Rational environmental management on the example of the Kingdom of Thailand

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Abstract. The article raises the problem of rational nature management in the Kingdom of Thailand. The research questions concern the loss of biodiversity, the reduction of forest space, the lack of fresh water, climate change, air and water pollution. Cost-benefit analysis is considered as the main economic tool to justify the adoption of design decisions in the field of nature management and environmental protection. When solving the research problem, the most promising direction of preserving the well-being of society through the effective use of natural resources, the concept of a "green" economy was adopted. The economic efficiency of the application of this direction of development was determined.

1. Introduction

The territory of the Kingdom of Thailand is abundant in natural resources. They play the leading role in the development of the economy and support of the local population. Forests, marine flora and fauna, minerals, reservoirs - all of this is widely used in industry, sold for export and attracts tourists to the country. It is sad that economic benefits often take precedence over conservation issues. The rapid development of the economic sector over the past few decades has led to an unwise and wasteful exploitation of natural resources.

In a number of regions of the country, experts note the growing degradation of the environment. These include: declines in biodiversity, plant and animal populations, degraded air and water quality, soil pollution, massive deforestation, and significant climate change.

In the rankings in relation to other countries, Thailand boasts a fairly high level of biodiversity. However, excessive consumption puts it at risk if the necessary measures are not taken to preserve them. Many species were included in the so-called "red list", according to the International Union for the Conservation of Nature. Many of them are classified as endangered. As of the end of 2019, about sixty species of mammals, more than fifty species of birds, more than a hundred species of fish, and more than one hundred and fifty species of plants were in danger of extinction [1].

The most important component of Thailand's coastal ecosystems are mangroves, with a third of the Kingdom's coastal areas bordering. These forests are a habitat for Thai fauna and a source of food, not only for animals, but also for the population. In mangroves, shrimp and fish nurseries are often set up. Also, such wood becomes a raw material for coal production. [2] Massive degradation of mangrove forests occurred...
between 1975 and 1993. Their area at that time was reduced by almost half. This was provoked by a large-scale invasion of aquaculture ponds for growing shrimp in forested areas [3]. Today, the Kingdom still maintains a leading position in the world in aquaculture production. However, between 2000 and 2020, because of conservation efforts, the rate of deforestation decreased significantly. However, small areas of residual mangrove trees in the country still need protection [4].

The most notable achievement of environmental policy was the introduction of a complete ban on deforestation in natural forests in January 1989. Since then, the government has developed a forest conservation strategy to conserve the remaining forest resources [5]. Negative factors affecting deforestation include illegal land clearing and encroachment on forests, resort development, mining, and road and hydroelectric power plant construction. Limiting the influence of these factors allowed Thailand to achieve the planned result for several decades [6].

Almost 19% of Thailand's total land area in 2019 was classified as a protected area. This figure is higher than the world average of 14.8%. [7] At the moment, the share of forested areas is approximately 32.1% of the total land area in the Kingdom. Increasing this indicator over a long period of time is on the national agenda.

Water resources are another of Thailand's treasures. Over the past sixty years, total renewable domestic freshwater resources per capita have declined by about half. One of the reasons for this was the significant increase in the country's population. [8]

The demographic surge has led to the need to increase the volume of agricultural production in order to provide both the domestic market and exports. So the need arose to develop irrigation schemes for the development of the agricultural industry [9]. At the same time, the critical problem was the uneven rainfall associated with the pronounced seasonality in Thailand. Water storage accounts for only 30% of total rainfall, with scarcity often occurring during periods of greatest demand. [10]

For this reason, the quality and quantity of water in the catchments has become much worse. Degradation of wetlands is observed near Thai cities. This is due to the fact that water bodies are rearranged into rice fields. In addition, urban and industrial development leads to pollution from sewage and industrial effluents [11].

Global climatic changes did not affect the values of the total precipitation in Thailand. However, in different regions of the country, precipitation trends differ. According to the latest data, the climate has become drier in the central and eastern parts of the Kingdom, while humidity has increased in the northeastern regions, the Gulf of Thailand and the surrounding area of the capital. Due to the changing climatic conditions, extreme weather events such as tropical storms, floods, and prolonged hot dry periods began to occur more and more often. Over time, they become more unpredictable and intense [12].

2. Methods
Sustainable development requires a trade-off between economic growth and environmental values. The Kingdom uses a number of economic instruments to assess the provision of ecosystem services. They allow you to make informed decisions about the consequences of environmental impacts. These tools include cost-benefit analysis and ecosystem assessment tools, which are used to communicate payment patterns and promote environmental protection. This analysis is one of the common practical methods for assessing the effectiveness of environmental protection measures to justify the adoption of design decisions in the field of nature management and environmental protection.

Conservation measures differ in their content. Some are responsible for the construction and operation of treatment and disposal facilities and devices, controls and monitoring of production processes; introduction of low-waste technological processes, equipment and production; disposal and recycling of waste; mastering the production of environmentally friendly products; land reclamation; measures to combat soil erosion; protection and reproduction of flora, fauna, etc. Others are responsible for the development and
implementation of new environmental standards and regulations; creation of a unified regional system of environmental monitoring; development and implementation of regulatory and governing documents; location of enterprises and traffic flows, taking into account environmental requirements, etc. Another type of environmental protection measures is engaged in research and development of new environmentally friendly technologies and equipment; devices and software products.

Undoubtedly, the implementation of such measures is accompanied by the corresponding costs, among which are: the costs of purchasing, installing and operating environmental protection equipment, control devices; expenses for the modernization of the main production in order to achieve the required level of environmental safety; costs of implementing environmental and energy and resource saving programs and projects; the costs of providing management and supervision in the field of environmental protection. Mainly, Cost-Benefit Analysis considers the costs of reducing or preventing environmental pollution. As a result of the implementation of these measures, the general environmental and general socio-economic effects should be achieved.

To assess the effectiveness of environmental protection measures, it is proposed to use the following indicators. In the case when the periods of construction, reconstruction or design life do not change significantly over time, the Net economic effect is applied, which is defined as the difference between the total economic result and the cost of performing activities.

\[ FEE = R - C \]  
Where \( R \) - economic result, \( C \) - costs of activities

\[ C = Co + Ke \]  
Where \( Co \) – operating costs (for maintaining and maintaining fixed assets), \( K \) – investment, \( e \) – standard coefficient of economic efficiency of capital investments for environmental protection purposes.

Another indicator that is determined to assess the degree of development of capital investments and to establish the national economic results of expenditures on environmental protection is the absolute economic efficiency of environmental costs

\[ Ce = \frac{P}{Co + Ke} \]  
\( P \) – full economic effect.

If there are several options for the implementation of environmental protection measures, the choice of the best one is carried out in accordance with the expression:

\[ NV = (R - C) \rightarrow \text{max} \]  

When determining the net economic effect of environmental protection measures designed for a long period of implementation, the calculation must be carried out taking into account discounting:

\[ NPV = \sum_{t=0}^{T} \frac{(R_t - C_t)}{(1 + z + r)^t} \]  
Where \( NPV \) – net present value t- step number \( t = 0, 1, 2, \ldots T \) (year of implementation); \( T \) - calculation horizon - the entire period of equipment use, a year; \( R_t \) – full economic result of environmental protection costs on the t-step; \( z \) – risk amendment; \( r \) – discount rate - constant, equal to acceptable

Currently, experts note that the standard model of a resource-intensive economy will entail higher costs and lower productivity. In this regard, the introduction of the green economy concept is a real chance for sustainable development. The above concept leads to a significant reduction in the harmful effects on nature, while increasing the health indicators of the population. This model of the economy can be regarded as low-carbon, resource-saving, socially inclusive. This concept, according to the definition of the Organization for Economic Cooperation and Development, is defined as the source of maximum provision for economic growth and development. At the same time, this model has an impact on the quantity and quality of natural assets and uses the full growth potential in the transition to a green economy. The so-called "green" growth, or GDP growth, which is associated with the terms of the concept, is an opportunity for expanding the labor market, changes in the employment system itself and professional competencies of workers.
Analytical calculations have shown that the implementation of a green growth policy, taking into account all the trade-offs, can cost more than $2 billion for the national economy of Thailand. Comparing this with the previous scenario, the potential for an increase in the net present value of ecosystem services associated with the exploitation of forests, including mangroves, wetlands and coral reefs, we see an increase in economic growth of 7.8%. Another obvious benefit from implementing green growth policies is related to improved water quality and regulation of domestic and industrial wastewater. After numerous experiments on modeling the application of various ways to protect ecosystems, experts have identified an improvement in performance by 8.4%.

3. Results
In 2019, Thailand was ranked 20th in terms of carbon dioxide emissions into the atmosphere, while the country accounted for about 0.9% of all global emissions. In general, this value corresponds to slightly lower per capita emissions than the global average. Thailand's economy with a moderate carbon intensity contributes significantly to the ranking of countries (9th out of 140 countries) in the Global Happy Planet Index. These results indicate that Thai citizens have achieved some success in building a sustainable economy that provides a relatively high level of well-being (6.3 out of 10), moderate life expectancy (74.1 years) and moderate social inequality (15%) [12].

The climate, picturesque nature, rich flora and fauna attract many tourists to Thailand every year. The tourism sector makes a significant contribution to the national economy of the country. However, the rapid growth of this industry has also led to negative environmental impacts such as depletion of natural resources and environmental degradation.

Within the framework of the “7th National Plan for Economic and Social Development” (1992-1996), the environmental protection policy was revised, a number of normative acts were changed with an emphasis on the sustainability of the state of the environment. Back then, this country's development plan identified environmental protection as a top priority for the Thai government. Building on this plan, the Law on the Improvement and Conservation of the Environment (1992) was developed. The purpose of this law was to reform the practice of natural resource management and environmental protection in the Kingdom through effective, transparent and accountable monitoring. This regulation was used to enhance public participation through decentralized governance processes conducted by local authorities in accordance with the polluter pays principle. [13]

According to the 12th National Economic and Social Development Plan (2017–2021), the Thai government is now committed to achieving the goals of stability, prosperity and resilience for the economy, society and the conservation of natural resources through the “economy of sufficiency ”. The adopted strategy of environmentally friendly "green growth" is becoming one of the main approaches aimed at sustainable development of the country for the period up to 2030.

Thailand's National Assembly has also developed a 20-year national strategy (2017-2036). This strategy is being used by the relevant line ministries to further develop the main policy vectors and ensure more sustainable and coordinated work. [14]

A good example of their activities is the National Environmental Quality Management Plan (2017–2021). [21] This policy identifies four main pillars related to natural resource management in Thailand, including environmental quality management, natural resource protection and restoration, natural resource efficiency improvement and international cooperation on climate change.

Thailand also adheres to other global policy frameworks, such as the Global Strategic Plan for Biodiversity 2011–2020 and the biodiversity targets. Thailand intends to fully comply with its international obligations under agreements such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Ramsar Convention on the conservation of wetlands.
The Kingdom of Thailand's policy today is to create a livable society with a stable and flexible economic system that can adapt to climate change and ensure low carbon emissions. At the same time, with the help of this policy, Thailand intends to enter the category of high-income countries. The goal of moving from above-average classification is projected to double Thailand's current GDP per capita from $6,357 to $12,236 per year. For this forms of socio-economic development that conserve natural resources will be used.

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