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Human Ecosystem Approach to The Dynamics of Sustainable Development in Komodo National Park, Indonesia

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ABSTRACT

This article aims to present the dynamics of sustainable development in Komodo National Park (KNP) using a human ecosystem model. The Human Ecosystem model is a coherent system of biophysical and social factors capable of adaptation and sustainability over time. A rural village in Komodo island, Labuan Bajo, East Nusa Tenggara, Indonesia can be considered a human ecosystem because it has identifiable boundaries, essential ecosystem functions, resource flows, social structures, social processes (including adaptive responses to changed conditions), and dynamic continuity over a period. In 2020, the "Jurassic Park" tourism project in Komodo National Park has become a hot topic on social media after a photo of a Komodo dragon blocking a truck popped up. The project's rejection became the most popular topic on Twitter with the hashtag #savekomodo. Various groups believe that the project will destroy the Komodo dragon's natural habitat, evict the local population, and be carried out solely for financial gain. As a result, it is critical to understand the current situation there. The HEM helps us identify the critical resources and the social systems, as well as the key flows that contribute to the dynamic of the human ecosystem in KNP. This article yields three important findings that should be considered in the future management of KNP. First and foremost, the Komodo dragon population is still stable, but it has the potential to decline in the long term due to changes in spatial planning, an increase in tourists, a decrease in food, and poaching. Second, expanding large-capital corporations that can replace local businesses such as boat rentals, car rentals, homestay businesses, restaurants, souvenirs, and tour guides/rangers will reduce local people's income from tourism. Third, kinship relationships between Komodo dragons and the clan of Ota Moda are eroding because of fewer encounters between Komodo dragons and the island's indigenous tribal communities.

Keywords: *Human ecosystem model, "Jurassic Park" tourism project, Komodo National Park, sustainable development, Indonesia*

ABSTRAK

Artikel ini bertujuan untuk menyajikan dinamika pembangunan berkelanjutan di Taman Nasional Komodo (TNK) dengan menggunakan model *human ekosistem*. Model *human ekosistem* adalah sistem koheren dari faktor biofisik dan sosial yang mampu beradaptasi dan berkelanjutan dari waktu ke

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waktu. Sebuah desa di pulau Komodo, Labuan Bajo, Nusa Tenggara Timur, Indonesia dapat dianggap sebagai human ekosistem karena memiliki batas-batas yang dapat diidentifikasi, fungsi ekosistem esensial, aliran sumber daya, struktur sosial, proses sosial (termasuk respons adaptif terhadap kondisi yang berubah), dan kontinuitas dinamis selama suatu periode. Pada tahun 2020, proyek wisata "Jurassic Park" di Taman Nasional Komodo menjadi topik hangat di media sosial setelah muncul foto komodo yang menghalangi truk. Penolakan proyek tersebut menjadi topik paling populer di Twitter dengan tagar #savekomodo. Berbagai kalangan percaya bahwa proyek tersebut akan menghancurkan habitat alami komodo, menggusur penduduk setempat, dan dilakukan semata-mata untuk keuntungan finansial. Akibatnya, sangat penting untuk memahami situasi saat ini di sana. HEM membantu untuk mengidentifikasi sumber daya penting dan sistem sosial, serta arus utama yang berkontribusi pada dinamika human ekosistem di TNK. Artikel ini menghasilkan tiga temuan penting yang harus dipertimbangkan dalam pengelolaan TNK di masa mendatang. Pertama dan terpenting, populasi komodo masih stabil, tetapi berpotensi menurun dalam jangka panjang karena perubahan tata ruang, peningkatan wisatawan, penurunan makanan, dan perburuan liar. Kedua, ekspansi perusahaan modal besar yang dapat menggantikan usaha lokal seperti persewaan kapal, persewaan mobil, usaha homestay, restoran, cinderamata, dan pemandu wisata/ranger akan mengurangi pendapatan masyarakat lokal dari pariwisata. Ketiga, hubungan kekerabatan antara komodo dan klan Ota Moda terkikis karena lebih sedikit pertemuan antara komodo dan komunitas suku asli pulau itu.

Kata Kunci: Model ekosistem manusia, proyek pariwisata "Jurassic Park", pembangunan berkelanjutan, Taman Nasional Komodo, Indonesia

INTRODUCTION

Destinations for tourism function as complex systems that are made up of various interacting components that are nonlinear, cross-scale, continuously developing, and depending on one another (Nyaupane et al., 2018). Because of the natural, historical, and cultural wealth that they possess, protected areas make excellent potential tourist destinations (Cengiz, 2007). This is especially true from the perspective of ecological tourism. The utilization of this goods and services approach has the potential to play a fundamental role in the Human-Ecosystem Approach, by enabling the pressures and demands of society, the economy, and the environment to be integrated into environmental management (Beaumont et al., 2007). This integration is accomplished using the Human-Ecosystem Approach.

Komodo National Park, also known as KNP, is considered to be one of the country's oldest national parks. On March 6, 1980, the park opened to the public. The combined land and water areas of the KNP add up to a total area of 173,000 hectares (Ha) (Walpole, 1997). The Komodo National Park is made up of a number of smaller islands as well as the three main islands of Rinca, Komodo, and Padar, which are all of volcanic origin (Fox et al., 2001). There are approximately 5,700 giant lizards living on these volcanic islands, and they are known as "Komodo dragons" due to their intimidating appearance and aggressive behavior. These characteristics led to the origin of this name. The Komodo dragon is the world's largest living species of lizard, reaching lengths of between 2 and 3 meters on average. They can be found nowhere else on Earth and are of utmost importance to researchers looking into the theory of evolution because of their uniqueness. The craggy

hilltops of the dry savannah and the patches of prickly green vegetation provide a striking contrast to the brilliantly white sand beaches and the brilliant blue waters that surge over the coral. The park was established with the intention of preserving the local population of Komodo Dragons (*Varanus komodoensis*) as well as the habitat that they call home (Ariefiandy et al., 2021).

KNP received many international recognitions; Man, and Biosphere Reserve (1977), World Heritage Site (1991), and The New 7 Wonder of Nature (2011). Those given titles help to boost the brand and increase tourist visits to KNP (ksdae.menlhk.go.id, 2022). KNP has the potential for terrestrial tourism activities such as trekking and bird watching, particularly seeing the Komodo dragon as well as marine tourism activities such as snorkeling and diving, which are popular with tourists. Each year, 90,000 tourists visit KNP, with 90 percent of them being foreign tourists and 10% being domestic tourists. KNP contributed Rp. 19.3 billion in non-tax state revenues in 2015, a 400% increase over the previous year. Even in 2018, KNP contributed Rp29.1 billion in non-tax state revenues from Komodo Island tourist visits. The revenue was obtained from the purchase of tourist tickets to Komodo Island, as well as trekking, surfing, and diving tickets (Walpole, 1997). KNP is one of the popular tourist destination in Indonesia (Kumari et al., 2010). The acceleration of the development of nature-based destinations is dedicated to achieving the 2015-2019 National Tourism Targets. During a visit to Labuan Bajo in 2015, Jokowi said the government would formulate a grand design that considers the capacity of the KNP to maintain a balance between tourist business interests and conservation. Therefore, Komodo Island would be exclusively reserved for conservation purposes while Rinca Island, which also has Komodo dragons, would welcome more visitors than the former (Ardiantiono et al., 2018).

Human ecosystems are the life-support systems of the earth, providing sustenance not only for the human species but also for every other kind of life, including KKP. They are dependent on one another and operate as dynamic units. The essential factors that determine the health and well-being of the population of the world are the stable ecosystems and the resources that can be sustained over time (Hancock, 2011). On the other hand, human activities, conduct, and the progression of society all have an impact on the ecosystem. The question of how human communities can protect human health without compromising their ability to meet growing demands for resources and ecosystem services while simultaneously fostering thriving, resilient communities and environmental sustainability is one of the great development challenges of the 21st century (Charron, 2011).

Following President Joko Widodo's 2015 visit, the Komodo National Park began to improve. Minister of Environment and Forestry (KLHK) and the Ministry of of Public Works and Public Housing (PUPR) signed a Cooperation Agreement in July 2020 to develop and implement tourism facilities and infrastructure in Loh Buaya, Rinca Island.

The "Jurassic Park" tourism project, which started in 2020, has become a hot topic on social media after a photo of a Komodo dragon blocking a truck popped up. The rejection of the project became the most popular topic on Twitter with the hashtag #savekomodo (Muhammad & Isnaini, 2021). Activists and United Nations Educational, Scientific and Cultural Organization (UNESCO) are concerned that Indonesia is endangering its Komodo dragons' deadly giant lizards — with its tourism ambitions (Erb, 2012). Various groups believe that the project will destroy the Komodo dragon's natural habitat, evict the local population, and be carried out solely for financial gain. Based on this, it is critical to comprehend the current situation in KNP. The HEM assists us in identifying critical resources, social systems, and key flows that contribute to the dynamic of the KNP human ecosystem. The model may also assist us in capturing the full range of potential impacts that we must consider.

THEORETICAL FRAMEWORK

"The structure and dynamics of human ecosystems framework" by Burch et al. (Burch et al., 2017) understands the human ecosystem as a unified system of biophysical and social elements that might adapt and sustain themselves through time (Burch et al., 2017). If a rural community has boundaries, resource flows, social structures, and a dynamic continuity, it might be considered a human ecosystem. 'Critical resources' in the HEM include natural resources (like energy, fauna, wood or water), socioeconomic resources (like labor or capital), and cultural resources (like myths and beliefs). The HEM also includes the human social system, which is made up of social institutions, social cycles, and social order, among other things. Human social systems govern and control both the supply and use of vital resources in this system (Burch et al., 2017; Machlis et al., 1997).

Three subsystems make up the social system. To begin with, there is a group of social institutions, which are collective responses to universal societal problems or needs. Social cycles, the timetable by which humans allocate their time, make up the second subsystem (Burch et al., 2017). These key resources are heavily influenced by social cycles. In a community or culture, a common example is the collection of synchronized rhythms used to plan events such as holidays, festivals, harvests, fishing seasons, and business days, among others. There are three major subsystems to the social order, which is the way people and groups interact in society. Personal identifiers (such as age or gender) are only one of three key processes in the social order that govern behavior. The other two are norms and hierarchies (for example, of wealth or power). Much of human behavior can be predicted to a large extent by the social order (individually, collectively, and in connection to social institutions and social cycles). The social system is made up of social institutions, social cycles, and the social order. The human ecosystem is the result of this and the flow of key resources. There is a strong correlation between each of these factors.

RESEARCH METHOD

Data Collection and Analysis

As part of our investigation of peer-reviewed publications, we used the SCOPUS database, one of the most comprehensive databases of peer-reviewed research literature, as well as WoS, PUBMED and Google Scholar databases. Our study employed the sustainable tourism concept to assign HEM to the ecological services, and the results were inconsistent. For a comprehensive global strategy, we utilize all of the HEM components necessary to enhance human well-being and a proper framework. HEM is influenced by policies and land management decisions, and hence must be addressed to quantify the impacts and costs on each resource. It is vital to emphasize that ecosystem services and ecosystem processes are not the same thing.

We need to focus on a few variables while studying an ecosystem. Due to time and information limits, as well as the significance of focusing on specific challenges, certain variables are more significant than others (Burch et al., 2017). There are key resources in Komodo National Park (KNP) that need to be identified before we can start working on solutions. Then, we'll examine how the social system administers these vital resources. The dynamics of the human ecology in KNP will be influenced by the flow of essential variables, such as humans, information, and capital. At KNP, a human ecological framework may be shown in Figure 1. This part begins with a discussion of important resources, then the social system, and ultimately the flow of crucial variables that influence the dynamics of the human ecology in KNP.

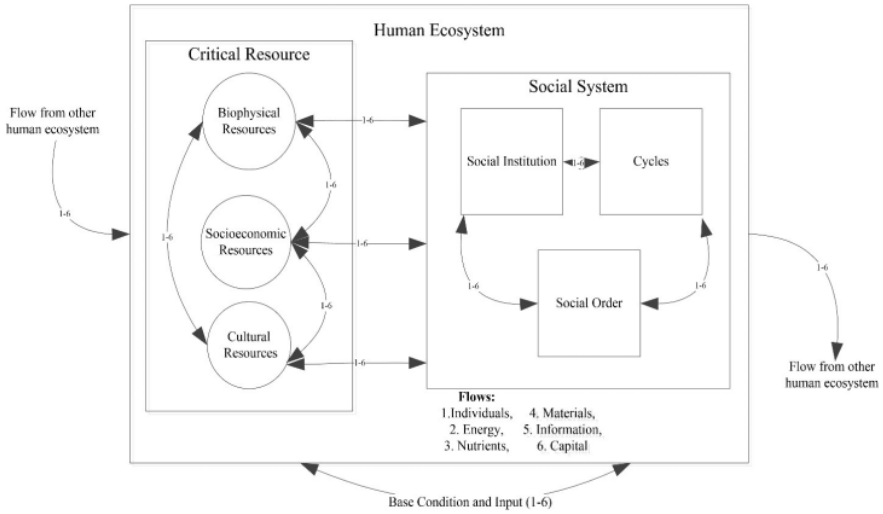

Figure 1. The Human Ecosystem Model
Source: (Burch et al., 2017)

Study Location

A volcanic archipelago in the middle of the Indonesian archipelago, KNP is made up of various smaller islands, including Rinca, Komodo, and Padar, which are all part of the KNP archipelago (Fox, 2004). Located at the nexus of the Australian and Sunda ecoregions in the Wallacea Biogeographical Region, this national park represents the "shatter strip" between the two plates. There are 219,322 acres of land and sea that make up the property, which has been designated as a worldwide conservation priority area. Specific evolutionary adaptations in terrestrial flora, from open grassland savanna to tropical deciduous forests, have been triggered by the dry environment (monsoon).

Forested areas, including some that resemble a cloud forest. Sand beaches and clear, turquoise water contrast sharply with the rough terrain and little flora of the nearby mountains. The Komodo Lizard, Varanus komodoensis, is the park's most notable resident (Jessop et al., 2018)v. The evolutionary implications of these huge lizards, found nowhere else in the world, are particularly intriguing to scientists. The Komodo Lizard, popularly referred to as "Komodo Dragons" because to its looks and aggressive nature, is the biggest extant species of lizard, reaching an average length of 2 to 3 meters. The species is the sole survivor of a once-vast population of giant lizards that previously roamed Indonesia and Australia in great numbers. Many interesting terrestrial species, like the orange-footed scrub fowl, an indigenous rat, and the Timor deer, can be found in the Park. Komodo's coral reefs are home to a wide variety of marine life, including sea turtles, whales, dolphins, and dugongs (Pulinggomang & J Fanggidae, 2019).

RESULTS AND DISCUSSION

Critical Resources

This article focuses on water, vegetation, animals, and land. Komodo Island has few perennial water sources. Several catchments and springs offer water year-round. Perennial springs along the shoreline and dry streambeds can be dug for water. Komodo island's greyish-brown soil combines latosol and fertosol (Pet & Yeager, 2000). Clay-textured soil cracks in the dry season. Andesite stone dominates the north (near Mt Satalibo) and south (from Mt Komodo in Southern direction). Dasitic stone dominates the west, while tuff, marl, and volcanic material dominate the east and northeast. Locals rarely grow grains or veggies. The island lacks perennial plantations (Pet & Yeager, 2000).

Local livelihoods in Komodo Village had been dominated by fishing (Lasso & Dahles, 2018). Drying fish and seaweed requires broad, flat spaces. Residential needs include houses of worship, the subdistrict administrative office (Kelurahan), public roadways, schools, and a community health center (PKA). Komodo's remaining land is a national park. Current land use is limited to coastal areas around springs. Komodo settlement at

Teluk Slawi bay is the island's land use center. Coconut trees and bamboo grass in the interior may suggest land use further inland; other forces may have disseminated these species. Komodo island's vegetation includes mangrove forests, coastal forests, savannas, monsoon forests, and quasi-cloud forests. Rhizopora mucronata, Ceriops tagal, Sonneratia alba, and Avicenia spp. dominate the East coast mangrove woods near Sebita. Borassus flabelifer dominates the savanna from the shore to 400 m above sea level. Savannah woods covers 70% of the land. Komodo Island is named after the indigenous Komodo dragon (*Varanuskomodoensis*) (van Hoek et al., 2019). Wild buffalo (*Bubalus bubalis*), wild pig (*Sus scrofa*), deer (*Cervus timorensis*), and the wild horse are among the other terrestrial species (Ariefiandy et al., 2013). Domestic and international tourists love Komodo's wild fauna. Its distinctive wildlife has drawn international scientific interest and research efforts. Komodo National Park has 1,000 tropical fish species, 260 coral types, and many marine creatures (Fox et al., 2001). Blue-ringed octopus, pygmy seahorse, whale sharks, ocean sunfish, eagle rays, manta rays, sponges, nudibranchs, sperm whales, blue whales, dolphins, dwarf fin whales, sea turtles, and dugongs are found in the park's surrounding seas (Erdmann, 2004).

Because of Indonesia's ocean-atmospheric circulation, high population of coastal settlements, and extensive marine activities, the country is grappling with the problem of a large amount of marine debris that has accumulated as a result of its movement and accumulation. (Nurhati & Cordova, 2020; Purba et al., 2019; Sari, Inoue, Harryes, et al., 2022; Sari, Inoue, Septiariva, et al., 2022; Septiariva & Suryawan, 2021). Marine debris is both pervasive and transboundary, as it was discovered in the marine environment and transported by currents to various directions, including uninhabited islands (Purba et al., 2019; Septiariva et al., 2022). During the inquiry, it was found that plastic litter predominated on the Padar Island (Cordova et al., 2021). It was discovered that filter cigarette butts accounted for most of the litter that was collected, followed by candy wrapper, wet tissue/wet wipes, and the outsole from shoe/sandals (Cordova et al., 2021). The activity of smoking, the consumption of food and beverages, and the action of trekking are all examples of behaviors that are likely to result in litter being left behind by visitors in this national park area sandals (Cordova et al., 2021). Because of this, more rigorous awareness measures and restrictions are required to limit the pollution caused by litter and avert future repercussions sandals (Cordova et al., 2021).

Socio Economic Resources

In terms of socioeconomic resources, the critical variables are labor (fisherman, tour guide, accessory makers, and hand-carvers), technology (such as Bagan), and capital (profit from agriculture or tourism business). In the island, two main economic activities follow an annual seasonal cycle, fishing, and farming seasons. Fishing happens during the dry season, while farming typically starts at the beginning of the rainy season. The

dry season is the period where lure fish (*engraulidae*) are in the bay. Once the fishing season ends, the farming season12 begins. Though the transition may depend on rainfall, as farming activities depend on it as their only water source (Sudibyo, 2019). Prior to its designation as a Tourism Village in 2013, most Komodo Village residents worked as fisherman but along with the development of KNP as a tourist destination, the residents have begun working as tour guides, accessories makers, and hand–carvers. In earlier periods, during certain months, residents of Komodo Village would harvest forest products such as tamarind (*Tamarindus indica*), srikaya (*Annona squamosa*), and honey for additional incomes (version 1987) (Sunkar et al., 2020).

Most people in and around the National Park rely solely on fishing for a living (97 percent). The remainder are business owners and government employees. Garden crops grow throughout the village, and forest products such as tamarind are collected for sale, bringing in capital. Agriculture is not an option for residents of the National Park because there are few opportunities to obtain land and the land is not fertile. Meanwhile, water and rain are scarce. Because education levels are generally low, alternative economic opportunities are limited in Sape, Sumbawa Island. The most economically valuable marine products are squid, grouper, lobster, shrimp paste, sea cucumber, and nener. The Bagan or bagang (a fishing instrument (lift net) that uses nets and lights to allow for light fishing, originating in Indonesia) is the most common type of equipment used by most fishermen. Bagan fishing focuses on aggregating pelagic species, particularly squid. With squid catches declining, flyfish and lemuru species such as anchovies and sardines are becoming more important for bagan fishing. This type of equipment is currently scarce, but it plays an important economic role. The equipment is used to capture high-value species such as lobster and live reef fish (via hookah compressors, cyanide, bottom line, and traps) and to capture large quantities in a short time (with dynamite and trawlers).

The National Park's spectacular scenery and aquatic biodiversity provide world-class diving, snorkeling, boating, sailing, bird watching, and fishing opportunities. To ensure sustainable tourism activities and protect the condition of natural resources, which are the main capital of tourism activities, tourism development necessitates careful planning and management, including clear regulations. To expand opportunities for ecotourism development, the quality of existing personnel must be improved. Accommodation (homestays) outside the area, transportation (local boats from Labuan Bajo to Loh Liang), visitor scouting, and handicrafts are examples of ecotourism opportunities (PKA & TNC, 2000). According to the Nature Conservation study of interest in alternative livelihoods, residents of Kampung Komodo are interested in tourism activities. Villagers requested assistance with training for National Park staff, handicraft development, and tourism business skills. Villagers also want to improve the quality of their environment to increase their chances of attracting tourists. The KNP authorities, in collaboration with the Tourism Office and TNC, run training programs for local villagers to increase their chances of

finding work in the ecotourism sector. These training programs have been successful in preparing participants for ecotourism jobs, raising awareness among the younger generation, and building a constituency for KNP protection (PKA & TNC, 2000).

Socio Cultural

The island's first resident is Ata Modo. Ata means "forest people," while Modo refers to "dragons," respectively. It's hard to find anything else like the clothing worn by this group. Their hat is the most recognizable feature. The shape resembles that of a komodo's skull. White fabric pants and a checkered sarong are the attire of choice. This tribe comprises most of the inhabitants of Komodo Island. Because of this, the residents of Komodo Village consider Komodo to be a close relative. The island's endemic dragon was said to be related to the Komodo people, according to folklore. It is said that their ancestor and dragons were both born from the same womb. They have a blood relationship called sebae (brother). This is based on the legend of Komodo Island princess Putri Naga (Sudibyo, 2019). Komodo people's first ancestor is said to have been an abnormal son of the same ancestors as the first Komodo creature. A customary head known as Umpu Najo is said to have given birth to twin sons, one of whom was born a dragon and chose to live in the forest as an adult. For this reason, the Komodo people do not kill or capture dragons, but instead bring them food from their fishing and other hunting and gathering activities. The Komodo dragon was protected from extinction for a long time before the area was designated a protected area by the government (Maestro et al., 2019).

Oras and their human relatives are thought to become ill if they get hurt. This has led the residents of Komodo Village to believe that Ora would not bother them unless there was a good reason for it. Those who hunted or fished also left a portion of their catch for the dragons. Komodo and villagers can co-exist, despite daily encounters and bite cases, thanks to this arrangement. According to Mehta-research, Erdmann's the Komodo Islanders have coexisted peacefully with Komodo dragons for at least a thousand years. The perception of Komodo is different among Komodo villagers and non-Komodo villagers like the Rinca Villagers, according to research conducted by Sunkar et al in 2020. In Komodo Village, 83% of respondents supported the idea of living near Komodo, while only 7% of Rinca villagers supported the idea (Suci, 2020).

Social Systems

The social system element sets demand on the critical resources and shapes how that demand is served and how resources are allocated. This article is primarily concerned with two social institutions: education and governance, as well as two HEM social cycles: institutional and environmental. The identity aspect of social order is emphasized by clan, while formal rules emphasize the norm aspect. Status, knowledge, and territory are

all highlighted in the hierarchical structure. The average level of education in the National Park's villages is primary school level four. Every village has an elementary school, but not every year. Each village has an average of four classes and four teachers. There are three kinds of SD in Komodo District: public SD, inpres SD, and private SD. Most children from the Komodo sub-small district's islands (Komodo, Rinca, Kerora, Papagaran, Mesa) do not complete elementary school. Children must be sent to Labuan Bajo to start junior high school, but this is rarely done by fishing families (Hoeppe, 2010).

Currently, few people want to continue their education after finishing elementary school because the main economic opportunity (fishing) does not necessitate a high level of education. Because of their low level of education, residents of the KNP have few opportunities to work outside of the KNP. The extraction of marine resources is the mainstay of the local economy, and the majority (97 percent) of KNP residents rely on the sea for a living. Unfortunately, to catch a large number of fishes, they engage in fishing activities that endanger KNP's survival. In particular, the park's coral reefs were subjected to unrestricted cyanide and dynamite fishing (Arrowsmith & Anderson, 2018).

Intensive surveillance patrols are an effective way to reduce explosive fishing, but cyanide fishing is difficult to prohibit. The advantages of cyanide fishing are substantial enough to justify large bribes. Immediate action is required to improve supervision, comanagement, and governance with local governments. If this area is not properly protected, the National Park's fishery resources will quickly dwindle. Fishing pressure on coral reefs is extremely high and increasing, and it must be mitigated in order for the National Park's objectives to be met. Demersal fishing in the National Park must be drastically reduced. Access to marine resources in the KNP and the Buffer Zone must be restricted. The fishing at fish spawning grounds in National Parks must be prohibited. Preliminary data clearly show that communities outside the Park are having the most negative effects (Pet & Yeager, 2000). Formal rules in terms of Exclusive use rights for local communities such as the clan of Ota Moda must be established in certain traditional use zones.

It is related to the research conducted by Ostrom in her article titled Self-governance and forest resources (Ostrom, 1999), which stated that community-based forest management institutions are critical variables that affect the sustainability of the resource system and its use. Wang in his article titled Community-Based Conservation Management: Strategies and Modeling of the Wildlife Refuge at Shin-Wu-Lue Cree also supports the importance of community involvement in forest management. He stated that the local community is critical in the action of preservation projects because the local communities are physically in contact with the protected areas and are the most impacted by biodiversity conservation programs (Wang) & Wu), 2005). With their privilege status as an indigenous people of the territory of Komodo Island and the knowledge of preserve

the sustainability of the Komodo's and their habitats that already proven for decades, the sustainability of human ecosystem will be achieved.

The Flow

About the flows that contribute to the dynamic of human ecosystem in KNP, this report focusses on the flows of individuals, information, and capital. In managing the human ecosystem in KNP, the social system is mainly influenced by those keys variables. Individuals moving into and out of the KNP impact its dynamics. For example, the relocation of the indigenous Ota Moda people from the KNP area has resulted in food shortages in Komodo. The indigenous people of Komodo, known as "Ota Moda," provide food for Komodo's because they consider Komodo dragons to be their cousins, ensuring the Komodo dragon's survival. They also do not hunt the main food of Komodo dragons on a large scale, such as deer and wild boars, to ensure Komodo dragon food availability remains stable. In contrast to the migrant residents from Makassar and Bugis who live surrounding the KNP such in Rinca island. They have no close relationship with Komodo dragons and hunt deer in the KNP, which greatly disturbs the ecosystem. In addition, fishermen from Makassar and Bugis use cyanide and bombs to catch fish in Komodo Island's waters. This aggravates the ecosystem in KNP even more. The introduction of non-native species, such as dogs, cats, and goats, threatens the sustainability of the ecosystem in KNP because they have the potential to transmit disease to endemic species especially Komodo that are on the verge of extinction (PKA & TNC, 2000, p. 20). The Komodo people's low level of education also limits their ability to understand information about sustainable development in KNP, especially for non-locals who come from Bugis and Makassar. Apart from having no kinship with Komodo, their desire for as much income as possible causes them to be more concerned with short-term profits than with preserving the ecosystem. New destructive fishing techniques have been in use for some time and are causing major issues. Hookah compressors are commonly used in bomb fishing operations to collect catches from coral reefs. One of the most harmful anthropogenic threats to coral reef ecosystems is fish bombing. The bomb caused structural damage to coral reefs, depriving them of their ability to provide food and shelter for marine organisms as well as protect coastlines. Fish and invertebrates living on coral reefs are killed by direct and indiscriminate bombing.

Furthermore, tours associated with coral reefs, which could be a source of additional income, cannot be developed in the bombed area. Material needs will rise exponentially over the next 25 years as society is exposed to outside influences, particularly through tourists and television. Between material desires and increased attachment of village markets to external markets, KNP's marine resources will bear a heavy burden in the future. Harvesting aquatic resources will most likely continue to be an economic

opportunity in the region for decades. To keep these resources available, they must be carefully managed. The village community does not benefit significantly from tourism income. If education levels rise, there may be more opportunities to view the economy. A strong partnership between the government and local communities is also required to jointly manage KNP. The target community must have clear and understandable information about national park regulations. National Park regulations are made available to all park visitors.

Although it is commonly predicted that the effects of ecotourism on animals will be proportional to the volume of human visitation and associated infrastructure development (Krüger, 2005), the effects can nevertheless be highly variable and contextual, with both positive and negative effects being reported. For instance, some animals who were subjected to ecotourism activities exhibited an increase in their anti-predator behavior, such as heightened awareness and higher propensity to flee (Dyck & Baydack, 2004). The possible adverse effects of altered behavior and adult-biased populations in ecotourism zones, both of which could influence demographic processes by means of intraspecific competition or predation. We advocate the following three management measures to be used in the future to solve this issue: (1) the elimination of human-mediated nutritional subsidies; (2) alternative ecotourism; and (3) geographical regulation of ecotourism. In addition, we advocate for the development of methods to promote socio–ecological sustainability, which has positive implications for the preservation of both humans and animals (Ardiantiono et al., 2018).

Currently, enjoyment of natural beauty spots appears to be rooted in an anthropocentric relationship with nature rather than a biocentric one, with a worldview associated with the "triumph of culture over nature" (Geertz 1960:28). This is demonstrated by the many Indonesian "nature lovers clubs" (Klub Pencinta Alam) within institutes of higher education, whose principal aims are mountain-climbing and other activities centered on conquering wilderness rather than comprehending it (Cochrane, 2006). Change is far more likely to be positive if it is accepted and planned for rather than occurring spontaneously while official policy looks the other way. The market is a tremendous force for change, and change is much more likely to be beneficial if it is embraced and planned for. This has been recognized, and a joint management strategy has been implemented in several Indonesia's protected areas (for instance Bunaken Marine National Park and Komodo National Park) (Cochrane, 2006)v.

CONCLUSION

Based on an analysis of critical resources, social systems, and key flows in the human ecosystem of KNP, this article concludes that the "Jurassic Park" tourism project in KNP should be postponed until the authorities have a design consistent with the sustainable

development model. The most important of these designs is to prioritize the safety of Komodo dragons in the KNP. It must be acknowledged that the surrounding community still requires tourism development in KNP because they have changed their livelihoods, previously working as farmers and fishermen, and now focus on the tourism sector as rangers, tour guides, restaurant entrepreneurs, souvenir traders, boat rentals, snorkeling and diving equipment, and others.

However, the safety of Komodo dragons, the local community's economy, and the kinship between Komodo dragons and local people must all be considered. As a result, it is hoped that the Indonesian government will develop a tourism development plan that prioritizes Komodo because the park has grown in popularity due to Komodo. Without Komodo, KNP's economic development will be bleak. This article anticipates national and local government support to strengthen the kinship bonds that have existed for centuries between local communities (the Ata Modo) and Komodo dragons. Because of the mythical legend of the Dragon Princess and the belief that the Komodo dragon and Komodo man are twins, it is reasonable to conclude that only the indigenous Komodo people have strong ties to Komodo, which is a valuable asset that the Indonesian government must preserve.

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