Framework of an Ecotourism Early Warning System: What can we Learn for Hainan, China?

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Abstract Early warning systems (EWSs) are important for risk management. This chapter develops a framework of an ecotourism EWS which includes hazard risk, carrying capacity of service facilities and tourism sites, and tourism development impact assessment, monitoring and warning. Tourism impact is an emerging research spot. In EWSs, negative tourism impacts should be emphasized, including environmental, economic, and social impacts. After the framework is constructed and analyzed, cases based on local characteristics are selected and the concentrated points for ecotourism early warning are analyzed.

Keywords Early warning · Ecotourism · Early warning framework · Tourism impact · Hainan

1 Introduction

Early warning system (EWS) is a key element for risk reduction and adaptation strategies to extreme events. Traditional EWSs focus mainly on hazard detection and immediate warning and evacuation processes in order to save lives in the context of an extreme event. Modern EWSs can be applied to societal well-being as well as to the well-being of individuals and the environment. According to different division base, EWSs can be classified as the following types [1]: formal

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and informal EWSs, political and apolitical EWSs, national and indigenous EWSs, objectively based and subjectively based EWSs, qualitative and quantitative EWSs, and so on. There are four components of EWSs: sources, channels, contents, and receivers [2]. Sources refer to the entity responsible for initiating hazard communication with the public such as government authorities and media figures. Channels are the communications medium used to transmit hazard information such as television and the Internet. Contents include the information of hazard, location, time, and guidance, based on the assessment of the existence and seriousness of a hazard and transmit information of guidance to the public for protecting themselves and adapting to the hazardous environment. Receivers remind disaster warning designers that they must consider the characteristics of the at-risk populations, which may influence the effects of the guidance seriously. Early warning is a part of risk management systems, which are a developing cycle of "hazardous event–response–recovery–mitigation–preparation–warning–adaptation and remediation" [3] (Fig. 1).

From detectability and visibility, risk can be classified into visible and invisible types. Visible risks are normally directly perceptible, or perceptible with the help of science, or virtual risks. Invisible risks generally have characteristics of being hidden from the senses, time-hidden (time latent), or scale-hidden (scale latent). Most underwater risks are hidden from the senses. Risks influenced by the ecosystem are always time-hidden. And risks in water flow normally occupy a large area and are scale-hidden [4].

Tourism management emphasizes risks prevention and related responsibilities guidance, for different stakeholders [5]. Uncertainty is one of the challenges for risk and risk tolerance simulation and forecast, especially for tourism management planning [6–8]. How to integrate individual's economic choice with coastal risk management [9], and how an EWS effects environment [10], are hot spots for research.

The objectives of ecotourism EWSs are threefold. The first objective is to reduce impacts on the environment and enhance interaction with nature. The secondary objective is to help tourists behave responsibly and enhance tourist satisfaction. The third objective is to improve the tourism impact on the local economy, to enhance community involvement and interaction with local people, and to improve local people's quality of life.

2 Ecotourism Early Warning Framework

To build an EWS, the framework should be studied and set up in advance. For sustainable ecotourism development, the complete EWS should include not only hazard forecast, simulation, and warning, but also ecotourism capacity monitoring and warning, with tourism impacts simulation and warning. Hazard forecast,

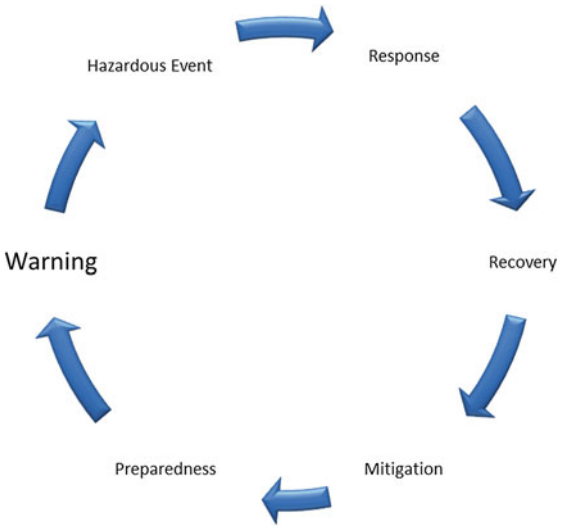

Fig. 1 Warning and risk management system

simulation, and warning are the fundamental contents of risk assessment and warning systems. It could be timely warning, mid-term warning, or long-term warning. Capacity monitoring and warning should provide receivers periodical information, i.e., hourly, daily, weekly, seasonal, or yearly. System impacts are applied to simulate the impacts of tourism development, forecast it and provide warning for negative outcomes.

Ecotourism EWSs have complex contents. Hazard subsystems include natural hazards and extreme weather such as tropical cyclones or coastal flooding; man-made hazards such as transportation accidents, fuel/resource shortages, air/water pollution/contamination, health/disease outbreaks and illness, criminal activity; and technological hazards, for example IT systems failure, telecommunications, product defect or contamination, which could be linked with the thematic hazard warning system [11]. Capacity subsystem refers to physical, economic, social, and biophysical carrying capacities, which could be linked with a real-time tourism statistical database. Tourism impact subsystem includes environmental, economic, social, and comprehensive impact simulation and warning, in which modeling and forecasts for medium- and long-term impacts are emphasized (Fig. 2).

In the framework, hazard risk monitoring is connected with the preexisting thematic hazard monitoring system. Carrying capacity monitoring should use the tourism statistical database and analyze relationships between tourism hotel, tourism sites, and tourist demands in order to find a balance. Tourism impact assessment is the most important content for research, as well as for long-term risk monitoring and warning.

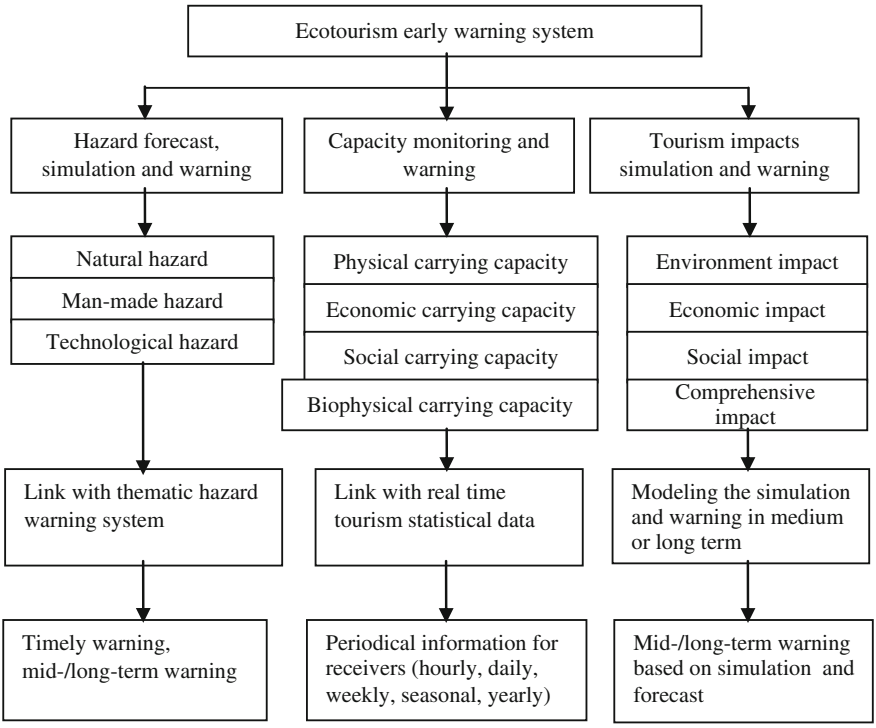

Fig. 2 The framework of ecotourism early warning system

3 Tourism Impact Assessments

3.1 Impacts of Ecotourism

Impact of tourism development is the key issue that should be studied in ecotourism warning system, since it concerns the long-term development sustainability of ecotourism itself. Ecotourism development generates positive and negative impacts on the economic, environment, and social community. Balance between different aspects is an important base for its sustainability. Ecotourism early warning focuses on negative impacts assessment, since negative aspects cannot be deducted by positive ones, even though in political decision-making processes, they normally are deducted. Potential negative environment ecotourism impacts are contained in many aspects [12], shown in Fig. 3.

From the perspectives of tourists' and indigenous communities' angles, the positive impact is the opportunity for leisure, enhancement of knowledge, improvements to indigenous communities' infrastructure, economic benefits, and the conservation of natural and cultural resources for communities. Tourists are negatively impacted when there is a disconnection between their expectations and

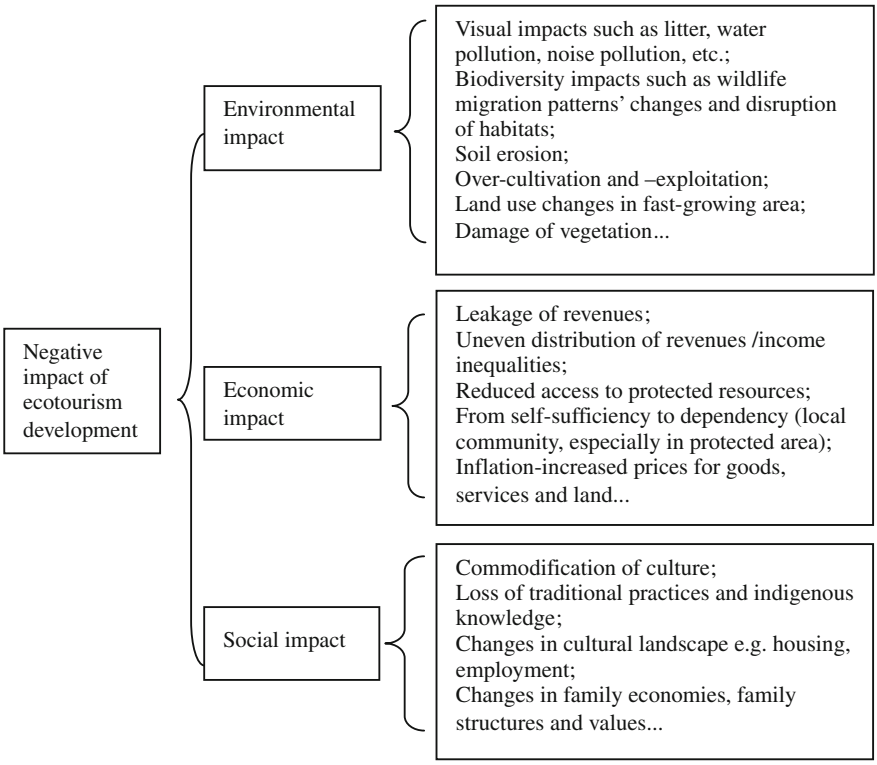

Fig. 3 Negative impact of ecotourism development (according to [12])

their actual experiences. Negative impacts for indigenous communities include over-straining infrastructure, socioeconomic unrest, and damage to the cultural traditions and the natural environment.

3.2 Challenges for Tourism Impact Assessments

Impact assessment is the most important and fundamental part for tourism EWS, for which challenges exist [13] (Fig. 4).

For all forms of impact assessment, there are still difficulties of establishing a benchmark against which to measure change; distinguishing human-induced changes from natural changes; modeling of the relationships between cause and effect; identification of the complexity of environmental interactions, and so on.

Specifically for ecotourism development impact assessment, challenges exist in identifying impacts from the diversified tourism and management activities and from the diversified environments in which tourism activities occur, as well as measuring impacts from the mobility of tourists, and dividing the impacts from accumulations.

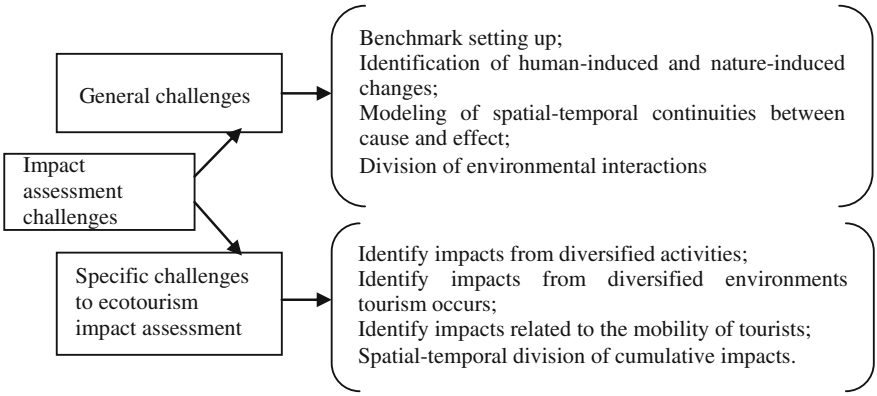

Fig. 4 Challenges for impact assessment (according to [13])

4 Hainan EWS Characteristics and Case Selection

4.1 Objectives

The objective of ecotourism EWS is to maintain the sustainability of ecotourism development, to improve the management quality of ecotourism, and to improve local benefits from ecotourism development. Hainan Ecotourism EWS aims to develop an appropriate framework, meaningful and scientific assessment index system, and a visualized management system.

The framework of this ecotourism EWS illustrates that we should focus on the main characteristics of a given study area and the negative impact assessment of ecotourism development.

Hainan is an international ecotourism island with high-quality coastal resources, high-quality forest and biodiversity, minority populations and an ocean/marine climate.

To assess ecotourism impacts on the environment, economy, and society, the focus should be on coastal regions, natural forestry regions, and indigenous communities. According to the characteristics, Sanya, Ledong, and Wuzhishan are the most appropriate cases for developing an ecotourism EWS (Table 1; Fig. 5).

4.2 Sanya

Sanya is the southernmost city on the Chinese island, with a population of 685,408 (according to the 2010 census), living in an area of 1,919.58 km^2. The city is renowned for its tropical climate and has emerged as the most popular Chinese "Sun, Sand and Sea" tourist destination. International resort hotel chains and new

Table 1 Case and characteristics of ecotourism EWS in Hainan, China

Case study area	Characteristics
Sanya	Urban, coastal (fine sandy), and developed tourism
Wuzhishan	Terrestrial, hilly/mountainous, nature-based resources, tropical forest, and developed/developing tourism
Ledong	Rural, coastal (fine sandy), minority, and developing tourism

Fig. 5 Case location map in Hainan (Sanya, Wuzhishan, and Ledong) (The base map is from http://d-maps.com/carte.php?num_car=21212&lang=en)

venues for resorts have been developed in the most popular sites such as Dadonghai and Yalong Bay. Prosperous tourism development also pushed city development with tourism, recreational, and real estate development, which expanded the physical space of the city and changed the structure of the society. In Sanya, the following themes for ecotourism development should be examined: (1) coastal security from landscape/physical and biodiversity security; (2) tourism economic impact related to urban fringe equity and the interactive role between tourism development and macro economy; and (3) the capacity of tourism sites and facilities. An EWS for Sanya's ecotourism development should focus on: (1)

urban landscape change and warning the landscape security, especially for coastal area and urban fringe; (2) timely monitoring for tourism facility capacity; and (3) local people livelihood benefit from tourism industry (economic equity).

4.3 Wuzhishan

Wuzhishan is a county-level city in the south-central part of Hainan. The city's total area is 1,129 km^2, with a population of 115,000. Wuzhishan is a typical tropical rain forest with abundant biological species and well-developed tourism. In Wuzhishan, (1) relationships between tropical rain forest and biodiversity, (2) tourism impact on local economic development, and (3) ecological capacity of tourism sites should be focused on. An ecotourism EWS for the city should emphasize (1) timely monitoring the tourist attraction zone capacity and communications; (2) tourism development impacts on natural resources and the environment; (3) local participation and benefit from tourism development; and (4) landscape and biodiversity security.

4.4 Ledong

Ledong is a Li Autonomy County, with a population of 458,876 (38.61 % of which are minorities, 2010), living in an area of 2763.22 km^2. Ledong is an agricultural county west of Sanya, with 84.3 km of coastal line and 1,389 km^2 of sea area. Jianfeng forest park is close to the Jianfengling tropical rain forest conservation area. Ledong has abundant biodiversity based on its diversified topographies such as beach, coastal plain, alluvial plain, hilly, and mountainous areas. Sustainable ecotourism in Ledong is concerned with the coastal development and impact, interaction between tourism development and tropical forest conservation, local agricultural development and tourism, and economic improvement for minorities. And the early warning of ecotourism development should focus on the landscape and biodiversity security based on tourism resources development plan, the impact of drought, agricultural, local participation on the tourism sustainability, and the impact of tourism development on the local economy.

5 Conclusion and Discussion

Early warning is the most important element for risk management systems. Ecotourism EWSs include hazard risk, carrying capacity, and tourism impact monitoring, simulation and warning. Hazard risk monitoring can be linked with preexisting thematic warning system. Capacity monitoring should focus on tourism facility and

resource carrying capacity, respectively. And impact assessment and simulation is the most important content for research and for long-term warning system. The impact assessment should focus on the negative aspects, not the balance between negative and positive, even though most of the political decisions are based on a balance. The impacts are for environment, economy, and society, aiming on the special characteristics within study areas. For Hainan, Sanya—the most famous southernmost coastal tourism city, Wuzhishan—the northern neighboring county to Sanya with high-quality tropical rain forest and local communities, and Ledong Li autonomous county with the expansion pressure for coastal tourism development based on the special west neighboring location to Sanya are selected as the typical cases for Ledong ecotourism EWS building.

Even though there remain lots of challenges for ecotourism impact assessment and the long-term real-time monitoring, for example, the benchmark for the changes, the relationships between cause and effect, the division between accumulate and diversified-driving-forces-induced changes, the framework and general methodology are available for further probing.

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