CONSERVATION STRATEGY AND ACTION PLAN KOMODO DRAGON (*Varanus komodoensis*)

I. Introduction

The Government of Indonesia supports global efforts in biodiversity management through the reduction of threats of loss and sustainable use. This commitment is manifested through active participation in the *United Nations Convention on Biological Diversity (*UNCBD), which was ratified in Law No. 5 of 1994 on the Ratification of the UNCBD. To support the implementation of the CBD, Indonesia has also ratified *the Cartagena Protocol* on Biosafety and *the Nagoya Protocol* on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization. At COP 15 CBD, *the Kunming-Montreal Global Biodiversity Framework* (KM-GBF) was agreed upon as a global framework for biodiversity management to be adopted by parties into their *National Biodiversity Strategy and Action Plan* (NBSAP). To this end, Indonesia is following up on the results of COP 15 CBD by updating *the Indonesian Biodiversity Strategy and Action Plan* (IBSAP).

The IBSAP 2025-2045 document contains the vision of "Living in harmony with nature for the sustainability of all forms of life in Indonesia." To realize this vision, the mission is "Biodiversity management through protection, sustainable use, enrichment of science and technology, and strengthening of resources and governance." To realize this vision and mission, the IBSAP 2025-2045 includes 3 (three) objectives, 13 strategies, 20 national targets, and 95 action groups. This document has been integrated with the National Medium-Term Development Plan (RPJPN) 2025-2045 and the National Medium-Term Development Plan (RPJMN) 2025-2029 in accordance with the mandate of Presidential Instruction No. 1 of 2023 on the mainstreaming of biodiversity in sustainable development at the national and regional levels.

The DragonKomodo Conservation Strategy and Action Plan (SRAK) is an implementation of the IBSAP 2025-2045 document, which focuses on efforts to protect and preserve Komodo dragons. In its implementation, the scope of actions and implementation of the Komodo Dragon Conservation Strategy and Action Plan (SRAK) aligns with the 3 objectives and 14 national targets of the IBSAP, namely: (TN1) ecosystem integration, (TN2) restoration, rehabilitation, and reclamation, (TN3) ecosystem protection, (TN4) species and genetic protection, (TN5) reduction of invasive alien species, (TN7) risk reduction and climate resilience, (TN9) sustainable cultivation, (TN13) enhancement of science and technology, (TN15) data integration, (TN16) mainstreaming of gender equality, (TN17) community participation, (TN18) private sector involvement, (TN19) financial support, and (TN20) incentive reform.

The government has formulated the National Long-Term Plan (RPJPN) 2025-2045 to realize the vision of Indonesia Emas 2045. The RPJPN document contains "A Sovereign, Advanced, and Sustainable Archipelagic State" consisting of 5 goals, 8 missions (agendas), 17 directions (objectives), and 45 key development indicators. The RPJPN 2025-2045 serves as a guideline for medium-term development planning to realize Indonesia Emas 2045. Furthermore, the technocratic document RPJMN 2025-2029 explains the policy direction of the Development Agenda (AP) for Social, Cultural, and Ecological Resilience, which has five development goals, one of which is a Quality Environment. One of the indicators related to this policy direction is the improvement of the biodiversity management index (IPK) through (1) reducing the loss of ecosystem and species diversity; (2) sustainable utilization of biodiversity; and (3) management of genetic resources. Some interventions to achieve the objective of a quality environment include: prevention of ecosystem and species damage and conservation, improvement of ecosystem and environmental quality, reduction of deforestation rates, and enforcement of environmental laws.

At the implementation level, the development program (PP) for reducing ecosystem and species diversity loss contains at least three development activities (KP) that are the performance mandate of the Directorate General of KSDAE. The three KP are reducing the threat status of species and ecosystems, controlling and eradicating invasive alien species, and strengthening data,

information, and science and technology on biodiversity. The design and implementation of the Komodo Dragon SRAK are crucial as part of the implementation of the national planning mandate, which is one of the tasks and functions of the Ministry of Forestry.

II. Population and Habitat

II.1. Population Status/Trends and Habitat

II.1.1. Species Distribution Areas and Regions

The dragon Komodois a protected species under Law No. 5 of 1990 on the Conservation of Natural Resources and Ecosystems, as amended by Law No. 32 of 2024 and Government Regulation No. 7 of 1999 on the Conservation of Plant and Animal Species, as amended by Ministerial Regulation No. P.106/MENLHK/SETJEN/KUM.1/12/2018. In the global context, the dragon Komodois classified as an endangered species in the Red *List* published by *the International Union for Conservation of Nature* (IUCN) as a species globally threatened with extinction (*Endangered)* (Jessop et al., 2021). Meanwhile, under *the Convention on International Trade in Endangered Species of Wild* Fauna and Flora (CITES), the Komodo dragon is listed in Appendix I (species prohibited from all forms of international trade).

Komodo dragons can be found along coastal areas up to an elevation of 800 meters above sea level. Generally, this reptile species is distributed across five islands within Komodo(TNK) National Park and a small portion of the coastal areas of Flores Island. On Flores Island, Komodo dragons are relatively rare at elevations above 300 meters (NTT BKSDA - KSP, 2019). Komodo dragons prefer coastal valleys with *open deciduous monsoon forest* habitats surrounded by savannas or near the coast. Komodo dragons are known to have the ability to move over a fairly wide range, but they seem to rarely move between islands or valleys (Jessop *et al.,* 2018).

In TNK, Komodo dragons are distributed across five islands, all of which are conservation forests: Komodo Island, Rinca Island, Motang Island, Kode Island, and Padar Island. On Flores Island, Komodo dragon populations are distributed in population pockets across two landscapes: the West and South Coastal Landscape and the North Coastal Landscape and Longos Island. Based on their area status, Komodo dragon habitats are not only found in conservation forests but also in other forest functions, namely Protected Forests, Production Forests, and Other Land Use Areas (APL). The nature reserves/conservation areas (KSA/KPA) that serve as habitats for Komodo dragons are: CA Riung, TWA Tujuh Belas Pulau, and CA Wolo Tadho in the northern landscape, and CA Wae Wuul in the western and southern landscapes. Administratively, these habitats are located within Manggarai Barat Regency, Manggarai Timur Regency, and Ngada Regency.

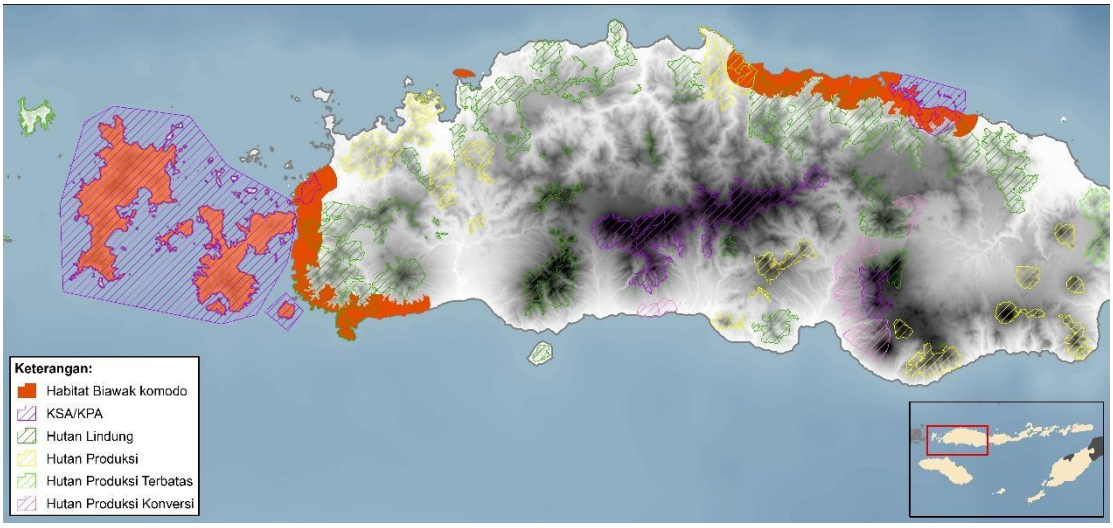

Figure 1. Distribution of Komodo dragons in TNK and on Flores Island

II.1.2. In-situ and Ex-situ Populations

In-situ Population

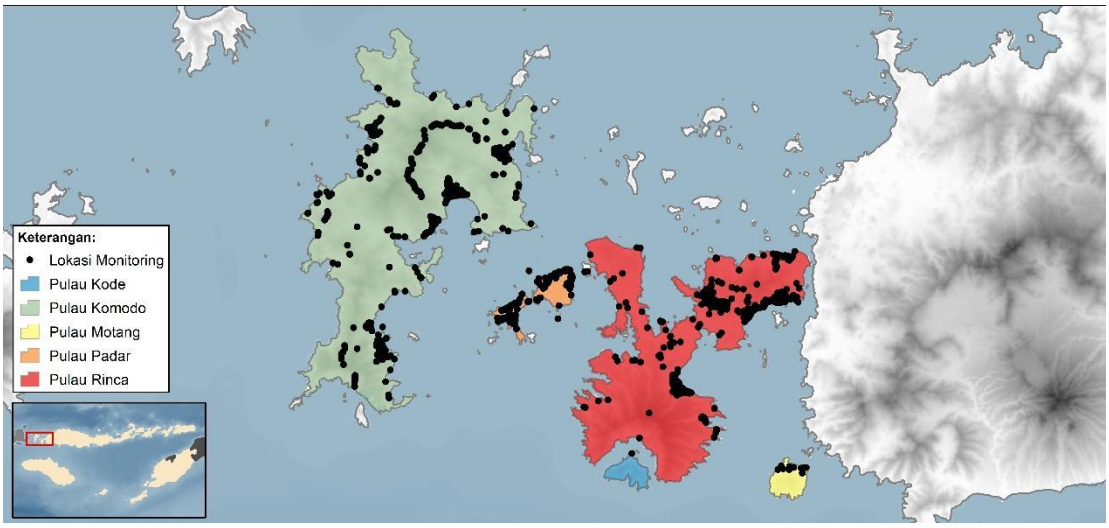

Figure 2. Population survey of Komodo dragons in TNK

Surveys and monitoring of Komodo dragon populations in TNK were conducted on 5 islands that serve as Komodo dragon habitats, as shown in Figure 2 above. From 2018 to 2024, population trends and distribution patterns of dragons Komodowere monitored at 11 monitoring sites across the five islands within the TNK area through annual surveys or monitoring conducted by the TNK Office in collaboration with the Komodo Survival Program (KSP). Population estimates were calculated using population observation methods with camera traps and *site occupancy* analysis to provide an overview of the population trend of dragonsKomodo. The Komodo dragon population in TNK from 2018 to 2024 fluctuated with an estimated abundance range of 2,897–3,303 individuals (95% confidence interval CI = 2,178–4,016 individuals). The population trend over the past seven years shows a positive trend (indicating an increasing population) with the latest estimate in 2024 at 3,270 ± 371 individuals. More detailed abundance data for the past seven years are presented in the following graph:

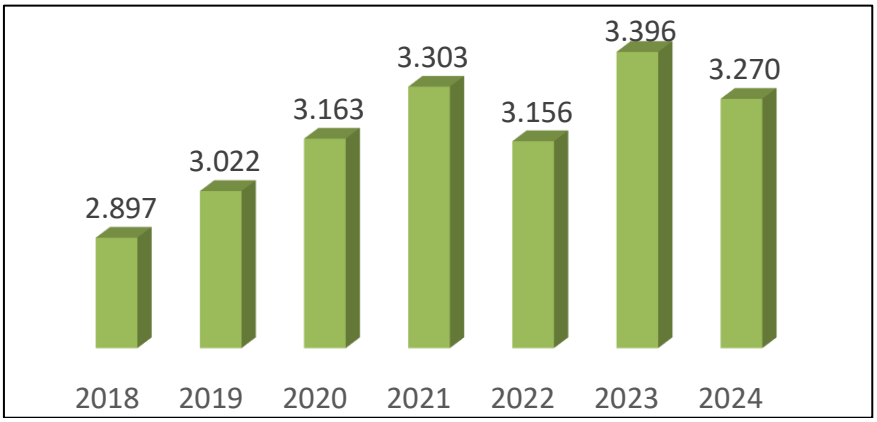

Figure 3. Population Trend of Komodo Dragons in TNK

As the largest natural habitat, the vegetation commonly found in TNK consists of tropical deciduous forests, savannas, and steppes (Auffenberg, 1981). Additionally, there are mountain forests (quasi-cloud forests) in mountainous areas and mangrove forests along parts of the coastal areas. The dominant vegetation composition consists of savannas and steppes (57.26%), deciduous forests (41.03%) spread across coastal valleys, and the remainder is quasi-cloud forests/mountain forests (1.71%).

The average *core home range* area of Komodo dragons is 1.09 ± 0.43 km^2(Purwandana et al., 2021), with an average daily movement of 573 meters/day. However, during the

mating season, when searching for female Komodo dragons, the average daily movement of adult Komodo dragons can reach 2,494 meters/day (Jessop et al., 2007). Newly hatched Komodo dragon hatchlings spend 98% of their time in trees until they are at least one year old, resulting in a relatively small home range (Imansyah et al., 2008).

Komodo dragons are classified as carnivorous animals. They are capable of preying on large vertebrate species such as Timor deer (*Rusa timorensis*), water buffalo (*Bubalus bubalis*), or wild boar (*Sus scrofa*) (Ariefiandy et al., 2013; 2016). Adult Komodo dragons rely heavily on strategy and wait to ambush their prey quickly. Meanwhile, juvenile Komodo dragons can prey on a more varied diet, including insects, small lizards, snakes, and birds, and are more active in searching for prey compared to adult Komodo dragons (Auffenberg, 1981). Based on monitoring data over the past 20 years, the deer population in TNK fluctuates annually but tends to remain stable. The population trend of deer is as shown in the following figure.

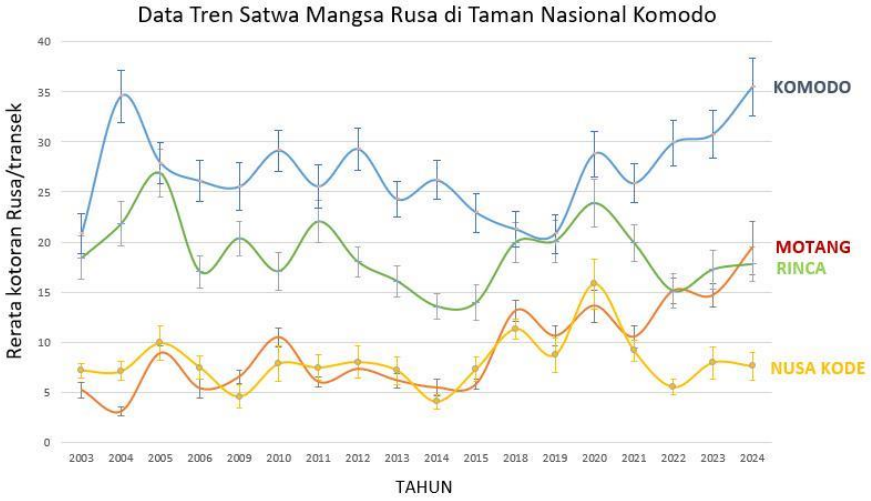

Figure 4. Population trends of Timor deer in TNK

Furthermore, based on the results of a survey conducted by BBKSDA NTT in collaboration with the KSP Foundation from 2015 to 2018, Komodo dragons can be found along the northern part of Flores, including: Wolo Tadho Conservation Area, Tujuh Belas Pulau Wildlife Reserve, Riung Conservation Area, Torong Padang, Golo Lijun, Pota, and Longos Island. In the western to southern regions, they are found in: Wae Wuul Conservation Area, Golo Mori, Kerita Mese, and Nanga Bere. Some of the Komodo dragon habitats are located in conservation forests, namely: CA Wolo Tadho, TWAL Tujuh Belas Pulau, CA Riung, and CA Wae Wuul, as well as protected forests, namely: Pota, Mbeliling, and Paelombe. However, some Komodo dragon populations in both the northern and southwestern landscapes are found in Other(APL). Land Use Areas In the western part of Flores Island, particularly in Golomori, Komodo dragon populations are also found in areas managed by the state-owned enterprise PT Pengembangan Pariwisata *Indonesia or Indonesia Tourism Development Corporation* (ITDC). This enterprise is a state-owned company focused on the development and management of integrated tourism areas in Indonesia.

Generally, Komodo dragons in the Flores region are found in savanna and open deciduous forest habitats. In addition to their natural habitats, Komodo dragons are also found in seasonal agricultural areas where prey animals are present. Based on current data on Komodo dragon presence on Flores Island, Komodo dragons have only been found at elevations ranging from the coastal areas up to 300 meters above sea level.

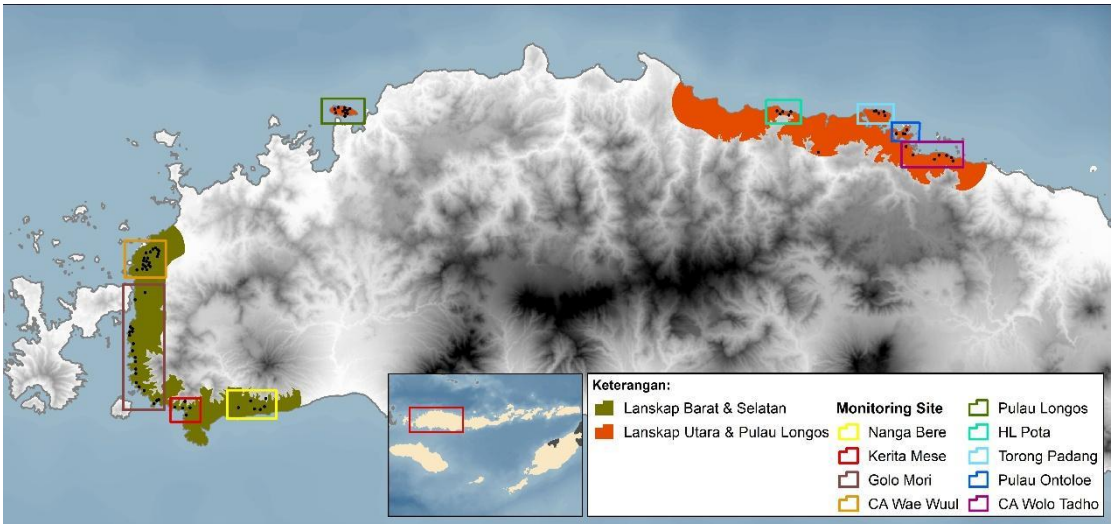

Figure 5. Komodo dragon habitat and *monitoring site* distribution on Flores Island

Efforts to collect Komodo dragon population data have been conducted by the NTT Natural Resources Conservation Agency (BBKSDA NTT) in collaboration with the KSP since 2009 using the *Capture Mark Release and Recapture* (CMRR) method (traps) and *Site Occupancy* (camera traps). Population abundance analysis was conducted using the *Site Occupancy* method at several monitoring sites across two landscapes: CA Wolo Tadho, Torong Padang, Golo Lijun, Pota, Ontoloe Island, and Longos Island in the northern coastal area, and CA Wae Wuul, Golo Mori, Kerita Mese, and Nanga Bere in the western and southern coastal areas. The analysis of the data indicates that the Komodo dragon population on Flores Island is approximately 701 ± 131 individuals. More specifically, the abundance of dragons Komodoin each landscape is as follows:

Table 1. Abundance of dragons Komodoon Flores Island

Landscape	Landscape Area	Site Occupancy	Density	Abundance
West & South	228.7	0.5	131 ± 0.22	301 ± 55
North & Longos Island	231.71	0.4	173 ± 0.34	400 ± 80

The Torong Padang Peninsula is one of the habitats for Komodo dragons in Northern Flores that still has good conditions. This is due to the availability of the Komodo dragon's primary prey species, namely deer, monkeys, and wild boars ( ). A population survey of Komodo dragons using camera traps estimated approximately 25.74 ± 6.38 individuals. Additionally, the traditional knowledge of the Baar tribe enables this area to remain largely free from human disturbance, except for traditional ceremonies.

Figure 6. Komodo dragons on Ontoloe Island (TWA Tujuh Belas Pulau; left), Riung (center), and HL Pota (right), photo: Alvanikson L. Awang and BBKSDA NTT-KSP

Ex-situ Population

In addition to their natural habitat, Komodo dragon populations are currently found in several conservation institutions (LK) both domestically and internationally. The first

recorded sighting of Komodo dragons abroad was in Fort Worth and Honolulu in September 1992. However, Komodo dragons were already on display abroad in 1926 at the Bronx Zoo in New York, United States. The animals exhibited were Komodo dragons brought from the Douglas Burden expedition in the same year. However, these animals did not survive long in the zoo (Burden, 1928; Barnard, 2011).

According to the *Zoological International Species Information* System/ZIMS Database (2024) cited on the iucnredlist.org website, there are currently 258 Komodo dragons registered in 102 facilities across 28 countries. Of these, 150 are male, 97 are female, and 11 have not yet been identified by sex. Since 1992, several ex situ conservation facilities abroad have reported successful breeding of dragonsKomodo, with the first recorded birth outside Indonesia occurring at the National Zoo in Washington, D.C., United States, named "Kraken." In 2006, parthenogenesis occurred in female Komodo dragons at London Zoo and Chester Zoo in the United Kingdom (Watts et al., 2006). Parthenogenesis is a reproductive phenomenon in reptiles where reproduction occurs without fertilization by males; eggs are produced without fertilization (mating) but can hatch. In early 2020, parthenogenesis also occurred at Chattanooga Zoo in the United States. Meanwhile, the first Komodo dragon was registered at LK Yogyakarta (Gembira Loka Zoo) in December 1978. By 2024, there were 177 Komodo dragons distributed across 12 conservation institutions in Indonesia, with the following details:

Table 1. Komodo Dragon Population in Conservation Institutions in Indonesia

No	Conservation Institution	Location	Male	Female	Undefined	Total
1	Indonesia Safari Park I Bogor	West Java	13	5	0	18
2	Lembang Park and Zoo	West Java	0	0	1	1
3	Mini Indonesia Indah Park	DKI Jakarta	4	3	0	7
4	Ragunan Zoo	Jakarta	1	1	0	2
5	Solo Safari	Central Java	1	1	0	2
6	Indonesia Safari Park II Prigen	East Java	2	2	0	4
7	Batu Secret Zoo	East Java	3	1	0	4
8	Surabaya Zoo	East Java	19	8	79	106
9	Indonesia Safari Park III Bali	Bali	17	10	0	27
10	Bali Zoo	Bali	0	1	0	1
11	Bali Bird Park	Bali	0	0	4	4
12	Bali Reptile Park	Bali	1	0	0	1
			61	**32**	**84**	**177**

As part of efforts to conserve plants and wildlife, ex-situ conservation plays a crucial role in accordance with Government Regulation No. 7 of 1999. Conservation Institutions (LK) as one of the implementations of species conservation outside their natural habitats are expected to contribute to the preservation and enhancement of the Komodo dragon population in their natural habitats (*ex-situ link to in-situ)*. Some of the roles of LK in supporting the Komodo dragon population in their habitats include:

1. Serving as a genetic reserve for Komodo dragon populations in their natural habitats (in-situ);
2. Technology to support conservation efforts;
3. Support for the development of facilities and infrastructure for Komodo dragon rehabilitation and release centers;
4. Sustainable conservation funding;
5. Public awareness.

II.1.3. Genetic Perspective

The genetic uniqueness of wild populations must be preserved to support their conservation. Populations in the wild evolve and adapt to different natural conditions

between regions, so there is a possibility that the genetics of dragons Komodoon Flores Island differ from those on Komodo Island or other islands. Therefore, the transfer of animals between two regions, or from ex situ populations back to the wild (in situ), must be carried out with caution, as reintroducing animals from ex situ populations into wild populations can negatively impact the genetic composition of a population. For the safety of the Komodo dragon species, the genetic composition of in situ and ex situ populations must first be mapped comprehensively, and it must be ensured that Komodo dragons reintroduced into the wild are genetically optimal.

Evaluation and monitoring of genetic diversity in natural populations are crucial aspects of conservation efforts (Frankham et al., 2010). This is directly related to the survival of dragonsKomodo, which play a role as umbrella species in ecosystem conservation. Genetic diversity and *genetic divergence* have been studied based on variations in *the control region* of mitochondrial DNA (mtDNA). Sequence comparisons were conducted between individuals within local populations (sampling locations) and between populations from different sampling sites. The control region of mtDNA was amplified using the Polymerase Chain Reaction (PCR) method with primers specifically designed for V. komodoensis. The mtDNA sequences were then statistically analyzed, including mtDNA haplotype analysis, diversity indices, molecular variance analysis, and phylogenetic tree reconstruction at the species level using the *neighbor-joining and maximum likelihood* methods.

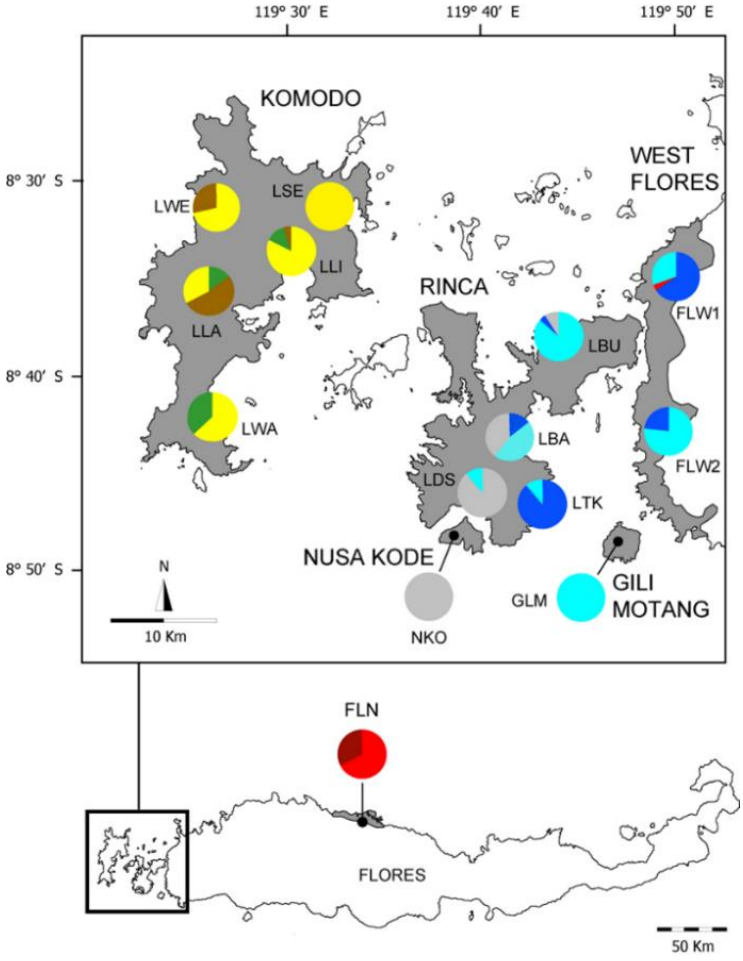

Figure 7. Distribution of Komodo dragon haplotypes in their native habitat based on mtDNA *control region* markers

The results of mtDNA sequence data analysis in Figure 7 show that Komodo dragon populations are divided into three regions. The population on Komodo Island is genetically distinct, so the island is proposed as a separate unit for management and conservation. The same applies to the population in Northern Flores (Mbarujawa, Riung Nature Reserve, and Ontoloe Island), which shows significant genetic

differences from populations on other islands and also from local populations on the western coast of Flores Island (Wae Wuul, Lenteng). Therefore, the populations in Northern Flores should also be considered for designation as a separate protected area managed specifically for their conservation. Komodo dragons in Sambi Rampas District in Riung and Tujuh Belas Pulau Nature Reserve, as well as Wolo Tadho Nature Reserve, which are located close to each other, are part of a relatively small population with low genetic diversity. Therefore, these populations should be included in a regular monitoring program that assesses genetic and demographic parameters.

Regular monitoring recommendations also apply to populations on Gili Motang Island and Nusa Kode Island within the TNK area. Small populations on these islands require attention due to the absence of diversity in their mitochondrial DNA *control region* sequences. On the other hand, populations on Rinca Island, Nusa Kode Island, and West Flores demonstrate the ability to maintain high levels of genetic diversity.

Monophyletic (single lineage) populations, such as those on Komodo Island and North Flores, which are currently separated from other populations, should be managed as separate evolutionary units to maintain the genetic diversity of this monitor lizard species. These two populations are separated from other populations by major ge al barriers, namely the ocean and unsuitable habitats. These monophyletic populations are also characterized by high levels of genetic distinctiveness and lower gene flow compared to other populations.

The results of gene flow analysis based on 10 microsatellite markers among 4 island populations indicate the lowest possibility of migration between the Komodo Island population and other island populations. For example, one individual migrated between the Komodo Island population and the Gili Motang Island population over a period of 54 years. Meanwhile, one migrant is likely to have moved between the Flores (West) and Gili Motang populations over a period of 24 years or two generations (Ciofi and Brufford, 1999). These gene flow data do not include estimates of gene flow in populations in northern Flores, including the small islands surrounding it. Gene flow on Nusa Kode Island and other small islands, such as Longos Island, also needs to be studied to provide foundational information for managing Komodo dragon populations on small islands, particularly those with low genetic diversity.

II.2. Challenges in the Protection and Conservation of Komodo Dragons

Factors that could potentially cause a decline in the distribution area of Komodo dragon populations in the wild, particularly on Flores Island, have been identified. These factors represent challenges for future Komodo dragon conservation efforts. Some of the challenges that require serious attention in Komodo dragon conservation efforts include:

II.2.1. Invasive species

Based on data obtained from camera traps during surveys of Komodo dragon distribution from 2015 to 2018 along the entire coast of Flores, high detection rates of feral dogs pose a serious threat to the survival of Komodo dragons, as they compete for prey. In almost all survey locations, camera detections of dragons Komodowere inversely proportional to feral dog detections. This means that in areas with high/dense feral dog populations, Komodo dragon populations are very low or even non-existent.

II.2.2. Protection and management of Komodo dragon populations

In mid-2019, the East Java Natural Resources Conservation Agency (KSDA) in collaboration with the East Java Regional Police successfully uncovered and foiled the smuggling of Komodo dragon hatchlings abroad. After the government, in this case the Ministry of Forestry in collaboration with BRIN, successfully identified the origin of the Komodo dragons, the East Nusa Tenggara Nature Conservation Agency, together with the East Nusa Tenggara Provincial Government and assisted by the KSP Foundation, returned the young animals to their habitat in Flores. Although incidents

of *illegal* hunting and *wildlife trade* involving dragons Komodoremain relatively rare, they pose a potential threat to populationthe and must be closely monitored and prevented to ensure they do not escalate.

II.2.3. Hunting of prey animals

Deer are known to be the main food source for dragonsKomodo, along with other mammals. However, deer are also the main target of hunters for protein needs of certain communities, leading to deer hunting, especially in the TNK, which has a large deer population area, particularly in the past. Auffenberg (1981) and Ciofi et al. (1999) speculate that the decline and disappearance of Komodo dragon populations on Padar Island around the 1980s were caused by a sharp decline in deer populations due to illegal hunting. Therefore, the threat of deer hunting must be monitored and prevented. Collaboration among stakeholders, particularly in the fields of security, and law enforcement, is a priority in efforts to conserve Komodo dragons.

II.2.4. Conflicts between humans and Komodo dragons

Data collected from 2016 to 2019 by the KSP Foundation in Riung and Pota recorded numerous direct conflicts between humans and Komodo dragons. These conflicts occur because Komodo dragons enter settlements or fields and prey on livestock, and there have also been cases of Komodo dragons being injured or killed by motor vehicles in the Pota area (Azmi et al., 2021). Since mitigation efforts were implemented by the NTT Natural Resources Conservation Agency (BBKSDA NTT) with support from KSP, the number of Komodo dragon deaths has decreased annually. Although the potential for conflict still exists, there have been no reports of Komodo dragons being killed by residents since 2018. In 2023, there were three recorded attacks by Komodo dragons on humans, while in 2024, only one incident of conflict between humans and Komodo dragons was recorded. All victims survived and were treated at local health facilities.

II.2.5. Synchronization of development planning

Synchronizing development policies with Komodo dragon conservation is key to managing Komodo dragon habitats and populations, especially with the designation of TNK and West Flores as premium tourist destinations and Labuan Bajo as a National Strategic Tourism Area. Revisions to the Regional Spatial Planning Master Plan (RTRW) for the province and districts (Manggarai Barat, Ngada, Manggarai Timur) and the development of an Integrated Tourism Master Plan for Labuan Bajo must integrate Komodo habitat protection, supported by a Conservation Action Plan Strategy (SRAK) as a guide for harmonizing development and conservation efforts. Additionally, strengthening understanding of tourism based on the Komodo dragon icon and implementing local policies (regulations) related to Komodo dragon protection are necessary to ensure long-term sustainability, encourage active stakeholder participation, and guarantee development that aligns with conservation.

II.2.6. Habitat changes

Based on recent studies conducted in several locations along the northern and southern coasts of Flores Island, there has been an acceleration in the change of potential habitats that were once believed to be the distribution area of dragonsKomodo. Habitat changes are primarily due to the conversion of habitats around Labuan Bajo due to increased demand for land for settlements and agriculture. Additionally, the conversion of savannah into rice fields in Lembor (southern coast of West Manggarai) and monsoon forest into farmland in Pota has reduced the potential habitat area for Komodo dragons (Ariefiandy et al., 2021).

II.2.7. Community involvement and improved well-being

Empowering communities around conservation areas, such as TNK and Wolo Tadho Nature Reserve, aims to improve their welfare and participation in sustainable conservation. In this area, there are villages such as Komodo, Rinca, Kerora, and Papagarang, as well as 14 other villages around TNK, while in North Flores there are six coastal villages such as Sambinasi, Lengkosambi, and Tadho that depend on agriculture and fishing. To reduce pressure on the ecosystem, the TNK Office and the NTT BBKSDA have developed alternative livelihoods through groups such as Conservation Cadres, Community Forest Rangers (MMP), and Naturalist Guides, and have involved the community in 3-pillar patrols (Government, Religion, Indigenous Communities). The main challenge is to ly enhance community skills in alternative livelihoods and align programs with Village Governments, including the utilization of village funds to support ecotourism and the well-being of communities around the conservation area.

II.3. Social, economic, and cultural aspects of the community

Communities living around the Komodo dragon habitat, such as in Komodo Village, Rinca, Kerora, and Papagarang in TNK, as well as six coastal villages in North Flores (Sambinasi, Lengkosambi, Tadho, etc.), primarily rely on fishing and farming for their livelihoods. Their lives are closely intertwined with the surrounding ecosystem, including the dragonsKomodo, which are considered an integral part of their culture. In Komodo Village, for example, the community believes in the legend of Putri Naga Komodo, which refers to komodo dragons as the twin siblings of humans. This belief fosters tolerance and protection toward these endangered animals.

In addition to traditional beliefs, the local community has traditions that support the conservation of dragonsKomodo. On the Torong Padang Peninsula, the Baar tribe conducts an annual traditional hunt that is not only an agricultural ritual but also regulates hunting to ensure that the populations of Komodo dragon prey, such as deer and pigs, remain stable. Such local wisdom is an important foundation for community-based conservation. Meanwhile, the TNK Office and the NTT BBKSDA encourage active community participation through groups such as Conservation Cadres, Community Forest Rangers (MMP), and tour guides, while reducing dependence on the ecosystem through craftsmanship and tourism training.

Sustainable tourism is one of the economic drivers for communities around Komodo dragon habitats, such as in the Tujuh Belas Pulau Wildlife Reserve, which offers natural and underwater beauty. The community is involved as tourism actors, from guides to boat operators, thereby increasing income while raising awareness of conservation. The local government is also mobilizing community participation through the Action Plan for the Management of the Flores Island Essential Ecosystem Area, using a "3-Pillar" scheme (government, religion, indigenous communities) for patrols and outreach. As a result, tourism development is proceeding hand in hand with efforts to protect Komodo dragons and their habitats.

II.4. Projected population growth targets

According to iucnredlist.org, around 68% of the population is found on Komodo Island and Rinca Island. Of this number, 1,383 are estimated to be adults. Studies in TNK estimate that most productive females can reproduce every year, but some do so every two years or more. However, based on monitoring results over the past two decades, the Komodo dragon population in TNK is estimated to be in good condition and stable, but the situation on Flores Island is not as favorable as in TNK. This is because most of the Komodo dragon's distribution area on Flores Island is outside conservation areas, leading to high threats to the Komodo dragon population, its prey, and its habitat. Over the past fifty years, several areas previously recorded as Komodo dragon habitats have been lost or degraded, including in northern Labuan Bajo, Nanga Lili, and west of Pota (Auffenberg, 1981; Ariefiandy et al.,

2021). Therefore, the remaining Komodo dragon distribution areas on Flores Island must be well-protected, and in the future, locations that were once Komodo dragon distribution areas but are now devoid of Komodo dragons should be rehabilitated and their populations restored.

Given the large population of dragons Komodoin ex situ and the success of the Komodo breeding program at LK, it is hoped that a good strategy can be developed in the future to enable the reintroduction of Komodo dragons from LK breeding programs to be carried out successfully, particularly in the context of , to restore Komodo dragon populations in habitats where they are no longer found. These strategies include the rehabilitation of degraded areas, the restoration of prey species populations, the eradication of *invasive alien species (IAS)*, and the preparation of supporting infrastructure for the release program, such as transit enclosures and transitional habitats in the form of rehabilitation and release centers supported by adequate resources.

III. Conservation Strategies and Action Plans

Conservation efforts for Komodo dragons are carried out through four programs, namely: 1) Protection of dragonsKomodo and their habitats; 2) Research, Education, and Institutional Strengthening; 3) Community Economic Development & Sustainable Financing; and 4) *Communication, Education, & Public Awareness* (CEPA). In its implementation, 15 strategic objectives and 41 action plans have been developed. Each action plan has been aligned to achieve the various targets outlined in the IBSAP 2025-2045 and to map the stakeholders who can play a role according to their authority and capacity. In its implementation, each action plan can be carried out through various technical activities to achieve each activity indicator. Details of each program, strategic objectives, and action plans are outlined in the following table:

Table 2. Conservation Strategies and Action Plans for DragonsKomodo

Program/ Strategic Objectives	Action Plan	Achievement Indicators	IBSAP Target	Timeline	Stakeholders
Protection and conservation of Komodo dragons and their habitats					
1. Establishment of Komodo dragon habitats within and outside the KSA/KPA	1.1. Protection of Komodo dragon habitats within the KSA/KPA	Protection of Komodo dragons from various forms of disturbance to their habitat	TN 3 TN 4	2025-2035	Ministry of Forestry, BRIN, Academics, Private NGOs
	1.2. Habitat *assessment* of Komodo dragons and their prey species	The implementation of annual monitoring of dragons Komodoand their habitats on a regular basis, supported by adequate human resources and budget in TNK and Flores Island (Western & Southern Landscapes and Northern Landscapes & Longos Island)	TN 3 TN 4	2025-2035	Ministry of Forestry, BRIN, Academics, NGOs
	1.3. Study and monitoring of invasive alien species (IAS)	Identification and management of invasive alien species (IAS) threatening the population and habitat of dragons Komodoand their prey species			Ministry of Forestry, Ministry of Agriculture, BRIN, Academics, NGOs
	1.4. Ecosystem restoration/habitat restoration and habitat development for Komodo dragons within and outside KSA/KPA areas according to their ecosystem types.	Restoration and expansion of the natural habitat of Komodo dragons and their prey in TNK and Flores Island (Western & Southern Landscape and Northern Landscape & Longos Island)	TN 2	2025-2035	Ministry of Forestry, Local Government, Private Sector
	1.5. Assessment of carrying capacity and carrying capacity	Availability of carrying capacity and sustainability data in KSA/KPA and conservation areas for Komodo dragons	TN 3 TN 4	2025	Ministry of Forestry, BRIN, Academics, NGOs
	1.6. Construction of a rehabilitation and release center for dragonsKomodo	Availability of infrastructure to support the release of Komodo dragons back into the wild	TN 3 TN 4	2025-2035	Ministry of Forestry, BRIN, Academics, NGOs, Conservation Institutions/Private Sector

Program/ Strategic Objectives	Action Plan	Achievement Indicators	IBSAP Target	Timeline	Stakeholders
2. Establishment of the natural distribution of Komodo dragons in the preservation area	2.1. Establishment of a conservation area appropriate for the habitat of dragonsKomodo	Availability of action plan documents for AP management in 5 areas (Longos Island, Golo Mori, Mbeliling, Pota, and Torong Padang Peninsula) Torong Padang Peninsula)	TN 16	2025-2026	Ministry of Forestry, BRIN, Academics, NGOs
	2.2. Review and revise provincial or regional spatial planning related to the proposal for the Komodo Dragon Habitat Preservation Area	Recommendation to include the proposal for the Komodo Dragon Habitat Preservation Area into the revision of provincial and district spatial plans	TN 1	2025-2027	Ministry of Forestry, Ministry of Environment and Forestry/Regional Environment Agency, Ministry of Agrarian Affairs and Spatial Planning/National Land Agency, Local Government, Academics, NGOs
	2.3. Development of the Management Plan for the Komodo Biosphere Reserve	Availability of management documents for the biosphere reserve where Komodo dragons and their habitats are distributed	TN 1	2021	Ministry of Forestry, National Research and Innovation Agency (BRIN), Academics, NGOs
3. Enforcement of laws against the trade and hunting of Komodo dragons and their prey species	3.1. Security and law enforcement against poachers and illegal traders, bioprospectors, and tourists who disturb Komodo dragons, their prey, and their habitats	Conducting law enforcement activities through collaborative efforts and joint patrols annually to protect the population, prey, and habitat of Komodo dragons in TNK and Flores Island (Western & Southern Landscapes and Northern Landscapes & Longos Island)	TN 3 TN 4	2025-2035	Ministry of Forestry, TNI/Police, Local Government, NGOs
	3.2. Enhancing law enforcement capacity against illegal hunting and trade of Komodo dragons and their prey species	Conducting annual thematic training programs for law enforcement officials on wildlife crime enforcement to protect individuals, prey, and habitats of Komodo dragons in TNK and Flores Island (Western & Southern Landscapes and Northern Landscapes & Longos Island)	TN 3 TN 4	2025-2035	Ministry of Forestry, TNI/Police, NGOs
4. Implementation of ex situ population management for Komodo dragons to support in situ populations	4.1. Enhancing the role of conservation institutions in efforts to conserve Komodo dragons in the wild	Involvement of at least one conservation institution as *a center of excellence* for Komodo dragon conservation, particularly related to the development and management of integrated	TN 13 TN 15	2025-2026	Ministry of Forestry, BRIN, Local Government,

Program/ Strategic Objectives	Action Plan	Achievement Indicators	IBSAP Target	Timeline	Stakeholders
		Komodo dragon conservation and research centers			Academics, NGOs, PKBSI
5. The implementation of community involvement both within and outside the KSA/KPA in efforts to protect and conserve Komodo dragons	5.1. Strengthening customary laws to protect Komodo dragons and their habitats	The issuance of written customary or village regulations recognized by customary leaders in 7 villages (Sambinasi Barat, Sambinasi, Latung, Iteraja, Nangamese, Benteng Tengah, Tado)	TN 16 TN 17	2025-2027	Ministry of Forestry, Local Government, Academics, NGOs
	5.2. Prevention and management of conflicts between humans and Komodo dragons	Issuance of regulations/village decrees establishing independent conflict mitigation task forces in villages prone to human-Komodo dragon conflicts, including funding aspects Operationalization of conflict mitigation into the Village Medium-Term Development Plan (RPJMDes) and Village Fund in three priority villages (Sambinasi, Latung, Sambinasi Barat)	TN 16 TN 17 TN 19	2025-2035	Ministry of Forestry, Ministry of Agriculture, TNI/Police, Academics, NGOs
	5.3. Development of integrated community livestock programs and construction of livestock enclosures resistant to wildlife attacks	Establishment of integrated livestock management programs and wildlife-resistant livestock shelters	TN 17	2025-2035	Ministry of Forestry, Ministry of Agriculture, Local Government, Academics, NGOs
	5.4. Prevention of competition and predation of Komodo dragons by domestic/wild dogs	Protection of Komodo dragons from competition and predation threats from wild dogs in TNK and Flores Island (Western & Southern Landscapes and Northern Landscapes & Longos Island)	TN 4	2025-2035	Ministry of Forestry, Ministry of Agriculture, Local Government, Academics, NGOs
Research, Education, and Institutional Strengthening					
6. Optimization of research and monitoring to support the conservation of Komodo dragons	6.1. Long-term monitoring of the bio-ecology of Komodo dragons and their prey species	Availability of a compilation of ecological, behavioral, distribution, population, diet, reproduction, ethno-herpetological data, and priority habitats for Komodo dragons and their prey, updated periodically and accessible to all stakeholders	TN 15	2025-2035	Ministry of Forestry, BRIN, Academics, NGOs, Private Sector
	6.2. A study of Komodo dragon behavior aimed at regulating tourist activities to avoid changes in Komodo dragon behavior	Availability of the results of the study on the behavior of Komodo dragons to be used in developing tourist regulations in Komodo dragon habitats	TN 3 TN 4	2025-2035	Ministry of Forestry, BRIN, Academics, Private NGOs

Program/ Strategic Objectives	Action Plan	Achievement Indicators	IBSAP Target	Timeline	Stakeholders
	6.3. Construction of an integrated conservation and research center for Komodo dragons	Establishment of 1 integrated conservation and research center for Komodo dragons and their habitat	TN 13 TN 15	2025-2028	Ministry of Forestry, Academics, Private NGOs
	6.4. Comprehensive study through molecular genetic analysis of Komodo dragons	Mapping genetic differences/distinctiveness between Komodo dragon populations on each of their distribution islands	TN 4	2025-2027	Ministry of Forestry, National Research and Innovation Agency (BRIN), Academics, Private NGOs
	6.5. Molecular genetic study to map the population genealogy of Komodo dragons in Conservation Institutions	Mapping the origin of Komodo dragons in each Conservation Institution	TN 4	2025	Ministry of Forestry, BRIN, Academics, Private NGOs
	6.6. Research on the impacts, mitigation, and adaptation of climate change on Komodo dragons	Availability of data, information on the impacts, mitigation, and adaptation of climate change on Komodo dragons, as well as management recommendations	TN 7	2025-2035	Ministry of Forestry, BRIN, Academics, Private NGOs
7. The establishment of a comprehensive data system related to various aspects of Komodo dragon management	7.1. The establishment of an integrated data system accessible to all stakeholders for the management of Komodo dragons and their habitats	The establishment of a sustainable integrated data system accessible to all stakeholders for the management of Komodo dragons and their habitats	TN 15	2025-2026	Ministry of Forestry, BRIN, Local Government, Ministry of Tourism, Academics, Private NGOs
8. Enhanced capacity of personnel and institutions, as well as community expertise, in the management of Komodo dragons and their habitats	8.1. Capacity building planning	Development of plans and curricula for capacity building of personnel and institutions in the management of Komodo dragons and their habitats	TN 13	2025	Ministry of Forestry, Ministry of Education and Culture, Local Government, Academics, Private NGOs
9. Implementation of strengthened multi-stakeholder forums focusing on the conservation of Komodo dragons and their habitats	9.1. Optimization of multi-stakeholder forums focused on the conservation of Komodo dragons	The establishment of 1 multi-stakeholder forum for tourism operators in areas adjacent to Komodo dragon habitats that can contribute to the conservation of Komodo dragons	TN 16 TN 17	2025-2035	Ministry of Forestry, Local Government, Academics, NGOs, Private Sector
10. The implementation of strengthened partnership	10.1. Establishment and strengthening of the capacity of the Komodo	The establishment and operation of the Komodo Forum at the national level, as designated by the	TN 16 TN 17	2025-2035	Ministry of Forestry, Ministry of

Program/ Strategic Objectives	Action Plan	Achievement Indicators	IBSAP Target	Timeline	Stakeholders
programs and cooperation among stakeholders at the regional, national, and international levels	Conservation Forum (Komodo Forum) to enhance stakeholder participation in Komodo dragon conservation at the local level	Director General of KSDAE and/or the Head of the Regional Government			Agriculture, Ministry of Tourism, Local Government, Academics, NGOs, Private Sector
	10.2. Enhancement of international cooperation in the conservation of Komodo dragons	Establish at least two partnerships with international institutions to support Komodo dragon conservation efforts	TN 13	2025	Ministry of Forestry, Local Government, Academics, BRIN, NGOs, Private Sector
Community Economic Development and Sustainable Financing					
11. Establishment of policy support and spatial planning for the development of tourism potential that aligns with Komodo dragon conservation	11.1. Strengthening tourism management policies at both central and local levels to align with Komodo dragon conservation	Incorporation of Komodo dragon conservation aspects into tourism development policies and plans in NTT, including a roadmap for super premium marine tourism with Komodo dragons as *Outstanding Universal Value* (OUV)	TN 16	2025-2029	Ministry of Forestry, Ministry of Agriculture, Ministry of Tourism, Local Government, Academics, NGOs, Private Sector
	11.2. Study on the potential carrying capacity for tourism within and outside the KSA/KPA	Availability of baseline data and recommendations on important conservation aspects of Komodo dragons to be adapted into tourism development policies and plans for NTT	TN 15	2025-2029	Ministry of Forestry, Ministry of Agriculture, Ministry of Tourism, Local Government, Academics, NGOs
	11.3. Building synergy between the government, private sector, and community in the development of ecotourism and Komodo dragon conservation	Establishment of agreements/cooperation between government, private sector, and communities in the development of conservation-based ecotourism for dragonsKomodo	TN 16 TN 17 TN 18	2025-2027	Ministry of Forestry, Local Government, Academics, NGOs, Private Sector
	11.4. Development of environmentally friendly economic potential based on the sustainable use of natural resources, including examples such as environmental services, organic farming, handicrafts, and ecotourism	Availability of recommendations and development plans for the development of environmentally friendly economic potential to support the protection and management of Komodo dragon habitats in at least 2 priority locations	TN 20	2025	Ministry of Forestry, Ministry of Agriculture, Ministry of Tourism, Local Government, National Research and Innovation Agency (BRIN),

Program/ Strategic Objectives	Action Plan	Achievement Indicators	IBSAP Target	Timeline	Stakeholders
					Academics, NGOs, Private Sector
12. Establishment of a Komodo dragon population through the provision of prey animals	12.1. Construction of community-managed deer breeding facilities to ensure the availability of food for Komodo dragons at integrated conservation and research centers	Construction of 1 community-managed deer breeding facility to ensure the availability of food for Komodo dragons at integrated conservation and research centers	TN 13	2025-2027	Ministry of Forestry, Ministry of Agriculture, BRIN, Local Government, Academics, NGOs, Private Sector
13. Achievement of a sustainable funding scheme to support Komodo dragon conservation	13.1. Development of various long-term funding mechanisms sourced from domestic and/or international sources that are non-binding	The establishment of an endowment fund (trust fund) and long-term funding mechanisms to support Komodo dragon conservation	TN 19	2025-2035	Ministry of Forestry, Local Government, NGOs, Private Sector
	13.2. Mobilization of funding sources or investments for programs related to Komodo dragon conservation efforts by civil society organizations and the private sector (optimization of village funds, corporate social responsibility funds)	The realization of funding or investment of at least USD 3 million in the form of a trust fund for the implementation of programs and activities related to Komodo dragon conservation by civil society and private sector entities	TN 18 TN 19	2025-2035	Ministry of Forestry, Local Government, NGOs, Private Sector
	13.3. Initiate *influence* for funding support from GEF and other legitimate and non-binding sources	Establishment of a system for organizing influence for funding support from GEF and other legitimate and non-binding sources	TN 19	2025	Ministry of Forestry, NGOs, Private Sector
Communication, Education, & Public Awareness (CEPA)					
14. The implementation of strengthened central and local policies to support the conservation of Komodo dragons	14.1. Issuance of Local Regulations to strengthen the protection of Komodo dragons in areas that serve as their habitat	Synchronization of policies and the issuance of local regulations on the protection and conservation of Komodo dragons in 3 districts and provinces	TN 16	2025-2035	Ministry of Forestry, Local Government, Academics, NGOs
	14.2. Issuance of Local Regulations to establish incentives for the conservation of Komodo dragons	Enactment of at least one regional regulation at the provincial level regulating incentives for the conservation of Komodo dragons	TN 20	2025	Ministry of Forestry, Local Government, Academics, NGOs
	14.3. Enhancing the implementation of regulations related to the protection of Komodo dragons	The issuance of local regulations that accommodate aspects of Komodo dragon conservation within regional development policies	TN 16	2025	Ministry of Forestry, Local Government, Academics, NGOs

Program/ Strategic Objectives	Action Plan	Achievement Indicators	IBSAP Target	Timeline	Stakeholders
15. Increased awareness among stakeholders to commit to Komodo dragon conservation	15.1. Strengthening awareness efforts through conservation education and environmental education related to Komodo dragons and their habitats	Availability of conservation education and environmental education plans and curricula related to Komodo dragons and their habitats	TN 13	2025-2035	Ministry of Forestry, Ministry of Education and Culture, Local Government, Academics, NGOs, Private Sector
	15.2. Dissemination of information (socialization, campaigns, education, publications) related to Komodo dragon conservation	Implementation of educational activities and campaigns (school visits, village visits, participation in events/exhibitions, etc.) at the national, provincial, and district levels in 5 districts	TN 13	2025-2035	Ministry of Forestry, Local Government, NGOs, Private Sector
	15.3. Establishment of citizen journalism for campaigns promoting concern for Komodo dragon conservation	Establishment of citizen journalists for the Komodo dragon conservation campaign	TN 16 TN 17	2025	Ministry of Forestry, Local Government, BRIN, Academics, NGOs
	15.4. Education, Awareness Raising, and Public Enlightenment: Enhancing understanding of the importance of Komodo dragons as unique and critically important species for international conservation	Conducting education, outreach, and awareness campaigns for the public to prevent illegal activities aimed at protecting individuals, prey species, and habitats of Komodo dragons in TNK and Flores Island (Western & Southern Landscapes and Northern Landscapes & Longos Island)	TN 17	2025-2035	Ministry of Forestry, Local Government, NGOs, Private Sector

IV. Monitoring and Evaluation

IV.1. Monitor

Monitoring is conducted at least once a year to assess the implementation of conservation strategies and action plans for plant and animal species.

IV.2. Evaluation

Evaluation is conducted based on monitoring results and/or incidentally based on urgency.

V. References

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