e-ISSN: 2347-7830
p-ISSN: 2347-7822

Research & Reviews: Journal of Ecology and Environmental Sciences

Key Methods for Land use Impact Assessment: An Overview

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REVIEW ARTICLE

Received: 23/08/2016
Accepted: 24/09/2016
Published: 30/09/2016

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Keywords: Environment, Forests, Land

ABSTRACT

Several types of approaches to assess land use impact assessment have been developed till date. Yet a systematic synthesis of all these approaches is essential to enlighten the most generally used and effective approach. The growing interest in this field of studies, a review of the various methods of estimating land use impact (LUI) was executed by using bibliometric analysis. 143 articles of biological and agricultural science, and environmental sciences were reviewed. According to our results, the most generally used land use assessment approaches are Life-Cycle Assessment, Environmental Impact Assessment and Material Flow Analysis. Analogy of these approaches allowed their specific characteristics to be identified and concluded that the combination of various methods is best for a overall analysis of land use impact assessment.

INTRODUCTION

The current position of development of economy of world is described by increasing level of the land use and the impact of environment associated with it. The intensity and complexity of the both manmade and natural interactions lead to a deterioration of the quality of land, food security concerns, lack of environmental sustainability and biodiversity reduction at different levels. As land is one of the most crucial resources required for human beings, not only for living but also for environs, it is very necessary to save it and reduce the effects that are associated with activities of human beings [1-12]. Considering about environmental impacts of land use, two basic

land use activities should be studied: land occupation and land use change. Land use change is a human made change of the land use from one type to another type, such as from forests to land for cultivation.

In present scenario there are many types of tools and methods to study the environmental impact of land use. Each of them has their own uniqueness, depending on the definitive research focus. To find the older methods that were used their level of application and scope, to find which ones are the mostly used, for what aspire and finally features the most encouraging ones to support diverse levels of decision-makings [13-20].

Several methods were elected to analyze appropriate methods and to understand their influence within different situations of land use. Our first method was based on the general presumption each method that were categorical in the generic existing description and definition. Second method considers the use of non-evident nature of the methods and this is the base of our study. These methods were chosen for distinctive logics. The utilization of the methods and the target public for whom the study is built, can affect the choice of method depending on the objective of the assessment. The next significant method assumed to be an indicator level depicting a quantitative or qualitative measure of the land use impact. Mostly the quality of results depends on how the data is collected.

METHODOLOGY

To obtain the goal of our study bibliometric analysis (BA) was carried out. We investigate various articles discussing several different approaches to implement a bibliometric analysis. This approach included two steps: (1) choose journals on the basis of scientific journal ranking (SJR); (2) choosing key words from those chosen journals. Choosing scientific journals that could be relevant to the ecological issue, among the various subject categories proposed by the SJR platform (SCmago Journal & Country Ran), as being of interest only two categories were retained: “Environmental Science” and “Agricultural and biological sciences” [21-30]. Next step was to search the related keywords that can help us to carry out our study. We chose mandatory and optional keywords to make our study more predictable. The mandatory words meant that all of them should be there in the article and optional ones are not mandatory but we have decided to add them as they can provide us more booming results. The mandatory words were environmental impact, land use, scale, data, and indicator. Optional words were assessment, estimation, evaluation, tool, method, analyze, and approach. After these two steps, we had the information necessary for our analysis. There are various fields that were to be completed to utilize this program, depending on the method used and the way sources were selected, the results can be quite different. Finally, 143 different articles were chosen and our first results are entirely based on them. Each and every article had been studied carefully.

Results

First screening: review of 100 articles

We inspect the state of development of methods for land use impact assessment for a particular time period. Our first screening that is based on 143 articles shows increasing in interest of the issue in last few years. However, real growth in this field had started in 1996. We presume that the Rio Conference held in 1992 initiated research in this field forward by given importance to critical resources such as land and water, as well as land use changes, and also by developing sustainable land-use management and planning. Furthermore, this thriving interest can also be connected with the launch, in the mid-90s The International Geosphere-Biosphere Programme and International Human Dimensions Programme focused at the study of primary key changes in land use. In 2011 the highest

number of studies was carried out. Before drawing any conclusions It will be necessary to follow the trends for the next few years [31-41].

Life cycle assessment:

Life Cycle Assessment (LCA) was the most generally used method in the sample with 100 out of 143 articles. Life Cycle Assessment is a method of accessing the possible environmental impact of a product or service through all the stages of its entire life, i.e. from extraction of raw material through production, transportation, distribution and use to the end of life. It is one method for the promotion and communication of environmentally responsible production and consumption. Nevertheless it is not a mandatory method, but is very often chosen due to its marketing advantages [42-50].

The first environmental life cycle research was carried out by Coca-Cola in 1969 in the USA, by one of their managers Harry E Teasley Jr and published it in Science Magazine in 1976. It encouraged the development of methods of life cycle assessment analysis. There are four main stages in the LCA (1) Goal and scope definition, (2) Inventory analysis, (3) Impact assessment (4) Interpretation. Goal and scope definition is a main step which needs the precise definition, aim of the study and the limits of the system that is being studied. The next step consist of collection of data, namely, input and output data to prepare inventory flows. The objective of the third step is to evaluate potential environmental impact based on inventory flow results. The last step consists of summarization of result interpretation of inventory analysis and impact assessment stages. It is mandatory to note that LCA gives an assessment of potential impacts on the basis of a chosen functional unit.

Material flow and input-output analysis

Material Flow Analysis MFA is a method which allows all the materials to be assumed for, quantify flows and to identify and stocks of materials in physical units such as kilograms, tons etc. in a described system on diverse temporal scales and spatial. It is not an essential method, but it is widely used in efficient and rational resource use interpretations. The method consists of two fundamental principles (1) The system approach (2) The mass balance. The principle idea of the MFA is a simple model representing relations in the environment and economy. Thus, inputs are all the natural resources and transformed products become outputs [51-61]. According to physical laws, the MFA system should be balanced, i.e. total input and output should be equable.

Environmental impact assessment

Environmental impact assessment (EIA) is a proposed by International Association for Impact Assessment (IAIA) focused at determining the intensity and level of risk of any kind of activity of planned project and its effects on the environment as well as on human health. One of the most crucial features of Environmental Impact Assessment is that it should always be available for all the interested agents in the initial stages of the development of project. Thus Environmental impact assessment has become mandatory in decision making whether the project should be carried out or not. Likewise Environmental impact assessment is the main method to accomplish sustainable development. Based on eight steps (1) Namely screening (2) Scoping (3) Impact analysis (4) Mitigation (5) Reporting (6) Review (7) Decision-making (8) Post-monitoring of the planned project [62-70], the basic objectives of Environmental impact assessment are to ensure proper utilization of natural resources, to prevent and improve the environment in a way that does not result in damage to human health and to the natural systems.

Second screening: review of 60 articles

The main results of our study are based on the 100 articles chosen out of 143 articles under the study during the research.

Geographical distribution of the studies

First step of our study was to evaluate the geographical distribution of land use impact assessment studies. This assumption was made according to the scientific and educational institutes where the articles originated. Certain articles were matured by association between educational establishments from many different countries. However, in some cases the locations of institution are differing from the geographical location of the study. So the distribution of land use assessments within the studied articles also studied [71-85]. We analyze different countries that were studied by different research teams and found that the most number of studies do not refer to any particular country; the researchers follows a generic approach to the environment impact assessment of the land use. Only a few articles out of 100 were focused on a study of a particular country.

CONCLUSION and DISCUSSION

We studied several articles, using various methods to get the best apprehension of methods and find which method is the widespread and most useful in land use assessment. It was analyzed that there is a diversity of methods that can be used, but the mostly used are LCA, EIA EF and MFA/IOA. It is very difficult to say which method is the most promising because each has their own uniqueness and specific characters. According to our analysis, LCA is the mostly used nowadays. Some of the studies constituted a combination of methods that seems to be a good strategy to deal with the problems of a using single method in the land use assessment. Therefore we recommend using this approach which can provide a full research vision and better results with the combinations of different aspects of each and every method. Our analysis has shown that there is a sharp increase of interest on land use impact assessment since 1992. Even the bibliometric analysis was done between time periods of 1975-2013; slight research was also done from 1976-1991. It is important that EIA and LCA were organizing concurrently and both methods appeared as a result of growing awareness of the environmental issues [86-100]. According to the geographical distribution search of land use impact assessment research, Europe is characterized by a large number of studies. This shows that, weather Europe is highly developed industrially, the agricultural sector is one of the important sectors in Europe, especially giving more importance to food self-sufficiency in European countries.

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