

## Applications of Digital Tools, Satellite Images and Geographic Information Systems in Data Collection of Greenhouses in Guatemala

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**Abstract :** During the last 20 years, the globalization of economies, population growth, and the increase in the consumption of fresh agricultural products have generated greater demand for ornamentals, flowers, fresh fruits, and vegetables, mainly from tropical areas. This market situation has demanded greater competitiveness and control over production, with more efficient protected agriculture technologies, which provide greater productivity and allow us to guarantee the quality and quantity that is required in a constant and sustainable way. Guatemala, located in the north of Central America, is one of the largest exporters of agricultural products in the region and exports fresh vegetables, flowers, fruits, ornamental plants, and foliage, most of which were grown in greenhouses. Although there are no official agricultural statistics on greenhouse production, several thesis works, and congress reports have presented consistent estimates. A wide range of protection structures and roofing materials are used, from the most basic and simple ones for rain control to highly technical and automated structures connected with remote sensors for monitoring and control of crops. With this breadth of technological models, it is necessary to analyze georeferenced data related to the cultivated area, to the different existing models, and to the covering materials, integrated with altitude, climate, and soil data. The georeferenced registration of the production units, the data collection with digital tools, the use of satellite images, and geographic information systems (GIS) provide reliable tools to elaborate more complete, agile, and dynamic information maps. This study details a methodology proposed for gathering georeferenced data of high protection structures (greenhouses) in Guatemala, structured in four phases: diagnosis of available information, the definition of the geographic frame, selection of satellite images, and integration with an information system geographic (GIS). It especially takes account of the actual lack of complete data in order to obtain a reliable decision-making system; this gap is solved through the proposed methodology. A summary of the results is presented in each phase, and finally, an evaluation with some improvements and tentative recommendations for further research is added. The main contribution of this study is to propose a methodology that allows to reduce the gap of georeferenced data in protected agriculture in this specific area where data is not generally available and to provide data of better quality, traceability, accuracy, and certainty for the strategic agricultural decision making, applicable to other crops, production models and similar/neighboring geographic areas.

**Keywords :** greenhouses, protected agriculture, GIS, Guatemala, satellite image, digital tools, precision agriculture

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