Research on the Evaluation of REDD+ Operational System

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Abstract
REDD+ operational system is a security system which is an organic bond of application system and evaluation system. According to the relationships of each elements in REDD+ operational system, such as interaction, mutual restraint, and the characteristics of organic unity, a mathematical method was used to build a hierarchical analysis model to solve the matrix by C++ procedure. Finally our study explored the weights and prioritization of the three above elements in REDD + running system and their priority ordering. Our results indicated an important theoretical and realistic significance in ensuring the balance development of REDD+ operational system and system's evaluation standard.
Keywords: REDD+, OPERATIONAL SYSTEM, MODEL, SYSTEM EVALUATION, C++ PROCEDURE

1. Introduction

Since the 20th century, earth's greenhouse effect becomes more and more serious, and leads to frequent natural disasters. CO2 emission reduction has become a matter of concern to all countries in the world [1]. Forest is the most important carbon sequestration and carbon sinks in terrestrial ecosystem, and plays an important role in regulating carbon exchange between terrestrial ecosystem and atmospheric carbon pools. At present, high rate of deforestation and forest degradation are increasing concentrations of greenhouse gases production [2], therefore, researches of climate change mitigation are focusing on reducing deforestation and forest degradation in developing countries and reducing greenhouse gas emissions (REDD+) as an important means of mitigating climate change.

Previously, researches on REDD+ were more focused on economic and technological standard, less on the view of law way and there was no systematic analysis of the various factors that affect the REDD+ hierarchical relationships, on the basis of which the study proposed a series of implementation steps to advance the REDD+ operational system.

The innovation of this article lies in the application of an original model produced by C++ procedure. This model was used to analyze the various factors that affect the REDD+ progress of hierarchical relationships, and according to the result of different importance of these impact, a series of the feasible steps were put forward to perfect REDD+ system.

2. REDD+ Operation and Its Existing Problems

2.1. REDD+ Proposed and Operated

"The 4th assessment report released by IPCC in comprehensive report on climate change showed that land and forest use change could lead to an increase in atmospheric concentrations of greenhouse gases which accounts for about 20% of global greenhouse gas emissions [3]". In 2010, "The global forest resources assessment report issued by FAO also suggested that in the 1990s, 16 million hectares of each

year for global land damaged due to natural disasters or converse purpose of land use [4]".The rate of deforestation and forest degradation have great effects on greenhouse gases concentration increase, and REDD+, which is taken as the significant means on climate change mitigation has gradually become the focus of world attention and discussion [5].

The UNFCCC 11th the conference held in Montreal in 2005 first brought "reduce deforestation emissions in developing countries: incentive mechanism" into the topic issue, which aimed at discussing deforestation emissions and motivate action for developing countries. In 2007, the 13th conference of the contracting parties discussed the importance of carbon emission reduction by reducing deforestation and forest degradation as well as the importance of conservation and sustainable of forest management in order to provide the carbon stock function in developing countries, which would be brought into the Bali action plan. In 2009, REDD+ mechanism was officially put forward in Copenhagen's 15th conference of the contracting parties, this mechanism used market mechanism, and encouraged the countries with highly greenhouse gases emission to reduce greenhouse gas emissions and prevent forest deforestation and forest degradation, and allowed those countries to get the corresponding income of greenhouse gases through the carbon market [6]. Discussion about REDD+ mechanism has a divergence constantly, however, it is one of the least contentious issues about the current climate negotiations, and many countries show their highly expectations.

Discussions and researches on REDD+ are transferred from the original scope of coverage, the mechanism of scale and the specific implementation of capital circulation mechanism to the national and global problems such as the specific project level of technical standards, monitoring system, methods and measures, financing channels and the social environment and safety, etc. [7]. At present, the parties in the scope of implementation of REDD+ have reached the basic consensus on incentive mechanism, technical and financial support, the activity type, as well as the aspects of implementation steps and stages, they are focusing on the REDD+ capital allocation mechanism, forest reference emission levels, REDD+ action effect of scalability, reportable and verifiable, and REDD+ action of security measures [8]. REDD+ action requires strategic plan to cope with the international convention of legal protection, economic policy and institutional guarantee system research is also gradually developed.

2.2. Problems Exist in REDD+ Operating System

With the quantitative increase of member states in REDD+ framework, people study REDD+ from multiple points of view, which include economic development, technical support, as well as the policy support and legal protection system, however, there are still some problems on system design, the rights equality of REDD+, reference emission levels and mitigation effect measurement [9].

First, the running mode of REDD+ is singleness and relevant mechanism remains to be perfect. From REDD+ design level, it plays a positive role in climate change and forest protection obviously. However, REDD+ mechanism has different connotation for different countries due to the complexity of deforestation and degradation, different state responsibilities and interests which lead to different costs [10]. REDD+ faces the significance challenge on forest right, the ownership of forest carbon credits and the install of incentive fund, if these fundamental problems cannot be solved effectively, REDD+ single operation mode would get a huge risk, and more negative influence would be followed.

Second, REDD+ justice problems. REDD+ exists right equality problems in the mechanism of environmental services payment, aborigines benefits and biodiversity protection. Equity issues among each parties in the running mode of REDD+, distinct problem in forest property right, broad powers of equality caused by indigenous peoples income risk and immigration as well as the relationship between the local interest fairness problem restrict the development of REDD+ operating system and also the REDD+ running mode of construction, the improvement of the operation mechanism and operation strategy of choice [11].

Third, lack of authoritative REDD+ assessment standards and methods. From macro level, REDD+ forest carbon scheme that uses the national scale, or the project scale or these two mixed scale for carbon measurement has not been decided[12]. From the Micro level, although some research methods exist in the REDD+ policy and project evaluation such as strategy based on variable structure, they are still lack of scientific system of unified standards and specifications for reference, and also lack the quantitative analysis and study the improvement of the operating system in REDD+ system.

3. Necessity of REDD+ Operating System

3.1. Effective Working of REDD+ Needs Rational Analysis and Results as References

The effective operation of REDD+ determines the basic features of REDD+ system and its development

direction, which provides the stability and balance for REDD+ operating system [13]. Operation system is the core competence of REDD+ mechanism, even the guarantee and conclusive factor of effective implementation of REDD+. According to the factors which show the characteristics of interconnection, mutual restrict and the organic unitive of REDD+, we can use the mathematical methods to build an administrative analysis model which can evaluate the system objectively and reasonably, and the operational system of REDD+ can be re known from the micro angle. We can use the results of rational analysis to guide the REDD+ operation system in its aspects of harmony, integrate and effectiveness.

3.2. Adjustment of Assessment Deviation in REDD+ Operating System

Evaluation standard deviation in REDD+ running system mainly embodied in paying attention to the policy evaluation, but in its internal operation system, security system and evaluation system of coordination and phase correlation have insufficient understanding, that means that pay attention to the surface analysis and interpretation during the implementation of forest reduction policy, neglects the further discussion of components in REDD+ operating system, and relationships among these components , these inevitably lead to REDD+ system imbalance, and affect the sustained and healthy development of the mechanism of REDD+ [14]. Regular assessment of REDD+ operating system can appropriately restrict and adjust REDD+ evaluation standard deviation and overcome some defects of the subjective evaluation and make REDD+ operating system perfect and reasonable.

3.3. Basis of Scientific REDD+ Operation Mode Establishment Using Quantitative Decision-Making

Hierarchical analysis model is a decision–making method which is a combination of qualitative and quantitative analysis. For REDD+ operational mode and strategy , hierarchical analysis model uses multi-objects thinking procedure to make this mode systematic, modelization and quantization and it is one of the most effective methods for each indexes' weight calculation in the operational system of REDD+. Analysis of REDD+ operating system's various factors and their relations, we have to get rid of some secondary factors and retain some major factors according to the actual progress of REDD+ and classify these retained factors into different levels, and then form multilevel structure for REDD+ operation system [15]. The importance of each level elements are judged according to a certain standards, and each elements' weight are arranged by solving some characteristic values and then combination weights of final targets are calculated from each level elements' weight. Hierarchical analysis model will provide a quantitative decision-making for the selection of REDD+ operation mode and strategy when it passes the consistence examination and shows the reasonable of its evaluation.

4. REDD+ Evaluation Model Established Based on AHP

4.1. Evaluation Index System Established for Main Factors of REDD+ Operation System

REDD+ operation system is formed by security system, working procedure system and assessment system. Security system is consist of REDD+ operation policy, law, policy, development planning and regulatory documents. The assessment mode is consist of REDD+ running mode, forest reference emission levels, measurement technology and related scientific problems, economic means and financing mechanisms on reduction effect. For REDD+ forest carbon detection system, policy and system operation results of judgment and evaluation contents and methods make up the assessment system for REDD+[16]. REDD+ assessment system is formed by the stable way of contact, the organization and operation mode of security system, procedure system and assessment system .For the effective operation of REDD+ mode, REDD+ should not only keep the most basic running procedure mode, but also ensure the long-term, stable and sustainable, dynamic and coordinated development of the security system and evaluation system [17].

4.2. Hierarchy Analysis Structure Establishment

All aspects of contents in REDD+ operation system are not an isolated existence and knocked together. REDD+ operational system is a unified system which is working under the environments of technology and economic transformation, policy and legal system coordination and guarantee, and the evaluation mechanism of monitoring and promoting. REDD+ systems of security, project and evaluation are all getting the promotion effectively based on the above environments [18]. According to the practical problems, we divided analytical structure into three layers: the objective layer, the criterion layer and the project layer. The objective layer is the top layer which reprints the intended target to be analyzed that is REDD+ operational system, which takes some restrict conditions referred to a general target realization as an interlayer. The criterion layer includes technical means, economic means, policy and legal protection. The lowest layer is component factors in REDD+ including security system, procedure system

and evaluation system. We use the block diagram to illustrate the subordinate relationship among each layer with lines between the relevant upper and lower layer, uncorrelated without lines [19]. See Fig. (1).

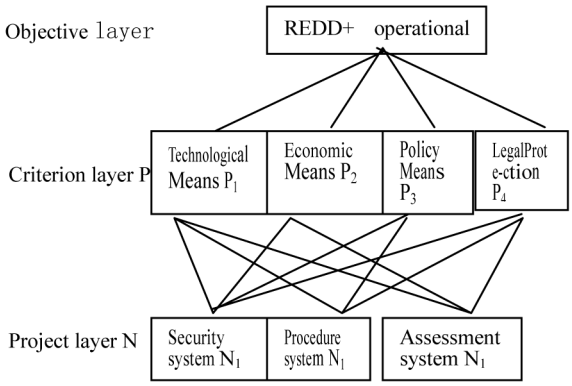

Figure 1. Structure of analytical hierarchy process in REDD+ operation system

4.3. Model Solution

The judgment matrix analysis method is based on hierarchical analysis theory, all related factors among each layers are judged by important quantization. Table 1-9 compare scales are introduced to show the results of each pair wise comparison matrix.

4.3.1. Construction and Solving the Judgment Matrix O - P

Based on the various values of criterion layer, P1, P2, P3, P4 are compared among important comparison, and the importance of introducing 1-3 compare scales are introduced to show the results of each pair wise comparison matrix(Table 1).

β: grades,

R_{ij}: degree of important between i and j,

$R_{ij} = \frac{1}{R_{ij}}$ represents the important of ration of i and j.

Pairwise comparison matrix o-p:

O	P_1	P_2	P_3	P_4
P_1	1	7/4	7/5	9/4
P_2	4/7	1	3/4	7/3
P_3	5/7	4/3	1	8/3
P_4	4/9	3/7	3/8	1

o-p matrixes are solved by C++ programme, the eigen value λ_{max}=4.04017, eignevector $w=(0.356,\ 0.232,\ 0.291,\ 0.121)^T$

Table 1. 1～9 Comparative scale

R_{ij}	1	3	5	7	9	2, 4, 6, 8
	Equal important	Weakly important	Important	Highly important	Absolute important	Important degree among each grade

Consistency check used compatible ration $CR=\frac{CI}{RI}$ to depict the matrix consistency, $CI=\frac{\lambda_{max}-n}{n-1}$ is the index of compatible ration, λ_{max} is eigenvalue, n is the order of a matrix, Riis the random consistency index, for 3-9 orders of judgment matrix, Ri values are showed in Table 2, when CR<0.1the judgment matrix possesses the approving consistency, or not the judgment matrix should be adjusted.

Table 2. RI value

n	2	3	4	5	6
RI	0	0.58	0.90	1.12	1.24
n	7	8	9	10	11
RI	1.32	1.41	1.45	1.49	1.51

o-p matrix passed consistency test with CR= 0.0463<0.1

4.3.2. Judgment Matrix Construction and Solution

P_1-N, P_2-N, P_3-N, P_4-N of the judgment matrix are showed below:

Judgment matrix P_1-N:

P_1	N_1	N_2	N_3
N_1	1	3/5	7/3
N_2	5/3	1	7/4
N_3	3/7	4/7	1

Judgment matrix P_2-N:

P_2	N_1	N_2	N_3
N_1	1	4/3	6/5
N_2	3/4	1	5/4
N_3	5/6	4/5	1

Judgment matrix P_3-N:

P_3	N_1	N_2	N_3
N_1	1	5/4	6/7
N_2	4/5	1	5/6
N_3	7/6	6/5	1

Judgment matrix P_4-N:

P_4	N_1	N_2	N_3
N_1	1	8/7	5/3
N_2	7/8	1	5/4
N_3	3/5	4/5	1

Weight vectors of the above four judgment matrixes bj= (b1j, b2j, b3j, b4j) tare solve by C++, eigen value of maximum and coincidence indicator CRj are showed in Table 3.

Table 3. Eigen value of maximum and coincidence indicator

P / N	P_1	P_2	P_3	P_4
	b_1	b_2	b_3	b_4
N_1	0.353	0.384	0.339	0.406
N_2	0.448	0.324	0.290	0.337
N_3	0.199	0.289	0.371	0.257
λ_j	3.071	3.012	3.004	3.003
CI_j	0.036	0.006	0.002	0.001
CR_j	0.062	0.010	0.003	0.002

CR_j showed the matrixes passed consistency test.

4.3.3. Total Weight of the Arrangement and Consistency Test

$$\eta_i = \sum_{j=1}^{4} w_i b_{ij} \ (i=1,2,3,4) \qquad (1)$$

Equation (1) showed the total weight vectors of the arrangements

$$\eta = \begin{pmatrix} 0.353 & 0.387 & 0.339 & 0.406 \\ 0.448 & 0.324 & 0.290 & 0.337 \\ 0.200 & 0.289 & 0.317 & 0.257 \end{pmatrix} \begin{pmatrix} 0.356 \\ 0.232 \\ 0.291 \\ 0.121 \end{pmatrix} = (0.364 \quad 0.358 \quad 0.278)^T$$

Radom consistency ratio of the total arrangements is $CR = \frac{\sum_{j=1}^{4} w_j CI_j}{\sum_{j=1}^{4} w_j RI_j} = 0.0213$, CR<0.1, passed the approving consistency test.

Security system, procedure system and the assessment system are must considered comprehensively, objectively and reasonably during the REDD+ system working, and the priority ordering of the three systems are N1 with 36.4 %, N2 with 35.8 %, N3 with 27.8 %.

Conclusion of REDD+ Operating System Evaluation

REDD+ operational system is the organic combination of security system, procedure system and assessment system. REDD+ operating system determines the whole running characteristics of REDD+, direction and its function, and is the decisive factor in the REDD+ effective operation. Therefore REDD+ operating system must fully consider the interests of each component factors. According to the elements relationship with each other, mutual constraints, the characteristics of organic unity, mathematical method are used to build a hierarchical analysis model which gave a reasonable and objective result about REDD+ operational system. Results showed that security system possessed the proportion of 36.4%, procedure system 35.8%, assessment system 27.8%. And the priority ordering of the three systems were security system, procedure system and the assessment system.

According to the results of social development and environmental changes and the model, REDD+ security system needs to be adjusted constantly. Procedure system and evaluation system minimized their own judgment and judged difference between stakeholders, as far as possible, we have to consider the correlation of the main related system, and properly constrain these systems, and restrain the system elements in the evaluation with high standard, and enhance the evaluation with low standard, then got the effective result in choosing REDD+ system strategy and its execution.

Acknowledgments

This research was supported by grants from the Fundamental Research Funds for the Central Universities (DL11GC02).

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