Características Práticas e Teóricas da Geomática

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APRESENTAÇÃO

A obra “Características Práticas e Teóricas da Geomática” aborda uma série de livros de publicação da Atena Editora, em seu I volume, apresenta, em seus 8 capítulos, discussões de diversas abordagens acerca os meios utilizados para a aquisição e gerenciamento de dados espaciais, com ênfase nas Geotecnologias.

A Geomática engloba, atualmente, alguns dos campos mais promissores em termos de pesquisas atuais. Esta ciência estuda as diversas relações existentes da Cartografia, Topografia, Mapeamento Digital, Sensoriamento Remoto, Sistemas de Informação Geográfica, GPS, dentre outros.

A percepção espacial possibilita a aquisição de conhecimentos e habilidades capazes de induzir mudanças de atitudes, resultando na construção de uma nova visão das relações do ser humano com o seu meio, e, portanto, gerando uma crescente demanda por profissionais atuantes nessas áreas.

A ideia moderna da Geomática refere-se a um processo de avanço tecnológico, formulada no sentido positivo e natural, temporalmente progressivo e acumulativo, segue certas regras, etapas específicas e contínuas, de suposto caráter universal. Como se tem visto, a ideia não é só o termo descritivo de um processo e sim um artefato mensurador e normalizador de estudos espaciais.

Neste sentido, este volume é dedicado a Geomática. A importância dos estudos dessa vertente, é notada no cerne das análises espaciais, tendo em vista o volume de artigos publicados. Nota-se também uma preocupação dos profissionais de áreas afins, em desvendar a realidade dos espaços geográficos.

Os organizadores da Atena Editora, agradecem especialmente os autores dos diversos capítulos apresentados, parabenizam a dedicação e esforço de cada um, os quais viabilizaram a construção dessa obra no viés da temática apresentada.

Por fim, desejamos que esta obra, fruto do esforço de muitos, seja seminal para todos que vierem a utilizá-la.

Ingrid Aparecida Gomes

SUMÁRIO

CAPÍTULO 3

ANALYSIS OF THE INTRODUCTION OF GEOTECHNOLOGIES FOR THE VALUATION OF FOREST ENRIVONMENTAL SERVICES AND THE INTEGRATION OF CLEAN DEVELOPMENT MECHANISM FOR A SUSTAINABLE ECONOMY

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ABSTRACT: The Clean Development Mechanism (CDM), an important instrument for reducing and mitigating greenhouse gas (GHG) emissions, has emerged as an effective tool to deal with issues related to environmental problems, which include waste management, preservation of environmental areas, expansion of reforestation systems, among other activities. One of the activities of the CDM encompasses the conversion of emissions into carbon credits, in which the valuation of the environmental services is applied, integrated to the CDM, having geotechnologies as a support. This article aims to present a correlation between environmental and economic issues, taking into consideration their importance for sustainability with the tools and analyses of the Geographic Information Systems in order to allow its security and technology for the benefit of the society.
KEYWORKS: Geotechnology, CDM, Forest Environmental Services, Sustainability.

RESUMO: O Mecanismo de Desenvolvimento Limpo (MDL), um importante instrumento que visa à amenização e redução das emissões dos gases do efeito estufa (GEE), surgiu como um forte aliado para o atendimento das questões relacionadas aos problemas ambientais, incluindo a gestão de resíduos, a preservação de áreas ambientais, a ampliação de sistemas de reflorestamento entre outras atividades relacionadas. Uma das atividades do MDL contempla a conversão das emissões em créditos de carbono, na qual se aplica a valoração

dos serviços ambientais aliada ao MDL, tendo ainda como apoio as geotecnologias. Neste sentido, buscou-se por meio deste artigo apresentar uma correlação entre as questões ambientais e econômicas, visando sua importância para a sustentabilidade com as ferramentas e análises dos Sistemas de Informações Geográficas a fim de permitir a sua seguridade e tecnologia em prol da sociedade.
PALAVRAS-CHAVE: Geotecnologias, MDL, Serviços Ambientais Florestais, Sustentabilidade.

1 I INTRODUCTION

Forests play an important role in the global carbon cycle not only because they stock expressive quantities of carbon, but also because of the active exchange that occurs between them and the atmosphere. The environmental service performed by the forests in order to counter the impacts of the irregular economic growth is essential to absorb and regenerate the effects caused by the negative externalities of human actions. The expansion of forest areas, whether of native forest or reforestation, is a viable opportunity to increase terrestrial carbon dissipation, which contributes to reducing the atmospheric concentration of carbon dioxide (CO_2). (SCHROEDER, 1992).

Society's concern regarding the maintenance of greenhouse gas emissions in the atmosphere is relatively new. Until the beginning of the previous century, it was impossible to imagine that human actions could cause any significant impact on the climate or on the survival of the terrestrial systems. However, history has proven the opposite, especially with regard to the increase of CO_2 quantities in the atmosphere (GORE, 1993; IPCC, 2003).

The planted forests perform a series of social and environmental services, such as the recovery of degraded land, the counter against desertification, and the carbon capture and storage (ABRAF, 2013). World's tropical areas seem to be particularly attractive to reforestation because of the high rates of productivity that can be achieved and the existence of huge areas of land that would be benefited from the planting trees. (IPEF, 2007).

In 2012, 5,102,030 ha of Brazilian land were reforested with species of Eucalyptus spp; 1,104,695 ha only in the State of São Paulo. The main products obtained from the eucalyptus processing are cellulose, paper, industrialized wood panels, mechanically processed wood, charcoal-based steel, wood, pallets, among others (ABRAF, 2013).

The eucalyptus is a highly productive plant to the wood industry. It presents low cost and high return on investment rates, which makes its cultivation very attractive (EMBRAPA, 2014).

According to the Brazilian Confederation of Agriculture and Livestock (Confederação da Agricultura e Pecuária do Brasil) – CNA (2001), a eucalyptus hectare removes 60 tons of CO_2 from the atmosphere. This plant's cultivation is a solution because it is an excellent CO_2 capturer and enables carbon storage in all reservoirs of biomass with an utmost efficacy. Complementing this perception and assessing a highly complex scenario of action and reaction of contemporary information, the geotechnological tools associated with econometric models of empirical analyses seem to be appropriate for studies related to the Carbon Credit and the Clean Development Mechanism (CDM).

To ensure the maximization of such information in a way that it contributes to the safety of environmental and economic sustainability issues, it's necessary to conduct an integration of the Environmental Science with the Economic Science.

This will be done by using the Remote Sensing (RS), which aims the estimates by the Vegetation Index (VI's) for the calculation of the amount of CO_2 absorption, and the Project Finance, as alternatives to the accounting treatment of economic-financial transactions resulting from the CDM, in a case study, on the feasibility and validation of the CDM for reforestation of *Eucalyptus spp*.

This interaction of areas will allow us to demonstrate and determine the temporal scenarios of this integration in the construction of an alternative and investigative reality for the Carbon Credit commercialization in the Capital Market of reforestation environmental services in order to ensure with scientific assurance valuable information, the quantity of inventory, and all the spatial analysis of the information of the geographic systems, and a proper mathematical modeling that encourages investors to apply their reserves to investments such as the CDM.

With this and the integrated answers and analyzes, it will be possible to develop and evaluate the perspectives of a New Sustainable Economy and its impacts on the economy itself and on the environmental, social, and regional development reading, with analysis tools, allowing a suitable and safe interpretation for the formatting and valuation of natural resources and their environmental services.

2 I METODOLOGY

To support the discussion of the proposed theme, the Content Analysis was used to verify the questionings required for this investigation in order to contemplate the connections between the geotechnologies and other issues analyzed in this article. According to Bardin (1977), the Content Analysis is used as a set of methodological tools that are constantly improved and applied to diverse discourses, mainly in the social sciences, with well-defined objectives. This methodology can be applied to both qualitative and quantitative research. (BARDIN, 1977).

Thus, the collection of information on economic and environmental issues was carried out from published texts, evidencing scientific research. However, texts and other materials, in addition to academic publications, were also included for analysis. Considering the qualitative analysis for the discussion, it was decided to follow a script based on the hypotheses and objectives of the research. Afterward, the exploration phase of the selected materials was contemplated, ending with the final treatment and discussion of the revision on the introduction of geotechnologies for the valuation of forest environmental services and also for the integration with the CDM, aiming a truly sustainable economy, or one as close to it as possible.

3 I CARBON CREDIT SCENARIO

To interpret the scenario related to the Carbon Credit in the world, it is necessary to highlight that some scientific aspects conflict directly with the theme. On one hand, there are scientists that justify the greenhouse effect relating the phenomenon to the human action (IPCC, 2016), which creates the imbalances and the negative externalities that favor the global warming and its impacts. On the other hand, there are scientists, called "skeptics", who claim that the phenomenon is natural and that it is part of the process of the evolution of the planet, combined to the solar system (LOMBORG, 2002). Both scientists have a significant amount of data and analysis that proves their positioning and arguments.

However, analyzing the historical context of formation and formatting, we find that (BRASIL, 2012)1:

> "... From the 2000s, a market emerged focusing on the creation of projects to reduce the emissions of gases that accelerate the process of global warming. This was the carbon credits market, which emerged from the Kyoto Protocol, an international agreement that established developed countries should reduce their emissions of greenhouse gases (GHG) by 5.2% between 2008 and 2012, compared to the levels measured in 1990."

The historical context of the Carbon Credit may be broadly analyzed and its temporal interpretation will depend on the opportunity the reading is linked to. Regarding the issue of forestry projects (SAPORTA; YOUNG, 2004, 2015), we find that:

> "The first initiatives of carbon sequestration in forestry projects predate the Kyoto Protocol. Even in the 1980s, when there was no legal restriction on the level of emissions of Greenhouse Gases (GHG), energy companies were already financing these voluntary projects to demonstrate best corporate practices."

And the theme has since been debated in conferences and promulgated in International Agreements. The structure and models have been continuously discussed with a focus on the reduction Greenhouse Gases (GHG) emissions; the metric form adopted is carried out by the measurement in tons of carbon dioxide equivalent (CO_2e). Each ton of CO_2, reduced or removed from the atmosphere, corresponds to a unit emitted by the CDM Executive Board, known as Certified Emission Reduction (CER). (AGUIAR, FORTES, MARTINS, 2016).

3.1 Kyoto Protocol

The CDM (Clean Development Mechanism) was conceived by the Kyoto Protocol[2] that establishes rules to reduce the emissions of gases that cause the GHG's (Greenhouse Gas), based on the principle of a common, but differentiated responsibility. This means the mitigation of the causes of the climate changes is a duty of all countries that ratify the deal, but, with a higher burden to the parties that have historically contributed more to Global Warming. (MMA, BRASIL, 2016).

Basically, the Kyoto Protocol establishes that the developed countries (listed in the Attachment 1 – CQMC3) compromise to reduce, in certain periods, the GHG's emissions in an effective percentage compared to the ones obtained in 1990. Despite being a compromise assumed by the countries, the deal does not have legal force and it does not predict any penalty to the countries that do not follow it. In Brazil, the legislative decree Nº 144, from 2002, describes in its content:

> "It approves the text from the Kyoto Protocol to the United Nations Framework Convention on Climate Change, opened to signatures in the city of Kyoto, on December, 14,1997, on the occasion of the Third Conference to the Parties of the United Nations Framework Convention on Climate."

All nations meet annually to debate and analyze several impact-related topics of environmental and economic sustainability of the Protocol. There are three mechanisms known as Emissions Trading, Clean Development Mechanism (CDM), and Joint Implementation. (IPEA, 2010).

3.2 Clean Development Mechanism

The Kyoto Protocol presents a total of 38 articles. The CDM, established in the Article 12, aims to promote the reduction of emissions of greenhouse gases and simultaneously stimulate sustainability actions in developing countries. It is the only flexibilization mechanism that gives conditions to developed countries to partly compensate for their GHG emissions by investing a value in projects allocated in developing countries. (MOREIRA, GIOMETTI, 2008).

When a country included in Annex 1 (developed) invests in mitigation projects in a developing country, recognized by the Executive Committee, it receives in return credits known as Certified Emission Reductions (CERs), which can be used for the reduction of the total emissions from that country or it can be traded in the International market.

The concession of the CERs depends on rules and reviews of several institutions, for the effective control of the results of the projects with regard to their emission reductions. (REBIA,2016). One of the lines of the CDM comprises forestation and reforestation activities in developing countries, with a focus on the regional sustainability of the project and the positive externalities generated, not only on the CO_2 absorption but on the environmental and social balance and on the quality of life of the local society. (BRAZIL, 2014).

The CDM respects a common structure of any traditional project, from its documentation preparation and design to the certification and issuance of credits that show the exact amount of absorption or removal of CO_2e from the atmosphere. (BNDES, 2009).

Since the Marrakesh Agreement, in 2001, two modalities of candidate projects to CDM were established: the ones of fuel replacement and increase of energetic efficiency in polluting matrices, that is, the ones that use technologies with less potential of GHG emission, and the ones that aim the removal and storage of CO_2e through sinks and activities related to land usage, including forestation and reforestation projects. (FURLAN, 2008).

This agreement also defined the final rules for the approval of the projects and created the Executive Board of the CDM, which is responsible for registering the projects and for the emission of the credits. Between the preparation of the project and the final certification, each proponent must comply with mandatory procedures for the future negotiation of the credits. Thus, the formation of such market involves the ability to comply with these key requirements. (BMFBOVESPA, 2016).

Forestry projects thoroughly suit the issues of the national agenda for the rural development and the sustainable usage of natural resources, which allows them to become tools and instruments of strategic public policies for the economic development of the country. (MMA, 2016).

Based on several issues that are questioned, there are points related to whether forestry projects must participate of the carbon credit market because of uncertainties as to the capacity of absorption of carbon by forests, given the mismatch between the fixation of CO_2e in the woody material form and the respiration of plants. (BARBOSA et. Al 2013).

In response to this question, about the form and type of the biological mitigation project regarding the investment of resources received from the CDM, the forestry issue presents a low level of reliability and difficulty in measuring results, so it should focus on studies that investigate the energetic sources with technologies that eliminate the consumption of fossil fuels. (PBMC, 2014)

There are currents of acceptable contexts that highlight forest conservation as an instrument of carbon sequestration. These currents justify that it also causes biodiversity conservation and the sustainable usage of forestry resources, decreasing deforestation, which contributes for the mitigation of the greenhouse effect.

Several Brazilian forestry projects involving carbon sequestration that aim to integrate all environmental questions, intercalated with the restoration of degraded areas, conservation and preservation of biodiversity that generate social benefits and economic development to societies are important because they allow the generation of comparative benefits by the analysis of the cost benefit with their application.

3.3 Applications In Brazil

One of the CDM projects, which involve afforestation and reforestation in Brazil, is that of the Valourec& Mannesmann Tubes –V & M Brazil, headquartered in Minas Gerais. The objective was to reduce its CO_2 emissions by replacing the energy matrix of its steel production, that is, by exchanging the mineral coal for charcoal obtained from its planted forests. In February 2003, the company signed the largest contract for the sale of carbon credits in the world until then, totaling an amount of five million tons of credit, with a result of 16 million dollars. (REBIA, 2016).

The project of the V&M Brazil is estimated to avoid the emission of approximately 21 million tons of CO_2e in the next 20 years; 17 millions of which are due to the energetic substitution and four million are related to the capture of methane gas in carbonization activities (REBIA, 2016).

Other CDM Forestry project in Brazil is the Plantar, a project of the company Plantar S.A., which is also headquartered in Minas Gerais. The company works in the area of Forestry Assets and in Steelworks of Gusa Special Iron Production. The project in the region of the Cerrado of Minas Gerais is justified by the utilization of charcoal as an emission reducer in the manufacture of gusa iron, instead of coal. It is estimated that it will generate credits equivalent to 3.5 million tons of carbon in 28 years. There is, however, a little extension of benefits to local producers and to a consequent promotion of sustainable development (PLANTAR, 2012).

However, projects of forestry carbon sequestration are considered one of the most advantageous forms of compensation for project costs and are also easy to adopt and implement compared to others, such as the energy and landfill ones. In addition to contributing to ecological protection by stimulating the conscious and appropriate use of natural resources, it complements positively to the care in soil issues, mainly in regions of agricultural borders (NASCIMENTO, 2012).

In these projects, the geotechnologies adopted in precision agriculture stand out. They aim to ensure and solve any doubts about spatial data, adding technology to the context and format of the CDM and adopting a methodology that is appropriate to the theme.

4 I GEOTECHNOLOGIES FOR THE CDM

The entire process, structure, and norms of the CDM follow the guidelines of the Kyoto Protocol, but the differential that adds value to any project, study, and this kind of analysis is conceived by the inclusion and analysis generated by the tools of the Geographic Information System (GIS), which deals with procedures and resources that allow and facilitate the analysis, management or spatial representation of the phenomena. According to Fitz (2008, p. 03):

> “The production and reproduction of space involve a set of even more articulated processes. The necessity to intervene in these spaces, seeking a better understanding of the geographic space and the relations of the society with its environment, makes the search for new conceptual and technical instruments a constant in all areas of knowledge.”

However, absorbing the issue and the technological advance related to the advent of geotechnology, highlighting the GIS and the advances in the area of Remote Sensing, allows the project to receive an odd and decisive modeling, respecting the criteria and focusing on the technological methodology complementing the guidelines of the CDM in a safe and traceable way.

As highlighted earlier, CDM Forestation projects are questioned as to safety and properly in the confirmation of the values and amounts of CO_2e and absorbed or stored in a certain area of vegetation. However, the tools adopted by geotechnology allow solving this perception in a scientific and high technological and safe way.

In order for the CDM to achieve its goals of reducing GHGs, it is necessary to perform several statistical calculations to quantify the CO_2e to be removed or stored (BRAZIL, 2014).

These statistics include geoprocessing tools and satellite imagery studies. Geostechnology tools provide support and immediate verification of observations and analysis with various instruments such as GPS, Cartography, Airphotogrammetry, etc.

Therefore, so that projects ensure their fairness, it is necessary to prove these demands for information and the issues of spatial analysis are fundamental, providing security conditions and data traceability; transparently unifying environmental and economic flows with a focus on environmental sustainability (INPE, 2010).

It is worth to highlight the Geographic Information System (GIS), following the definition of (Burrough and McDonnell apud Fitz, 1998; 2008, p. 11): “is a powerful set of tools for collecting, storage, recovery, transformation, and visualization of real-world spatial data for a set of specific purposes.” And the Remote Sensing (RS) is a science that studies the physical and chemical properties of samples from the surface samples.

4.1 Geographic Information System and Remote Sensing

In general, the concepts of GIS are based on the tool that allows the spatial data analysis, Almeida (2010, Moreira, 2008), defines:

> “[...] a GIS is as a set of tools that allows analysis involving spatial and non-spatial data on terrestrial space... it allows the association of geographical (positional) data with a multitude of attributes (alphanumeric data), thus enabling one to carry out queries, analysis, and simulations, involving all kinds of information in which the variable “space” is important.”.

On the interaction between the terrestrial atmosphere and solar radiation, we have, according to Moreira, (2008, 38), “[…] the terrestrial atmosphere is indispensable to life because of the gases it contains and because it is a protective filter against high-penetrating solar radiation such as ultraviolet radiation, X-rays, etc."

Recent studies published in several annals and scientific congresses of Remote Sensing highlight the possibility of the use of spectral (IV's) to estimate biomass, stock, and carbon sequestration.

As far as the remote sensing technique is concerned, it is fundamental to record the land usage over time, since it allows evaluating the changes occurring in the landscape. (GALVINCIO, NAUE, ANGELOTTI, 2011); (MARTINS, BAPTISTA, 2015).

To characterize targets on terrestrial surface, RS addresses the complexity of analyzing several environmental factors interacting simultaneously - however, one of the most important of these factors is the vegetation covertures, in which several vegetation indices were created with the purpose of highlighting its behavior in relation to land use and other targets. (INPE, 2013).

4.2 Vegetation Index

Whether a forest, a pasture, a field, or an agricultural crop, the first analysis to be considered and understood is of the individual that constitutes this vegetal community; according to (MOREIRA 2008, p. 68), "the plant, since it is in it that all biological and physicochemical activities are processed, besides being the smallest vegetation unit that will interact with the solar radiation".

The usage of VI as the Normalized Difference Vegetation Index (NDVI), Soil-adjusted Vegetation Index (SAVI), facilitates the acquiring and modeling of biophysical plant parameters, such as leaf area, biomass and ground cover, with an emphasis on the region of the infra-red electromagnetic spectrum, which can provide important information on the plant evapotranspiration (JENSEN, 2009; EPIPHANIO *et al.*,1996).

The modeling of the vegetation indexes is based on the opposite reflectance behavior of vegetation in the visible region, in other words, the higher the vegetation density, the lower the reflectance due to the radiation absorption by the photosynthetic pigments and the greater the plant density, the greater the reflectance due to the dissemination in the different layers of the leaves.

The Normalized Difference Vegetation Index (NDVI) is considered to be an efficient biomass stimulator by many authors and, as a consequence, can be related to the carbon storage in plants.

However, the Photochemical Reflectance Index (PRI), which expresses the relation between the green and blue stripes, can be related to the photosynthetic ratio. According to *Rahman et al.* (2000), carbon sink by vegetation depends on the integration of these two indexes (NDVI and PRI), which generate a new one: The CO_2flux.

The majority of the studies performed with those indexes are for areas and forest species. Considering the current importance of the subject of the global climate change, it is important to investigate the correlation between the spectral indexes (NDVI, PRI and CO_2flux) and the agronomical parameters (Leaf Area Index (IAF) and biomass (B)) representatives of the afforestation and reforestation of eucalyptus culture, aiming at finding relations of Storage and Carbon Sequestration.

The vegetation index allows the concretization of the analysis and evaluation of quantities and absorption values and Carbon Sequestration in the areas. Such condition will be the database so that the economic study performs its interaction with this flux.

Aggregating perspectives and scenarios which were restricted to studies with an environmental focus, in other words, aside from the guarantee and security of the SIG and SR instruments generated by Environmental Science, it allows the integration of economic views of the result analysis not only for the sole purpose of the study, but also for the projects and for sustainable regional development. It allows the quantification and the appraisal of the actions of the environmental services that such culture performs for the eco-systemic, social, and economic balance.

5 I CONCLUSIONS

While several studies and proposals advance in the search for answers that meet the high inflammation growth of the negative externalities in a disorderly manner, which change the environmental systems and proposes a new stance, focusing on sustainability to generate a so-called Green Economy. Acc. to *Hargrave and Paulsen* (2012):

> "The Green Economy is an economy in which the finiteness of natural resources, the eco-systemic services, and the planetary limits given by Science are taken into consideration and constitute clear goals within which there are the production, distribution, and consumption activities will have their place. In a Green Economy, the services are considered in the decision-making process, the environmental externalities are internalized and issues such as climate change, natural resources shortage, energetic efficiency, and social justice are main elements and behavior guides of the agents.''

The issue of Sustainable Development is a broad and abstract perception that indicates values to be held. Therefore, the Green Economy would be a concrete manner of increasing solutions that provide breakthroughs towards Sustainable Development, without conditioning or limiting economic growth and development. (WWF, 2017).

The transition to a green economy is not an option, but a tendency of the global economy. (PNUMA, 2011). Its propellants are both regulatory changes that modify the prices of resource usage (carbon markets), as well as changes in the consumers' attitudes. Hargrave and Paulsen (2012), "[...] Thus, it concretizes not only in terms of necessity to adapt to new regulations but also in opportunities for new business." And still indicate some issues that must be taken into consideration in a strategy for a Green Global Economy. (IPEA, 2012):

a) the centrality of the concepts of the ecological footprint (or some variety) and bio-capacity, which show the environmental impact of the production standards as well as each country's consumption;

b) payments of eco-systemic services at an international level;

c) national and international technology transferring and financing schemes for the development of sectors based on green economy;

d) some kind of carbon pricing;

e) elimination of perverse subsidies, for example, to fossil fuels.

Taking into account points c and d, we have in the proposal of this article the answer to the question. Geotechnology and remote sensing tools play a major role in this context so that there are scientific security and the conditions for economic issues to run smoothly. Adding to this point the econometric analyzes and projections, feasibility and impacts of variance.

And its acceptance by society becomes transparent and methodological, responding to all in a safe way and taking into account the requirements for the CDM to generate positive externalities for the whole society, respecting the environment and sustainable development and the correct valuation of environmental services.

REFERENCES

ABRAF. **Anuário estatístico** ABRAF 2013 ano base 2012 / ABRAF. – Brasília: 2013.

BARDIN. L. **Análise de conteúdo**. Lisboa: Editora Edicoes 70, 1977.

BRÜSEKE, F. J. **O Problema do Desenvolvimento Sustentável**. In: CAVALCANTI, Clóvis (Org). **Desenvolvimento e Natureza: Estudos para uma Sociedade Sustentável**. 5. ed. São Paulo: Cortez; Recife, PE: Fundação Joaquim Nabuco, 2009.

CARMO, C.A.F.S; ENEGUELLI,N.A.; LIMA, J.A.S.; MOTTA,P.E.F.; ALVARENGA, A.P. **Estimativa do estoque de carbono na biomassa do clone de seringueira** RRIM 600 em solos da Zona da Mata – Minas Gerais. Boletim de Pesquisa (no prelo).

CASSOL, H. L. **Estimativa de biomassa e estoque de carbono em um fragmento de floresta ombrófila mista com uso de dados** ópticos **de sensores remotos** - Porto Alegre: IGEO/ UFRGS,2013. [143 f.].

FITZ, Paulo Roberto. **Geoprocessamento sem Complicação**. Oficina de Texto. São Paulo – 2008.

FRANCISCON, L.; GARRASTAZU, M. C.; ROSOT, M. A. D.; OLIVEIRA, Y. M. M. de. **Cadernos de geoprocessamento** (5) WebGis da fazenda experimental em Colombo: organização da base de dados e acesso às informações geográficas

FREITAS, H. M. R., CUNHA, M. V. M., Jr., & MOSCAROLA, J. (1997). **Aplicação de sistemas de software para auxílio na análise de conteúdo**. Revista de Administração da USP, 32(3), 97-109.

GALVÍNCIO, J. D., NAUE, C. R., ANGELOTTI, F., MOURA, M. S. B., 2011. Vitisvinifera **SPECTRAL**

RESPONSE TO THE INCREASE OF CO_2. Available on line at Directory of Open Access Journals, v. 01, p. 001-018.

GODOY, A. S. (1995). **Introdução à pesquisa qualitativa e suas possibilidades.** Revista de Administração de Empresas, 35(2), 57-63

GOODCHILD, M.; BRADLEY, P.; STEYAERT, I. **Environmental modeling with GIS.** New York: Oxford University Press, 1993. 488p.

GULLO, M. C., **O pensamento econômico e a questão ambiental: uma revisão**. IPES Texto para Discussão Publicação do Instituto de Pesquisas Econômicas e Sociais. Setembro de 2010. Texto nº 041. Versão 31.08.2010

KUHN, T. S. (1991). **A estrutura das revoluções científicas** (3a ed.). São Paulo: Perspectiva.

HABOUDANE, D., MILLER, J. R., PATTEY, E., ZARCO-TEJADA, P. J., SRRACHAN, I. B., 2004. **Hyperspectral vegetation indices and novel algorithms for predicting green LAI of crop canopies: Modeling and validation in the context of precision agriculture**. Remote Sensing Environment, v. 90, p. 337-352.

HARGRAVE J., PAULSEN. S, **Economia Verde e desenvolvimento sustentável**. IPEA. Ano 9. Edição 72 - 2012

HILL, Carter; JUDGE, George G; GRIFFITHS, William E.; **Econometria** 3ª Ed. Editora Saraiva – 2010.

IBGE. SIRGAS – Sistema de Referência Geocêntrico para as Américas. Disponível em: <http://www.ibge.gov.br/home/geociencias/geodesia/defa ult_sirgas_int.shtm>

IPEA Publicações: http://www.ipea.gov.br/portal/index.php?option=com_alphacontent&view=alphacontent&Itemid=357>

INPE Serviço de Informações e Documentação. http://www.inpe.br/biblioteca/ (Acesso em 28 abr 2017)

JOLLIVET, M.; PAVÉ, A. **Meio Ambiente: Questões e perspectivas para a pesquisa.** In: VIEIRA, P. F.; WEBER, J. Gestão de Recursos Naturais Renováveis e Desenvolvimento: Novos Desafios para a Pesquisa Ambiental. São Paulo: Cortez, 2002.

LAURINI, R.; THOMPSON, D. **Fundamental of spatial information systems**. Toronto: Academic Press, 1992. 680p.

LEFF, H. **Complexidade, Interdisciplinaridade e Saber Ambiental**. In: PHILIPPI JR. A. et al. (Orgs.) Interdisciplinaridade em Ciências Ambientais. São Paulo: Signus Editora, 2000.

LIRA, W. S. **Sistema de Gestão do Conhecimento para Indicadores de Sustentabilidade** – SIGECIS: Proposta de uma metodologia Campina Grande – PB. 2008. Tese (Doutorado em Recursos Naturais) - Universidade Federal de Campina Grande. Programa de Pós-Graduação em Recursos Naturais, 2008.

LIRA, WS., and CÂNDIDO, GA., orgs. **Gestão sustentável dos recursos naturais: uma abordagem participativa** [online]. Campina Grande: EDUEPB, 2013, 325p.

LOMBORG, Böjrn Ed(2002) **O ambientalista cético revelando a real situação do mundo**, São Paulo: Campus, 541

IPEF. MARTO , G. B. T. Supervisão e orientação do Prof. Luiz Ernesto George Barrichelo e do Eng.

Paulo Henrique Müller; Instituto de Pesquisas e Estudos Florestais http://www.ipef.br/identificacao/hevea.brasiliensis.asp (Acesso em: 28 abr 2017)

MAY, P.; BOYD, E.; CHANG, M.; VEIGA, F.C. **Incorporando o desenvolvimento sustentável aos projetos de carbono florestal no Brasil e na Bolívia**. Estudos Sociedade e Agricultura, Rio de Janeiro, vol. 13, no. 1, 2005: 5-50.

Ministério do Meio Ambiente do Brasil MMA - **Entenda como funciona o mercado de crédito de carbono**. http://www.brasil.gov.br/meioambiente/2012/04/entenda-como-funciona-o-mercado-decredito-de-carbono (Acesso em: 26 jan. 2017).

MOREIRA , H. M.; GIOMETTI A. B. R; **O Protocolo de Quioto e as Possibilidades de Inserção do Brasil no Mecanismo de Desenvolvimento Limpo** por meio de Projetos em Energia Limpa. Artigo recebido em outubro de 2006 e aprovado para publicação em junho de 2007. CONTEXTO INTERNACIONAL Rio de Janeiro, vol. 30, no 1, janeiro/abril 2008, p. 9-47

MOREIRA, Mauricio A. **Fundamentos do Sensoriamento Remoto e Metodologias de Aplicação**. 4.Ed. Atual e Ampl. Viçosa/MG. Ed.UFV, 2011.

MOREIRA, M. M. A. M.; SOUZA, R. C. R. **Avaliação do Sistema Nacional de Gerenciamento de Recursos Hídricos no Brasil**. In: seminário latino-americano de políticas públicas em recursos hídricos, 1, 2004, Brasília. Anais... Brasília/ DF, 21 a 24 de setembro de 2004

MOZZATO A. R., GRZYBOVSKI D. **Content Analysis as a Qualitative** Data Analysis Technique in the Field of Administration: Potentials and Challenges. RAC, Curitiba, v. 15, n. 4, pp. 731-747, Jul./Ago. 2011

PAUL Schroeder. **Carbon storage potential of short rotation tropical tree plantations.** Forest Ecology and Management, 50 (1992) 3 I-41 Elsevier Science Publishers B.V., Amsterdam 31

PNUMA, **Caminhos para o Desenvolvimento Sustentável e a Erradicação da Pobreza** – Síntese para Tomadores de Decisão, 2011.

POPPER, Karl R. **Conjecturas e Refutações**. Brasília: Editora da UnB. 1980.

RATTNER, H. **Tecnologia e Desenvolvimento Sustentável: uma avaliação crítica**. Revista de Administração. São Paulo, v. 26, n.01, 1994.

REVISTA DO MEIO AMBIENTE - REBIA – Ano 2016. http://revista.rebia.org.br/component/jdownloads/viewdownload/21/507?Itemid=0

SACHS, Ignacy. **Caminhos para o Desenvolvimento Sustentável**. Rio de Janeiro: Garamond, 2000

SAPORTA, Luis A. C.; YOUNG, Carlos E. **Créditos de Carbono e o Reflorestamento do Entorno da Rebio de Poços das Antas**. Revista de la Rad Iberoamericana de Economia Ecologica. Vol.12 pg. 17-32, 2009.

YOUNG, Carlos E. F. **Desenvolvimento e meio ambiente: uma falsa incompatibilidade**. Ciência Hoje: v.211, p.30-34. 2004

YOUNG, Carlos E. F. **Financial Mechanisms for Conservation in Brazil**. Conservation Biology: v.19, n.3 (June), p.756-761. 2005

YOUNG, Carlos E. F. **Desmatamento e Desemprego Rural na Mata Atlântica**. Floresta e Ambiente, v.13, p.75 – 88.2006.

WWF, O que é desenvolvimento Sustentável. http://www.wwf.org.br/natureza_brasileira/questoes_ambi entais/desenvolvimento_sustentavel/

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