Guidelines for the Use of Precision Agriculture for Palm Oil Sustainability and Competitiveness

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Summary

Precision agriculture is a modern system of production management through which advanced technologies are applied sustainably for the collection, analysis and handling of information. This presentation addresses the work performed by the Colombian Oil Palm Research Center (Cenipalma) regarding precision agriculture and the way it is being used to help achieve competitiveness in the palm oil sector in Colombia.

Introduction

It is worth remembering that Colombia had been closely linked with the paths to production and productivity sketched by the *Green Revolution*, not just for palm oil but also for other crops. The idea was to increase production and productivity through the intensive use of inputs, without environmental or system sustainability considerations. The related policies led to the development of interesting crop varieties, especially in cereals, with examples such as hybrid maize.

Precision agriculture arises in the face of a need to develop more rational crop management, which takes into account spatial and temporal differences between plantations. The reason is that these differences determine the specific

needs of a crop in a particular location to ensure sustainable production.

Precision agriculture looks to detect different agro-ecological conditions in the same plantation, even on the same plot of land, and to obtain greater information that will undoubtedly allow the taking of better decisions in the management of the plantation.

Precision agriculture

Today it is no longer possible to continue acting from a point of view that is merely spatial, and emphasizes only aspects such as the design of the plantation due to infrastructure and the viability of roads and irrigation.

Instead, it is necessary to go a little further and to broaden the focus so that the land's agro-ecological characteristics are linked to the materials which are used on it. As a result of such an approach, a much more efficient use of different inputs will be achieved, pollution will be reduced, and producers' profit margins and product quality will be increased.

The previous passage refers exclusively to the management of the plantation, yet it concerns the achievement of responsible management through the application of the RSPO Criteria. And, if precision agriculture can be incorporated into the plantations, it will certainly facilitate compliance with what the market is forcefully demanding.

For example, the first RSPO Criterion refers to transparency, in part as it relates to the origin and the destination of the palm oil. Precision agriculture can be very useful to help in this and to begin the path to compliance with the Criterion.

Precision agriculture can be defined simply as a modern system for productive management through which advanced technologies are applied sustainably for the collection, analysis and management of information. All this is related to factors that affect the crop, including climatic, soil, and agronomic conditions. From this basis, attempts can be made to establish the interrelations which optimize the taking of decisions to increase yields, reduce production costs, and reduce environmental impacts.

In Colombia there is a serious problem of high production costs, seen mainly in processes such as fertilization, harvesting, transportation of fruit, weed control, and sanitary control.

With the use of precision agriculture technologies, each of these processes can be optimized and competitiveness can be improved within the framework of environmentally-sustainable development.

This can be looked at from three perspectives directly related to the fourth RSPO principle: from an agronomic perspective, with the adjustment of agricultural practices by taking into account the real needs of the crop (for example, with the specific management of fertilization and irrigation); from an environmental perspective, with the reduction of agricultural impacts (for example, greater precision in estimating the nitrogen required means that a lower quantity of this element is emitted into the atmosphere); and from an economic perspective, with the increase in production per unit area, the reduction of inputs, or increase in efficiency (for example, with lower nitrogen fertilization costs).

How is this done? By researching, evaluating and adapting geospatial principles and technologies to the management of the oil palm agro-ecosystem, on the basis of spatial and temporal variability. The aim is to achieve the sustainable use of the sector's inputs and resources, thereby achieving greater and higher-quality yields.

For example, with an aerial photograph or satellite image, geomatical methods can be used to generate detailed maps which show not just infrastructure but also rivers. Such maps complement, for example, yield maps which correspond to maps of soils and genetic materials.

What is needed to do this? Information about the plantations, including basic and thematic cartographical information, the active participation of the plantations, and the use of equipment to collect data in the area.

Such information must be incisive. Cenipalma can only use the information which palm companies supply in order to try to build truly-reliable information systems. These systems can even benefit and enrich regional analysis, allowing a more effective management of problems such as pests and diseases.

Currently, Cenipalma has a geographical information system which, through geographical software and

networked work stations, receives information which has been taken from the plantations using modern technology (or alternatively registered on paper forms). Cenipalma then creates geographical databases with the aim that companies can benefit from an interactive consultation system to see what is happening in their plantation or region at any given moment, thereby facilitating the taking of relevant decisions.

The Cenipalma tool

The precision agriculture program is relatively new within Cenipalma: it began in January of this year and is currently in a process of consolidation. Initially, it was established that the catalogue would be based on the *Agustín Codazzi* Geographical Institute one and that it would consist of a tool to standardize the minimum coverage that would be taken into account in each plantation as basic information for the structuring of the system. A system was developed for the acquisition of information about plagues and diseases using PDA. This requires the installation of a software, which allows censors to record information in a way that makes a census of plagues or illnesses very simple, then to register this information in forms that are found on the PDA and are linked to a GPS, and hence to know exactly what is happening and where.

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Currently Cenipalma has forms for different plagues, which facilitate the recording of information about defoliators, *R. palmarum*, predators, mites and others, as well as forms for recording how the harvest is going, forms for plant diseases and, of course, forms for bud rot. All this is aimed at validating a piece of software or recently-developed expert system, which it is hoped will be strengthened for trials in different plantations.

The system started with a case study regarding the defoliators of the Central Zone. A successful outcome was the creation of a webpage which the different participating plantations can visit to view the state of a plague at any given moment in order to then take the appropriate actions.

At this moment Cenipalma is working on a research program, which links the censuses and other information, for example about climate and soils, with plague biology, in order to generate efficient early-warning systems. It is hoped that in the very near future it will be possible to provide palm producers with a tool which allows them to determine, in accordance with environmental conditions, when there is a high possibility that a particular plague may emerge. This will allow the taking of timely decisions and therefore reduce the quantity of inputs used to control the plague.

This requires a network of agro-meteorological stations, which is being consolidated for the collection and monitoring of detailed climatic information (with variables of precipitation, relative humidity, and solar brightness) in such a way that companies can also access this information online.

Cenipalma, in particular, benefits from the strengthening of research into the biology and habits of insects. Palm producers, for example, benefit from research into the application of inputs, in accordance with wind speed and direction, the possibilities of rain and other factors.

A monitor of multi-temporal yields is already being used for a commercial palm oil plantation, employing satellite images to make predictive models of production on the basis of agro-climatic variables. This allows yield information to be combined with soil information, for example, about aluminum content and saturation, phosphorous levels, and pH. Tools can be generated to help producers to improve management of these soils and maximize production.

Of course all this requires a training system. As a result, an e-learning system is being developed to act as a virtual campus where professionals in palm oil production can learn about precision and geomatical agriculture techniques.

Case studies

To illustrate Cenipalma's work in precision agriculture and what can be applied to the RSPO Principles, it is appropriate to mention some ongoing case studies.

Initially, the Corpoica research center and the Ministry of Agriculture and Rural Development began an exploratory analysis of the spatial and temporal occurrences of bud rot in oil palm plantations in the Western Zone. Then Corpoica, Cenipalma, the Palm Development Fund and Fedepalma developed a second phase to identify occurrences in Tumaco.

Impact maps were drawn up, showing infrastructure, rivers, streams and other bodies of water. These were used to define the zones to be studied and then the occurrences of the disease were recorded. Until some time ago, notifications about the disease were merely informative. However, since the causal agent was discovered and a management method was developed, it has been possible to take decisions about when and where to act.

One of the most important things that has been said about the management of bud rot disease is the opportunity for action. If the disease can be monitored, and some geostatistical predictions about where it is moving to can be performed, containment barriers can be established and the battle may be won. It is obvious that in Tumaco, where the disease is so widespread, such tools may not be practical or worthwhile, but this does not necessarily apply to the other zones.

Elsewhere, efforts are being made to establish a national system of information for Integrated Pest and Disease Control for the palm oil sector. With that aim, Cenipalma has been working together with palm producers who have led the fight against Lethal Withering, in particular, in the development of a webpage for interactive consultation.

Finally, it is necessary to state the fact that one cannot take advantage of information and technologies if the management practices they require are not implemented. Precision agriculture generates support systems in the taking of decisions, but ultimately it is those who run the plantations and the processing plants who must decide how to apply technological developments.