THE APPROACH OF ECOLOGICAL-SOCIAL REGION TO ADAPT TO CLIMATE CHANGE

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Abstract

In the face of the threat of the climate change to all of territories, aspects of living and producing. The States have strongly focused on work of adaptation to climate change from recognizing in legal system to practical deployment solutions aiming at steadily minimizing negative influences of climate change to development progress of territory on the basis of different research results. However, achieved results have been restricted, the territories are still struggling against unpredictable happenings of weather and extreme phenomena. Therefore, in order to proactively adapt to climate change is necessary to have effective solutions on the basis of reasonable approaches; in particular, the approach of social-ecological region with core that is to analyze mutual relationship among ecosystems, social system in internal region, inter-region would provide bases to ensure the scientific, objective to propose the most effective adaptation solutions.

Keywords: *climate change, adapting to climate change, approach of ecological-social region*

1. Introduction

The impacts of climate change (CC) are prevalent and deepen the complexity and severity of extreme phenomena through changing the relationship between natural systems and social systems in all development regions and domains. In particular, development activities depending on natural resources are increasingly exposed to risks, facing challenges to maintain and develop.

To gradually overcome the above difficulties, the Party and the State have issued and implemented many adaptation solutions, including structural and non-structural solutions on the basis of different research results. However, the achieved results still exist many limitations and shortcomings, as territories and communities are still facing many difficulties and pressure from unpredictable happenings of weather and natural disasters. Therefore, to proactively adapt to climate change, it is required to have a systematic and synchronized solution based on an integrated territorial approach; in particular, the approach of social - ecological region with core that is to analyze mutual relationship among ecosystems, social system in internal region, inter-region would provide scientific, objective information to

propose adaptation solutions with the spirit of "*respect and utilization of nature*".

2. Method

The main methods used in this article are the review of domestic and foreign research documents and the method of statistical and descriptive analysis.

Along with data sources related to climate change manifestations and scenarios; impacts of climate change and natural disaster on socio-economic areas in Vietnam; etc. were collected from the Ministry of Natural Resources and Environment, General Department of Water Resources, General Department of Natural Disaster Prevention and Control, and General Department of Statistics for the period from 2011 to 2020.

3. Results

3.1. Social-ecological regions

The approach of social-ecological region is one of the tools for effective territorial management through the study of the mutual relationship between human and nature, which emphasizes that human is an inseparable part from nature (Berkes & Folke, 1998); social-ecological research results by territory are an integrated scientific basis, thus determining the specificity of ecological funds, spatial resources, and society in regional stratification; objective scientific bases in the active inclusive development and adaptation to climate change for any territories.

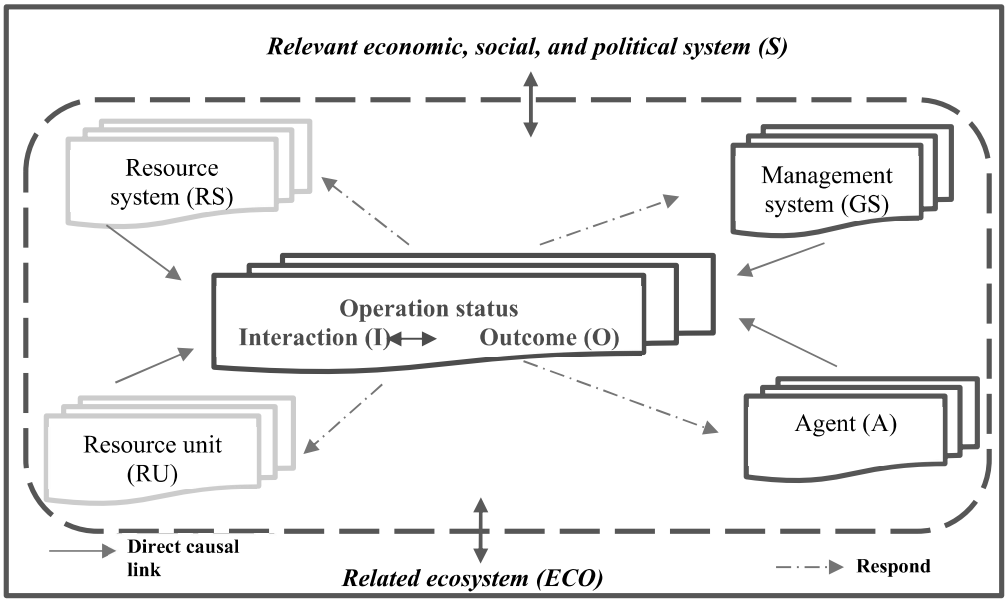
In our country, the concepts of regions and territorial zoning have been used in research works and legal documents with a defined scale depending on different management criteria and objectives. For example, with regard to geoscience, Hoover (1984) and Le Ba Thao (1998) stated that "the region is a territorial part of one or more countries with different geographic features, levels of socio-economic development, structured and operated as a system in mutual relationship among the country and other regions"; According to the Law on Planning 2017, "the region is a part of the country including adjacent municipal provinces and cities directly attached to river basins or bears the similarity in natural, socio-economic, historical, population, infrastructure conditions and interactive relationships which create lasting connections with each other"[88]. The region is a geographical space with the unity of the peer relationship among constituent elements, creating products with specific characteristics regarding nature, economy, society and environmental security (Ngo Doan Vinh, 2003).

The 70-80s of the 20th century witnessed the appearance of the approach of social-ecological region in research. This is the proposed interdisciplinary and multidisciplinary approach to overcome the singularity of the territorial approach, moving towards the integrated approach, the system of constituent factors, including bio-geo-physical units and

[88] Article 3, the Law on Planning was passed by the 14th National Assembly in November 2017 and came into effect on January 1, 2019.

related social organizations of the system (Glaser, Krause, Ratter and Welp, 2008; Elinor Ostrom, 2009); SES findings are more comprehensive, widely applied in resource management, sustainable development of territories in the world with an analytical framework of social ecosystems, including four core components: resource system (RS); resource unit (RU); management system (GS) and agent (A); common components and the interactions among them will appear related sub-attributes. This is a general oriented framework - tangible structure combined with different theories of politics, institutional economics, and anthropology (Ostrom, 2009).

Figure 1. Analytical framework for the sustainability of social-ecological systems



Source: Elinor Ostrom, 2009

The framework of social-ecological analysis has been applied in some research of our country; accordingly, the approach of social-ecological region in the zoning is a variation of the human ecosystem, emphasizing the social element with the connotation of a complex and unified system of both human and nature, which constitutes with a bio-geo-physical unit and associated social and institutional factors (Truong Quang Hoc and Hoang Thi Ngoc Ha, 2016); in terms of sustainable development, the social-ecological region is considered a possible space within the administrative territory of many localities (Mai Trong Nhuan, 2018), this understanding has improved the political will, short-sighted vision during term of office, and local interests of the subjects involved in planning.

From the above concepts, it can be understood that *the socio-ecological region is an area with similar ecological conditions (geography, natural resources, environment), socio-economic and cultural characteristics, along with the institutional system and regional governance. At the same time, there is an interactive and interdependent relationship between the natural system and the socio-economic, human and institutional systems, creating the uniqueness of the territory.*

The connotation of the approach is quite consistent in terms of: i) A functional system, which interacts regularly in a climate-resilient and sustainable manner; ii) A system exists in a defined space and time, whose structure, functions and organizational levels interact with each other; iii) A combination of important resource types (natural, socio-economic and cultural resources) developed and used by a complex of both ecological and social systems; iv) A constantly changing complex system with continuous adaptation (Truong Quang Hoc and Hoang Thi Ngoc Ha, 2019). Each social-ecological region has its own territorial characteristics, which is mainly reflected through the following factors:

Regional-institutional characteristics: Regional characteristics are objective factors defining regional institutions, thus, regional governance regulations are subjective factors. Regional institutions are institutions at the regional level that only exist to serve the governance of that region. For example, the Mekong River Delta has to rely mainly on water resources of the Mekong River; therefore, it requires an institutional connection to effectively manage and share water resources (Bui Quang Tuan, 2018).

Regional-economic characteristics: Each region has different resources for economic development. With a diversified river system and ecosystem, the Mekong River Delta has the potential and advantages for economic development of fisheries, fruit, rice, etc.

Regional – cultural and social characteristics: Culture and society play an important role in creating regional characteristics, which is reflected in the relationship between human and nature through cultural knowledge about dealing with the natural environment. At the same time, the accessibility to social resources such as support networks, cooperation mechanisms, participation in mass organizations, etc. is an opportunity to access scientific and technical resources, finance, information, etc. to adapt to climate change. Agricultural livelihoods associated with rivers are predominant in rural areas in the Mekong River Delta; however, this kind of livelihood is susceptible to natural disasters, drought, saltwater intrusion, riverbank and coastal erosion if there is no appropriate adaptation measure.

Regional – environmental and natural capital characteristics: Ecological region characteristics have direct and indirect impacts on the environment where humans live. The environment in the Mekong River Delta is associated with rivers and water, so residents' life is attached to the sea and alluvial grounds. However, climate change, natural disasters, and extreme weather have changed the living environment, migration and livelihoods of some community groups.

3.2. Approach to social-ecological regions in climate change adaptation: The case in Vietnam

In the process of human evolution and development, there is no natural system without human intervention, and at the same time, no social system lacks natural elements. The result of this interaction is the formation of social-ecological systems with closely related components to evolve together. Therefore, enhancing resilience according to the

approach of social-ecological system for each specific locality and region is considered as a strategic solution for sustainable development in the context of climate change. (Truong Quang Hoc, Hoang Thi Ngoc Ha & Nguyen Tien Truong, 2015). This is emphasized by the following characteristics:

i) Clarity due to close, sustainable interactions and resilience of bio-geo-physical and social-economic factors, natural disasters, and climate change.

ii) Is established by defined spatial and temporal scales; structure with specific forms and functions; and hierarchical connectivity with two-way relationships (top-down and bottom-up).

iii) Is constituted by a set of important resources (natural capital, ecosystems, economy, society and culture, infrastructure, science and technology, finance, etc.) with linking flows governed by the integration of social and ecological system factors;

iv) Dynamic complex systems with the capacity to adapt flexibly (based on community and ecosystem). Therefore, this is a suitable territorial unit for implementing planning orientation based on its potential and comparative advantage (Pérez-Soba & Dwyer, 2016).

With these preeminent features, in recent times, the approach of social-ecological region and enhancing resilience has been widely applied in many countries around the world for sustainable development in the context of climate change (Holling & Walker, 2003; Resilience Alliance, 2007; WB, 2010; United Nations University, 2014). In Vietnam, research on resilience and adaptation to climate change based on social-ecological system has been conducted by domestic and foreign researchers with the support of international organizations (Truong Quang Hoc, Vo Thanh Son, 2008; ACCCRN – Vietnam, 2010; Truong Quang Hoc, Hoang Thi Ngoc Ha 2016; Shaw, 2013) with the principle that man is the center of the ecosystem, which means: i) People are the most powerful factor influencing the ecosystem, and ii) Ecosystem conservation activities must ultimately be directed towards and providing human social welfare (Millennium Ecosystem Board, 2005). As for social-ecological systems, the adaptation process is more complicated because of human intervention and human factors; thereby, it is likely to reduce or increase the resilience of the ecosystem as well as of the whole system.

a. Resilience of the social-ecological systems

Resilience: is a term commonly used in many different sciences, expressing the ability to recover or adapt well when faced with challenges in the course of existence and development. (Masten & Coatsworth, 1998; Darity, 2008). For such system defined as a set of elements, its parts interrelate, interact with each other and form a coherent whole; the system's resilience is the ability to self-reset its balance when faced with external impacts, demonstrated in the following states:

(i) Physical resilience

A physical system has a certain degree of resilience depending on the nature and structure of the whole system and each of its components, such as the resilience of a construction work depends on the construction planning and design with the appropriate calculation with the load capacity of the constituent elements (Truong Quang Hoc, Hoang Thi Ngoc Ha, Nguyen Tien Truong, 2015).

(ii) Ecological resilience

Ecological resilience is a term first proposed in 1973, expressing the stability, balance, and capacity of the ecosystem to self-regulate against external influences (Holling C.S. and Walker B. 2003; Lance H. Gunderson, 2000). Ecological resilience is maintained by fundamental structural processes on a number of scales, renewable sources, improvement, and biodiversity functions; is the process of changing metabolism in accordance with the environmental conditions. In fact, maintaining renewable capacity in a dynamic environment provides an ecological buffer that protects the system from natural and human impacts; resilience is not a single process but a response of the entire ecosystem with different levels of spatial and temporal scale; therefore, researching and learning about resilience capacity will be the basis for managers to make appropriate decisions in using and exploiting ecosystem service values towards sustainability and adaptive governance. (Lance H. Gunderson, 2000; Donald AF et al., 2019).

(iii) Resilience – adaptability

Resilience and adaptability are closely related, taking place intertwined within the system, demonstrating the system's sustainability against external factors. In fact, resilience – adaptability are the abilities to effectively maintain integrity, integrity, and reduce vulnerability in response to changing contexts. The above relationship shows that in order to ensure an effective response to external impacts, it is necessary to reinforce the system's resilience and adapt to changing conditions in a way that is in harmony with nature and human (Mark R., 2010).

(iv) Social resilience

Social resilience is the capacity of human and community to cope with and adapt to external impacts through environmental, policy and social changes based on four factors: (i) the components making up the system (individuals, communities); (ii) relationships (interactions between components – social relationships such as family, community, membership of associations or clubs, participation in decision making); (iii) innovation (external solutions and responses: R&D, new technology, knowledge, and skills); (iv) continuity: system characteristics maintained over time (shared traditional values and knowledge) (Adger, 2000; Truong Quang Hoc et al., 2015).

(v) Social-ecological resilience

Social-ecological system is the link between human and nature, in which human is the product of interaction between ecosystem and social system. This interaction is also

known for a number of terms, such as human-environmental integration system, socio-ecology, or socio-ecology, which is formed based on factors influencing the system's resilience. For example, many factors such as water cycle, fertilizer, crop and climate diversity, etc. strongly affect the system, leading to different results. Diverse human activities in many different sectors affect and, at the same time, depend on the resilience of terrestrial, aquatic and marine ecosystems. In addition, many human activities, especially in terms of institutions, science and technology, can have a strong impact on increasing/decreasing the resilience of the whole system (Truong Quang Hoc et al., 2015).

b. Assessment of the resilience to the climate of the social-ecological system

There are many different approaches applied to assess the resilience of the social-ecological system to climate impacts. These approaches can be based on an assessment of the capacity of territorial capital to form livelihood modes, such as natural capital, financial capital, physical capital, human capital and social capital; in which, identifying the components of the ability to recover and adapt (hence the intervention points in the resilience management system) is the primary objective of the assessment (Resilience Alliance, 2007). Assessment of the resilience of the social-ecological system requires an interdisciplinary approach with the participation of relevant sectors on the basis of prioritization and the ability to appropriately integrate experiences and knowledge to put forwards solutions ensuring the totality on the basis of key factors in the interactive relationship of the social-ecological system, including: adaptation for change; Diversified development for reorganization and renewal; combination of different types of knowledge to cope; creating opportunities for self-organizing towards social-ecological sustainability (Folke & Berkes, 2003; Truong Quang Hoc et al, 2015). From the above viewpoint, the resilience and adaptation of the social-ecological system to climate change will be based on the following five factors:

(i) Infrastructure and facilities to maintain and develop the essential needs of human and production.

(ii) Society – culture: population, labor, education, health, social capital/social network, community willingness to participate, community knowledge, culture of dealing with nature.

(iii) Economy: income, employment, assets, finance-accumulation, budget subsidy.

(iv) Environment – nature: intensity/frequency of natural disasters, ecosystem/natural capital, land use.

(v) Institutions: risk management, knowledge management, agency coordination, policy integration, environmental policy, risk management (Shaw, 2013).

c. Social-ecological climate change adaptation in Vietnam

With diverse social-geographical features, the impacts of climate change in our

country clearly show territorial characteristics. However, the scale and scope of the impacts of climate change are increasing strongly, exceeding the independent coping capacity of each individual locality. Therefore, it is necessary to have the connection and integration among localities and regions in responding to climate change. The National Target Program to Respond to Climate Change emphasizes the notion that "responding to climate change is conducted on the principles of Sustainable Development, ensuring systematic, integrated, inter-regional factors" (Prime Minister, 2008).

Table 1. The severity of climate change and natural disasters to several regions in Vietnam[89]

	Natural disasters	Northwest	Northeast	Red River Delta	North Central	South Central	Central Highlands	South East	Mekong River Delta
1	Storm	4	4	4	4	3	2	1	1
2	Tropical depression	4	4	4	4	4	-	1	1
3	Flood	4	4	4	4	4	4	3	2
4	Flash flood	4	4	-	3	3	3	2	-
5	Tornado, prime	4	4	3	2	2	2	2	1
6	Drought	3	3	3	4	4	4	3	4
7	Salinization	-	-	1	2	3	-	1	4
8	Flooding	-	-	3	3	4	-	2	2
9	Landslide	4	4	2	2	2	2	2	-
10	River and sea landslide	1	1	2	3	2		2	4
11	Sea level rise	-	-	2	2	2	-	1	4
12	Wildfire	4	4	1	4	3	2	2	2

Source: National Target Program on Climate Change, 2008; Institute of Hydrometeorology & Climate Change, United Nations Development Program, 2015; and author group update, 2018.

In principle, each locality/region itself has a certain specificity, a certain environmental load capacity, a certain resilience to climate change, depending on territorial location, capacity and adaptive resources. For example, the coastal area, which is influenced by both the law of the continent and the sea, forms diverse sources of capital for socio-economic development, but is also subject to the under pressure of natural and human laws, such as impacts of climate change leading to degraded coral reefs, with changes in climatic conditions leading to a decline in fisheries resources, thus affecting the productivity and yield of fishing and farming products.

The Mekong River Delta is assessed as one of the regions severely affected by climate change, including an increase in droughts. Drought occurs on a large scale with

[89](4) Very serious, (3) Serious, (2) Moderate; (1) Trivial, (-) Not affected

increasingly serious impacts affecting production, mainly due to the decline of water resources and lack of moisture reserves, This leads to the degradation of capital sources, which are the basis for people's livelihood activities, especially rural residents – those are vulnerable but have difficulty in recovering from a disaster due to limited drought adaptive resources and conditions, making it difficult to change livelihoods; challenges affecting the results of the national target programs, such as sustainable poverty reduction, new rural construction, etc.

Thus, climate change is increasing the complexity and severity of the impacts through changing the relationship between the natural system and the social system; considered as one of the main limiting factors in territorial development. However, responses to climate change, managed by administrative territory, have not taken into account inter-provincial and inter-regional climate change resilience (Nguyen Song Tung et al., 2017). Therefore, climate change adaptation based on social-ecological regions will bring about the following benefits:

- The suitability level of socio-economic conditions and natural resources, ecological environment for each sub-region.

- The ability to develop the sub-region's comparative advantages, potentials, and strengths.

- Promoting the historical values, indigenous knowledge, and cultural values of the community in adapting to natural disasters and climate change.

- Maintaining the sustainability of the natural capital system and flexibly respond to socio-economic risks and climate change.

- Enhancing connectivity among localities and between localities with centers (nuclear – economic drivers) and infrastructure development connecting localities within the region (Institute of Development Strategy, 2018).

- The scale of the sub-region will be consistent with the organization and management capacity of the local government, as well as the regional connection in responding to climate change among localities.

The results of practical research combined with analysis of framework for approaching social-ecological systems shows that the flexible customization of assessment indicators in accordance with specific territorial conditions, the results of implementation satisfying the practical requirements of several subjects, in different impact contexts, it can be used to answer questions related to the rational territorial management of policy makers, especially linkage, mutual relationship among factors through integrated analysis of development resources. This comprehensive and systematic research result will provide the most objective and scientific view of the research object and territory; thus, it is the basis for proposing proactive solutions to effectively adapt to unusual, extreme and unpredictable changes such as climate change. In particular, the application of theoretical analytical

frameworks and functional zoning results according to the social-ecological approach is the spatial basis for the application of effective territorial development and management solutions through collective learning the territorial factors according to natural ecosystems and social systems. In other words, it is necessary to apply research results, evaluate ecological potential, spatial potential and social-cultural characteristics of the territory, conduct functional zoning on the principles of contingency, relative homogeneity, regional relationship, ensuring sustainable territorial development to create a scientific basis for the development orientation and spatial planning in accordance with the development priorities of each particular territory on the basis of ensuring the load-bearing capacity of nature. Additionally, the knowledge, cultural identity, and management capacity as well as ensuring feasibility in the implementation process should be taken into account.

4. Discussion and Conclusion

Climate change has seriously affected the coping resources of the territory, especially coastal deltas – which are influenced by both ocean and continental laws. Therefore, to proactively adapt to climate change, it is necessary to have appropriate solutions on the basis of a systematic and integrated territorial approach. In Vietnam, there are many territorial research projects with different approaches. However, with the increasingly complex impacts of unpredictable happenings of weather, it is required that territories must regularly update and apply a variety of appropriate research directions in order to maximize their potential.

The approach of social-ecological region is considered as an effective one with thinking about territorial specificity combined with comparing similarities and differences with other territories. This approach has been applied by many countries in adjusting the harmonious relationship between man and nature in order to seek solutions that both ensure sustainable development and well adapt to the increasingly unusual happenings from inside and outside the territory, including climate change. In fact, it has been shown that adopting a natural-social interdisciplinary approach will contribute to elucidating ecosystem responses, including adaptation to human impacts through livelihoods and socio-economic development. On the contrary, in terms of society-humanism, if the natural-social approach is not used, the exploitation of biodiversity resources will be ineffective and unscientific. That is when we do not comply with the social-ecological resilience threshold while allowing people's livelihood and economic activities to destroy the environment and deplete resources.

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