

# PRECISION AGRICULTURE TECHNOLOGY IN A REGIONAL APPROACH: THE ABC FOUNDATION EXPERIENCE

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## ABSTRACT:

The adoption of precision agriculture practices is just starting in Brazil. In Paraná State, ABC Foundation, a research organization owned by farmers, is conducting a strong program of evaluation and adjustment of precision agriculture techniques. The farmers profile in the region, always incorporating new technologies, and the coop environment, make possible the development of such studies. An example of the regional development is the no till system, established in the region 25 years ago. No till technology increased soil fertility and yield, providing sustainability to the productive system. This paper aims to present the whole idea, efforts being made, results and challenges as an interdisciplinary experience. The program is divided into two major projects. The first one, started in 1998, contemplates the detailed study of 14 fields between 20 and 30 hectares each. Yield mapping, remote sensing, soil grid sampling and other practices are being used to understand the variability within each field, always looking for profitability. A great amount of information has been acquired and the understanding of variability is being possible with the knowledge about regional aspects. The second project is the implementation of the regional infrastructure that will allow farmers adopt related technologies. Basic information such as topographic maps, soil and climate, among others are being organized. Recently, it was produced digital color ortophotos covering an area of 2.200,000 hectares, with emphasis on productive land. A database including information from technical assistance, soil classification, meteorological and environmental aspects is being georeferenced and linked in a GIS. As the project is primarily designed to produce and let this information available to the associated farmers, an application was build using the Map Objects library from ESRI, the "GeoFarm" software. It was designed to be simple to install and use, in order to be easily accessible to the farmers with minimal training. With the GeoFarm, the user can explore the ortophotos and other layers, add GPS-taken coordinates, print layouts, make queries and drawings, and manage the associated farm database. Today in its second version, the software is already been used in 133 farms. It is a planning tool to help bring the latest technological solutions to each farmer desktop.

## 1. GIS FOR COOPERATIVES AND GROUPS OF RURAL PRODUCERS

GIS's will have each time more importance in precision agriculture, specially as concerns to automation in the field.

Cooperatives and organised producers in the form of groups or associations has the constant challenge to evolve in the search of better economic results for its agricultural organisations and companies.

The Technology of Information is being largely used on the different enterprises, since the industry, service renderings and now on the agribusiness. It aims to increase the competitiveness of the companies, pressed by globalisation and the need to compete with transnational companies and worldwide activities. Systems of geographic informations allow us a better planning of the desirable resources for the production from the recognition of the farms in space, to the presence of rivers, areas of protection, native vegetable coverings, roads and the physical structures scattered in the farms and service renderings cooperatives. Through a GIS it is permitted to compare the different results obtained in each crop, in each farm or whatever unit desired to be compared. With a GIS it is possible to use tools of logistics, helping in the studies of reduction of costs of transportation, storage and of new enterprises such as the better way to construct new silos, factories of food for animals, posts of attendance for the associates, the recognition of the better

safe alternative routes and ways to allow the outflow of the crop safely.

## 2. CREATION OF A DATA BANK

The competitiveness increased by the globalized environment has put us in front of constant challenges. The Brazilian agriculture and cattle raising activity stopped being an amateur one to be viewed as highly competitive. In order to us to face the market requests, supplying products of quality, concerning the environment and economic maintenance, it is necessary a complete control of a assemblage of technologies. With the increase of informatics, data bank tools has been largely used on the different branches of business. On agriculture and cattle activities it attends the technique-economical accompaniment and now appears as an alternative to compare the different technologies used in each farm.

## 3. ENVIRONMENT AND AGRICULTURE ACTIVITIES

Nowadays the pressure of society demands from us the development of the concept of sustainance. It is not enough only the domain of technology and the consequent rise of productivity. The respect to the environment, has introduced in our middle a constant concern about the use of raw materials that do not attack man and the environment. In an activity such

as modern agriculture, the presence of artificial raw materials created by man is necessary. The cost / benefit must be constantly observed, since in the measure that population requests more safe raw materials the synthesis cost of new molecules is high. Suppliers of raw materials, producers and consumers must be constantly in touch and showing the strength of each sector in search of a maintainable agriculture and cattle raising activity in economical, environmental and social aspects.

#### **4. SOIL SURVEY**

The soil survey searches for the recognition of the genetic characteristics of the soils in a scale that offers informations to the distinguished handling of each pedologic unit. With the mapping it is possible to treat the different units with distinguished handlings bringing less risks to the environment, rationalization of raw materials and a better domain of the soil-plant factors. Integrating precision agricultural tools it is possible to apply raw materials to the variable rates, magnifying doses in determinated areas and lessen others.

#### **5. SYSTEM OF AGRICLIMATIC MONITORING**

The collect of agrimeteorologic data allows to collect events that help in the understanding of the effects of precipitation, temperatures and of the correlations with evapotranspiration in the different phases of development of the economic cultivated cultures. Meteorologic stations allow the collect with precision of what happens during the day, month and year. Modelling of these variables allows a better understanding at long term of the beneficial effects and the regional characteristics, allowing crossing of data with the different kind of soils of the region and to recognise the levels of storage of water in the soil, to know the evapotranspiration and its influence to the different cultures.

#### **6. ECONOMIC ADMINISTRATION**

The use of softwares that help the taking of decisions has been largely used in the big size estates. The rural producer and his business in the country has been the weaker link in the productive chains, due to the climatic risks, variation of prices and the lack of devices of protection of the front sector to the developed countries.

On one side, the developed countries and Brazil's competitors on the globalized markets perform subsidies as a way to guarantee a parcel of their population in the agricultural and cattle raising activity. On the other side, they create difficulties to the entering of brazilian products in their countries, disguised as phytosanitarian barriers.

For this and others reasons, that is why the agricultural businessmen must amplify the knowledges of its costs allowing that the profits of the activity could be utilized in a safe manner. Administration softwares must be used as a way to control the financial resources inside of each business. To integrate technical and financial aspects is an attitude that distinguishes those considered efficient and in plain development.

The recognition of the sector results and of each crop allows to identify with safety the economic recession years. In these periods, the producer recognises the areas of cost that must suffer alterations without put into risk the activity.

In years of good price the producer does safe investments, such as the purchase of lands, renewal of the fleet, correction of areas with raw materials, amplification of the physical structure. Only with the domain of these tools is that activities of risk as

agricultural and cattle raising must become profitable to its enterprisers.

#### **7. TRACKABILITY**

Consumers of the developed countries demand products with well known origin. By trackability is understood the need of registries that allow the consultation by the buyers and consumers on the final end of the chain of any and all raw material used in the manufacturing of a determined product. With the arrival of the Genetic Modified Organisms - GMO's - part of consumers' society saw themselves compelled to demand from the supervising organisations ways to control products free of transgenics. It was the beginning of the trackability that nowadays acts on the markets of meat, dairy products and commodities like soya, wheat and maize. Tools of geotechnology allow the recognition of the production areas, as well as the crossing with a data bank where are inserted the information and the application of each raw material for the attainment of these products.

#### **8. RESTRICTIONS FOR A FAST ADOPTION OF PRECISION AGRICULTURE IN BRAZIL**

One of the great restrictions of the adoption of new technologies as the precision agriculture in Brazil is, without doubt, the lack of basic information in order to producers and technique consultants could take better decisions.

In Brazil, there are not available soil maps in scale that allow to know the soil characteristics of the boards and consequent differentiable management in these unities.

The cartographic information are not enough to projections, even in regional ambit, with lack of digital maps.

The same way, the climatic informations are in scale that do not allow regional detailing, in order of understanding the possible interaction between climate variability and the productivity.

This does not make impracticable the awake of a great group of producers. On Parana State, in the area of performance of ABC Foundation, tools of administration are beginning to be daily used. GPS equipments, softwares of economic administration, data bank, gathering of climate information, mapping of soils, environmental legalisation, investments in regional agricultural and cattle raising researches, cooperativist culture, investments in agrieconomic consultancy are some of the differentiations for those who are concerned in keep themselves in the activity.

Plagues, diseases and harmful plants are now georeferenced, allowing the monitoring of the populations and their correlations with the regional environment.

Multinational companies invest in technical cooperation projects to develop and introduce new concepts. Only this way, with the participation of the representatives of each link of the chains, we will have more sustainability of the agricultural systems.

#### **9. PRECISION AGRICULTURE**

Many question are being asked about the factors that limit the increase of productivity, precision agriculture can answer than.

The agriculture areas present a variability on the efficiency characterized by the use of precision agriculture tools.

Precision agriculture offer a new way to administration the farms. The technology use different tools, like GPS, sensors onboard in a number of equipments and implements, softwares that allow the correlation of the data and the formulation of different strategies to administration of the rural estates.

The production variability inside of a determined board is obtained through maps of efficiency, attained by a grid of samplings, maps of soil fertility, studies of compactness and electric conductivity of the soils, scouting of harmful plants, diseases and other parameters obtained by the use of remote sensors. This characterises precision agriculture inside the boards. Other activities can be implemented and characterized as "outside of the boards" precision agriculture or precision agriculture in a regional approach.

In this case, what is desired is to characterise the space variability on a region. So, regional informations are necessary, containing cartographic, climate, soil, technology used in each farm. With cartographic basis it can be obtained the set of the farms to be studied, allowing that the field informations contained in data bank could be analyzed in a map.

## 10. PRECISION IN AGRICULTURE AT THE "CAMPOS GERAIS" PROJECT

Precision agriculture is seen as a great technologic innovation, that can revolutionise the way of thinking and administrate the rural estates. ABC Foundation has involved itself with research in this area since 1997. More recently it started a vast project of research with the aid of other institutions, universities and companies. There was installed 15 pilot areas that are experimental fields to the development of technology. The areas are being monitored to estimate the variability of productivity and production factors. The diagnostic is used on the localized treatments, what characterises the precision agriculture "inside of the boards" and that resulted in the search of a more wide work aiming to prepare the region to a new technologic advance. Other activities were implemented by ABC Foundation and characterized as precision agriculture "outside of the boards". For this, a cartographic basis is being manipulated from the purchase of ortophotos in approximately 600,000 ha, area where are inserted the producers of "Campos Gerais". At the same time, it is being implemented a data bank that has as basis the boards, to whom are attributed all the parameters associated to the production to each cycle of farming. Meteorologic stations additional to the official network of SIMEPAR/IAPAR are allowing the modelling of the climate with degree of detailing compatible with the local variations. The mapping of the soils was obtained in the scale of 1:100,000, aiming to offer subsidies to the technical assistance for later details. All of the infra-structure demanded the creation of a Laboratory of Geographic Information - LGI, that has as main tool the geotechnologies GIS/Remote Sensing/Data Bank. This way, the region is facing the challenge to evolve to the intense use of the geotechnological information in search of a better economic result for farmers.

## 11. GEOFARM

As the project is primarily designed to produce and let this information available to the associated farmers, an application was build using the Map Objects library from ESRI, the "GeoFarm" software. It was designed to be simple to install and use, in order to be easily accessible to the farmers with minimal training. With the GeoFarm, the user can explore the ortophotos and other layers, add GPS-taken coordinates, print layouts, make queries and drawings, and manage the associated farm database. Today in its second version, the software is already been used in 133 farms. It is a planning tool to help bring the latest technological solutions to each farmer desktop.

Besides the visualisation of the image of the farm in several scales, it allows various operations involved on the processes of planing and accompaniment of the production.

Functions of Geofarm:

- several levels of zoom;
- reading and introduction points with geographic coordinates;
- integration with GPS data;
- topographic measurement of areas;
- distances measurement;
- texts and annotations about boards;
- to colour boards and make legends;
- printing in scale;
- to transform in picture files;
- reading of informations about boards;
- integration with data banks.

Use of Geofarm in the administration and planing of the farm:

- measure areas for amplification
- measure distances of fences
- calculate distances by roads
- divide farming lands
- paint boards in different colours relating to the kind of culture
- remark over boards
- measure areas with different kinds in the same board
- follow the harvest
- plan the planting
- locate infestations
- geolocate points of soil sampling
- communicate with employees
- see environmental conditions
- map soil spots
- bound wet areas
- recover historic data
- illustrate reports
- visualise the projection and the altitudes of the farm



Figure 1: Paraná State location

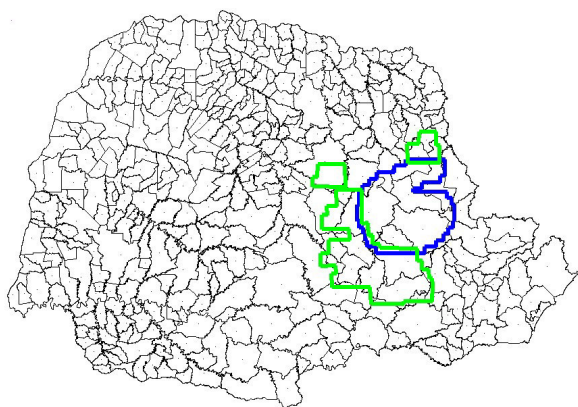


Figure 2: Project location in Paraná State

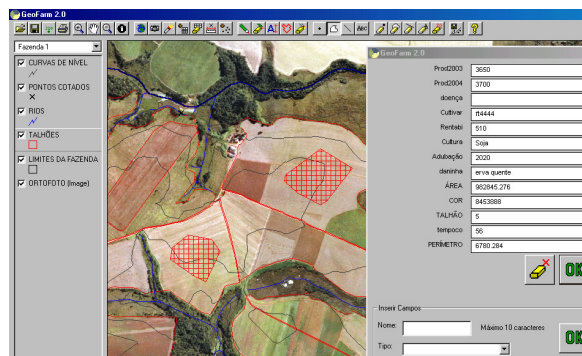


Figure 5: Illustration of Geofarm used by farmers

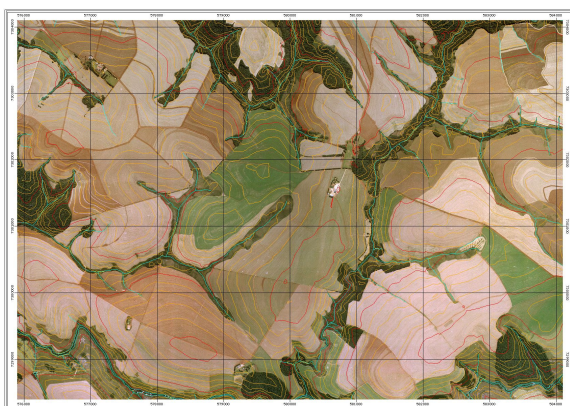


Figure 3: Orthophotos used to mapping the farms and boards

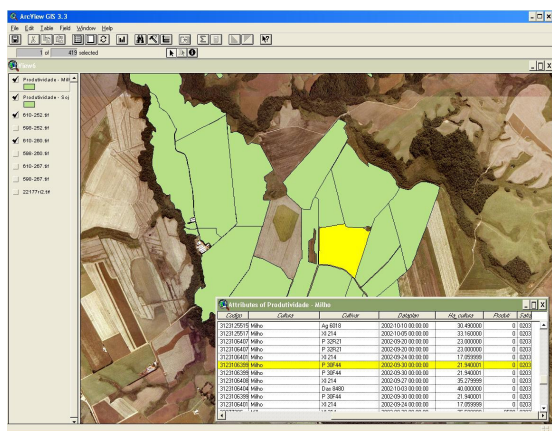


Figure 4: Orthophotos integrated with data bank