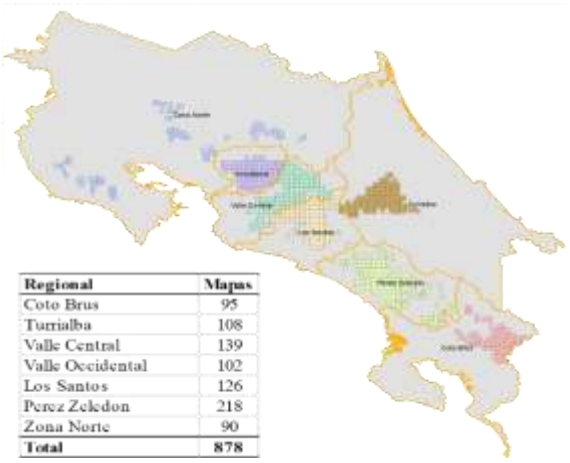
ICAFE Regional Offices are 7 in total, which has the same boundaries defined according to the planning and administration of the institution.

We had the ICAFE Regional Offices staff cooperation, who develop all upgrade areas fieldwork after prior training by technical GIS regarding the methodology for lifting field updated information and coverage. See Figure

Figure 1: Coffee Regions. Costa Rica limits, ICAFE
Source: Costa Rica Coffee Institute

Coffee areas were divided by coffee regions on smaller maps for printing. These maps include roads, hydric network, villages and coffee areas.

Through this process, we look for easier data observation, because having smaller areas images quality improve, and better handling is allowed. Also, observation is clearer and a road, planting areas, villages and other crops identification is easier, which allow a naked eye differentiation in the picture. See Figure 2



Regional	Mapas
Coto Brus	95
Turrialba	108
Valle Central	139
Valle Occidental	102
Los Santos	126
Perez Zeledon	218
Zona Norte	90
Total	**878**

Figure 2: Coffee zones division for printing maps.
Source: Costa Rica Coffee Institute, 2012

In order to carry the fieldwork out, maps were given to each ICAFE Regional.

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Fieldwork consisted of all programmed coffee area path for each Region, performing field verification of existing areas and proceeding to mark on printed maps; thus pointing to the deleted areas, segregated and new areas.

Once all coffee areas were verified, they send it to the SIG at CICAFE for fingering and databases incorporation.

4. Data processing and results

For the 2012 coffee areas updating, we used, as a base, the coffee areas files generated in 2001 by CATIE in the ArcGIS .shp format.

These files were opened in conjunction with the information layers of 2005 roads and towns aerial photos.

Editing was performed by digitizing polygons based on aerial photographs and information provided on 2012 fieldwork by each Regional Office.

5. Nationwide Coffee area coverage change

Once field data was processed and compared to satellite images, a new updated coverage is generated, where Costa Rica coffee planted areas has experienced a significant change since 2001. For that year there were 133 939.7 hectares.

Then, with final INEC coffee Census results, it determined that this area had a 15 259.1 ha declined and, finally, thanks to 2012 coffee updating work, we can see that this decrease over 2001 amounted to 20 165.5, corresponding to 19.7% of the 2001 area.
The 2012 national coffee cultivated area is 93 774.2 hectares. See Table 1

Table 1: 2001 - 2012 nationwide coffee coverage areas changes for all coffee regions.

Coffee Region	CATIE 2001 has	INEC (2003-2006)	SIG 2012 has	Change area compared CATIE	
Turrialba	11.919,0	11.514,6	6.850,9	-5.068,1	-42,50%
Coto Blus	10.283,0	10.835,1	8.947,7	-1.335,2	-13,00%
Cantral Valley	18.502,0	17.196,4	14.892,4	-3.609,6	-19,50%
West Valley	25.902,4	21.679,4	23.616,1	-2.286,3	-8,80%
Los Santos	25.728,0	21.260,5	23.353,1	-2.374,9	-9,20%
Pérez Zeledón	18.465,4	14.341,2	13.821,1	-4.644,3	-25,20%
Zona North	3.139,9	1.853,4	2.292,7	-847,2	-27,00%
TOTAL	**113.939,7**	**98.680,6**	**93.774,0**	**-20.165,6**	**-17,70%**

Source: Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) de 2001;
Instituto Nacional de Estadística y Censos (INEC) 2003-2006;
Instituto Café de Costa Rica, 2012

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6. SIG: analysis tool and its contribution to coffee

The Coffee Research Center (CICAFE) develops and disseminates technology in different areas of the coffee industry through field trials in all coffee growing regions of the country, in order to generate a genetic coffee improvement.

Thus, it has four Research Units, which uses this updated coffee coverage for research purposes and improved coffee farming.

6.1. Breeding

It evaluates and selects promising materials and study the adaptability of new coffee varieties, integrating climate parameters and crop adaptability to new production techniques.

6.2. Pest Control

It is responsible for pest affecting coffee studies, generating alternative strategies for integrated pest management.

Within their studies and contributions to coffee farming they have used the SIG tool in the identification and distribution of rust and coffee berry borer, and trials locating and other very important inputs for coffee production. See Figure 3.

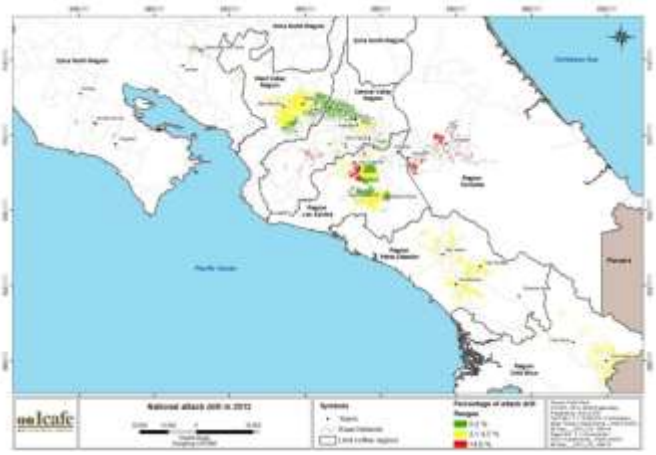

Figure 3: Coffee Berry borer national field attack, 2013
Source: Costa Rica Coffee Institute, 2013

6.3. Phytopatholog

It focuses on conducting research for diseases affecting the coffee control. It is also responsible for the weather stations which CICAFE keeps nationwide covering much of

the coffee coverage, in order to generate and keep accurate data regarding to precipitation, temperature, humidity, among others, which could affect or foster coffee farming. See Figure 4 and 5.

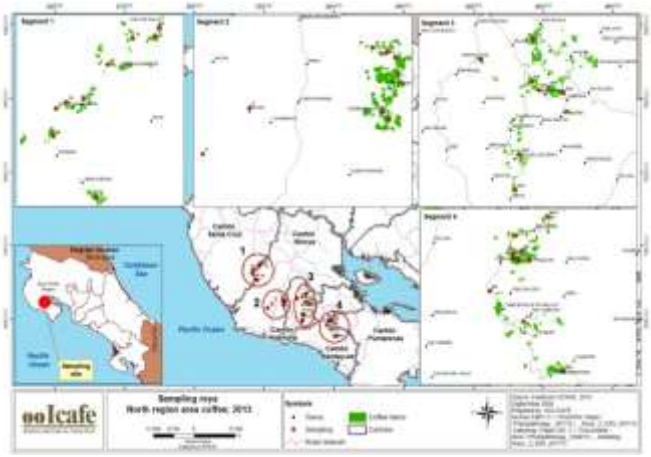

Figure 4: Coffee rust in field sampling, 2013.
Source: Costa Rica Coffee Institute, 2013

Weather Stations

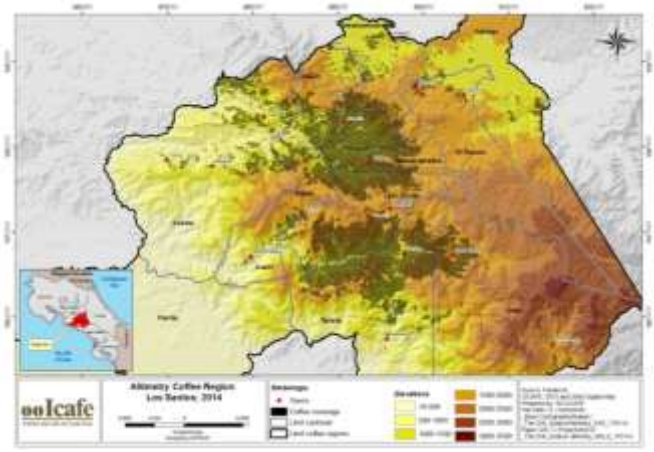

Figure 5: Los Santos: Coffee Region Altimetry. 2014.
Source: Costa Rica Coffee Institute, 2013

6.4. Mineral fertilizing

This research area is responsible for evaluating fertilizers and amendments; it focuses on the development of soil and fertility studies to determine the best recommendations for the Producer.

On the great contributions this research area has played is the fertility mapping. This study made the need of getting reference maps of the distribution of some chemical parameters of interest to the coffee area, such as phosphorus, potassium, pH, manganese, among others.

Once having coffee area coverage defined, soil sampling was conducted in different geo-referenced with GPS points, and results of chemical analysis.

Having this information sampling points and the geographical area, interpolation is performed by the SIG, therefore obtaining the maps distribution of the geographical area variables. See Figures 6 and 7.

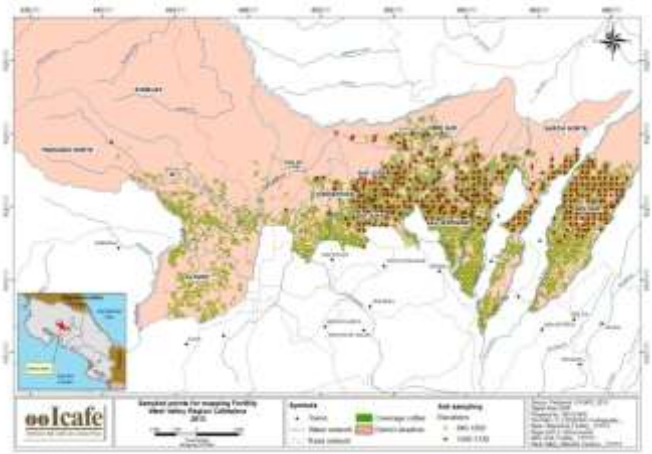

Figure 6: Sampled points for soil fertility mapping.
Source: Costa Rica Coffee Institute, 2013

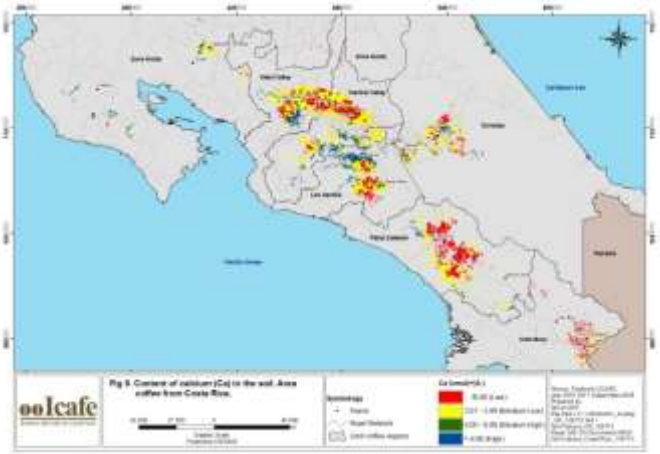

Figure 7: Soil Calcium contents (Ca)
Source: Costa Rica Coffee Institute, 2013

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7. Conclusions

The technological systems development (GIS, GPS, etc.) applied to coffee farming, represents a quantum leap for concentration, handling and efficient information management.

This current work consisted of coffee coverage updating for Costa Rica, using satellite imagery and ICAFE Regional Offices involvement in participatory and active process and activity space.

We only had CATIE and INEC (2001-2006) contributions, which we helpful as a reference for the study of dynamic of the coffee coverage update.

However, to be able to propose research projects and focus the reality of coffee production is necessary to have such cartographic constantly updated.

In conclusion, it is important remembering that the use of tools such as GIS technology allows easy access and analysis of information, improving coffee growing management and planning in the orientation for making decisions based on the joint display of variables, the spatial layering, determining distances, the deployment of associated thematic data and search for selective information from a research approach, as CICAFE it is.

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