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DIAGNOSIS OF OPERATIONS OF THE ENVIRONMENTAL CONTROL COMMAND IN THE DESENGANO STATE PARK, STATE OF RIO DE JANEIRO, BRAZIL: A CASE STUDY OF LAW-ENFORCEMENT CONTROL USING LOW-COST UNMANNED AIRCRAFTS

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1 INTRODUCTION

The growing use of VANT platforms fitted with embedded sensors for Remote sensing has been growing popular lately in different ways. Feeding back the binomial Remote sensing plus Geographical Information Systems will give rise to a great diversity of products. Aiming at the existing possibilities to deploy this kind of technology to back up environmental control and considering cutting down operating costs, given its higher safety for not carrying anyone aboard, providing the Environmental Control Command (CPAm) with subsidies to make decisions, brings on visibility and performability to the tripod environmental control, geotechnologies and unmanned aircrafts, with a view to streamline results.

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2 METHODOLOGY

As a theoretical basis, we will perform a bibliographical review of the Brazilian legislation and approach the major topics and authors writing about this subject matter. We will also survey the major problems the Command has to face in their control operations. Methodology wise, we will prepare and have semi-structured questionnaires answered by members of the CPAm Command and the Officers of all UPAms. We will also carry out participatory observations to draw out the profile of the CPAm in terms of operations, statistical data on previous occurrences and the operation of each UPAm in particular. Our goal is to outline the operating profile of the CPAm in the State of Rio de Janeiro. The same will be done with the members of the CPAm; we will calculate a sample with characteristics of these officers (population) in order to apply our questionnaire. This information will be used to populate a Geographical Information System (SIG), using Geo-referenced maps of the sites, creating exits according to the arisen needs.

We will also develop a participatory research, to establish a trust (rapport) relationship and reciprocity with locals to get answers that may aid the asked questions. We will also suggest initiatives to engage the local community, valuing native knowledge in managing local natural resources, using the Transectos method, mapping and participatory modeling.

As for our case study, we will be using an Unmanned Aircraft (VANT), to support control, aiming to promote the Surveillance and Monitoring of the area, to get video images and geospatial data to be populated into a Geographical Information System. We will be using a material of low-cost implementation. We will also refer to the application of this technology in Brazil and in the world with a bibliographical review of the VANT topic, approaching the following aspects: Brazilian legislation, a range of applications, studies based on these technologies. To achieve that, we will research the major authors writing on this subject matter.

This technology was first used in Brazil by the military. The U.S. leads this market, followed by Israel, holding a significant stake, and some European countries. In Brazil, it is used by the Instituto Militar de Engenharia (IME), the university of the

Brazilian Army, and by the Instituto Tecnológico da Aeronáutica (ITA), the Brazilian Airforce university. They both use VANTs in their law-enforcement control projects.

The field research will be performed in the Desengano National Park in the vicinity of Santa Maria Madalena town. Because its air space is virtually void of aircrafts, it was quite easy to get the Experimental Flight Clearance Permit (CAVE) issued by the Brazilian Aviation Agency (ANAC) to use VANT in research. Moreover, the Desengano Park faces environmental problems as a result of the misuse and misoccupation of the soil and other environmental damages occurring in the area. Those problems can be recorded by the VANT's embedded sensor, allowing a more precise, reliable response to law enforcement.

The sensor will send video images in real time. Considering the cost and the post sale, the VANT platform might be the most cost-effective and meet the expectations aimed at by the research: autonomous flight, reliability, easy maintenance and operation.

The SIG will be primarily used with open-source software, not to increase the costs of deployment and updating of the system. We will be testing *Quantum GIS 2.8* because of its similarity to *Arc GIS* and the quality of the output products.

3 DEVELOPMENT

The CPAm is a military police organization, known as OPM in the Brazilian acronym, of the Military Police of the State of Rio de Janeiro (PMERJ). The CPAm reports to the Head Command of the corporation and the Environmental Control Facilities which it is in charge of organizing.

The area under its responsibility is the State of Rio de Janeiro. It branches out into seven Environmental Control Facilities (UPAm), one of which is a mobile support UPA. These facilities replaced the Forest and Environmental Batallion (BPFMA) and 15 Forest Control Subunits which perform an ongoing environmental law-enforcement control to fight off predatory hunting and fishing activities, deforestation, river silting, beach areas, illegal coal-mining sites and other activities that may harm the environment.

The Constitution of Brazil of 1988 steers the approach to environmental issues. Article 225 states that:

> "Everyone has the right to have an ecologically-balanced environment, a public-use asset that is key to life quality. Public authorities and the communities have the duty to stand up for it and protect it for current and future generations" (BRASIL, 1988).

The Federal Government, in performing its duties, divides environmental liabilities into federal, state and local levels. This divide does not prevent them from setting up joint initiatives to approach environmental issues.

In the meantime, cities and towns hold the duty to legislate over issues of local interest, complementing federal and state laws. The States hold the duty to rule over issues that do not overlap the duties of the two other levels.

In the State of Rio de Janeiro, the state government has set up environmental research, development, management and control bodies (the Instituto Estadual do Ambiente (INEA) is one example), has identified the need to introduce a special police force to control the environment throughout the State. This need led to the issue of Decree 10,376/87 that created the Forest and Environmental Police Batallion (BPFMA), which was then renamed in 2012, by Decree 43,641, the Environmental Control Command (CPAm) which remains effect to date. To do its duties, CPAm has entered into partnership with Federal, State and Local entities like the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), the Brazilian Institute of the Environment and Renewable Resources, and the Environment Secretaries of the cities in the State of Rio de Janeiro. They operate jointly to achieve successful results and strengthen their initiatives targeting the protected environmental areas.

Approaching this topic is relevant because it aims to address issues having a poor literature on the market. As the theoretical basis, the Brazilians legislation stands out in approaching the environment, when, as of the Constitution of 1998, first refers to this topic, which, since then, has been widely debated by different groups of society.

This research aims to bring visibility to the tripod: law-enforcement control, ecosystem protection and management of protected areas, addressing the significance of its legitimacy, with a view to streamline results. Some questions are to be answered: Which problems the Command faces to operate in the area under study? How many police officers and cars are used? Does the population that takes advantage of the service provided by the CPAm realize the actual importance of the environmental protection and sustainability? Are geotechnological tools like cooperative/interactive

maps in Geographical Information System (SIG) used? Are existing partnerships enough to provide the necessary support to the good development of the environmental surveillance activities?

To ground this analysis, the proposals suggested here are based on the Environmental Law, which is grounded on the Brazilian Constitution of 1988 which assigns Public Authorities and citizens a list of environment-related rights and duties.

Pursuant to what article 225 of the Brazilian Constitution reads, we will debate Law 6,938/81 which introduces the Brazilian Policy for the Environment (PNMA) regulated by Federal Decree 99,274/90. It is the primary tool to preserve, increase and recover the environmental quality in Brazil. In this line, they pass Law 9,605/98 (the Environmental Crime Law) which categorizes the actions that cause environmental damages, setting sanctions that vary from alternative penalties to fines and the arrest of crime performers. In this line, working with the "environmental damage" category is necessary because it is the target activity to which the operations of the Environmental Law-enforcement Control Command (CPAm) are oriented, which is inherent to the Military Police of the State of Rio de Janeiro (PMERJ).

Considering the environment is a public asset and environmental damage is any harm to the environment, one can repeat Leite (2000, p. 107) when he says that "The environmental damage" is beyond its classical definition, since the environment is a public-use, bodiless, immaterial, unsplittable asset and not likely to be seized by one single person".

Distributing duties into Federal, state and local levels has enabled to set up tools to comply with the proposals to preserve the environment. In this line, the CPAm is a trained expert force to perform military law-enforcement control to comply with the current environmental legislation.

That said, the relevant role the CPAm plays is then characterized and grounded, considering Public Order and the environmental sovereignty in the of the State of Rio de Janeiro.

4 FINAL REMARKS

The technological breakthrough that has most influenced the geographical research is directly linked to the development of geotechnologies with special emphasis on Remote sensing and on the Geographical Information Systems (SIG). The conception of SIG must be understood as a tool that supports users to make decisions. It is made up of these components: *hardware* (the used computer platform); *software* (programs, modules and linked systems); data (records of information from a research); *peopleware* (engaged professionals and users), (FITZ, 2008).

The number of remote sensing systems that can populate the SIGs with current information has been increasing significantly in the last few years. Recent technologies such as the GPS and multisensor satellite systems, besides the development of digital photogrametry generates data with increasing spatial, spectral and temporal resolutions. The development of sensor systems having digital recording and photogrametric quality is helping the airborne sensing to undergo a revival (EHLERS, 2002a, 2007).

The use VANT-embedded sensors in remote sensing enables getting information that could be gathered in a field survey. The advantage is that it allows covering a bigger area in a shorter period of time, with reduced operating costs and increased safety.

Our goal is to contribute to an increased knowledge about this topic and to share the information collected along the process. Moreover, it aims to aid in the environmental law-enforcement control by policemen, returning to local society the provision of a top-notch service and enhanced methodologies in the use of Geotechnologies to that industry.

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