ZSL
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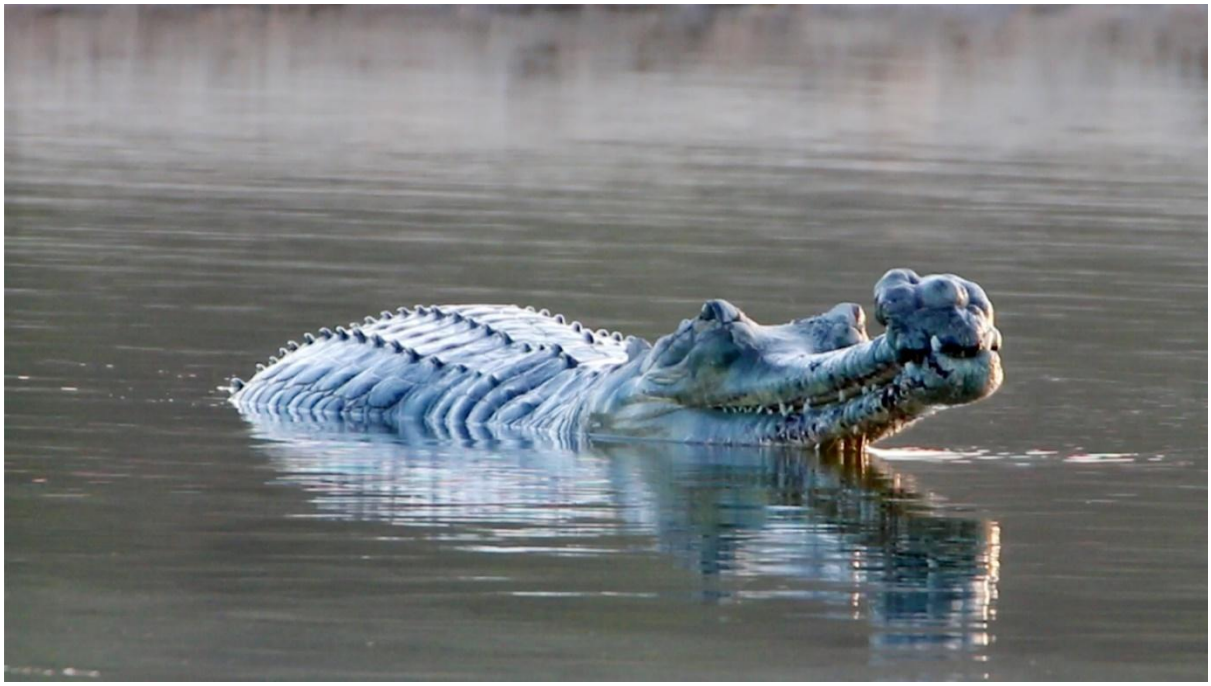
EDGE

EVOLUTIONARILLY DISTINCT & GLOBALLY ENDANGERED

Survival Blueprint

Gharial*, Gavialis gangeticus*



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1. STATUS REVIEW

The IUCN Red List assessment and its supporting documents (Lang et al. 2019), was a vital source of information on gharials globally, supplemented with recent updates.

1.1 Taxonomy: The ancient order Crocodylia, within class Reptilia, contains four sub-orders, of which only the Eusuchia (containing all living crocodylians) survives to the present (Romer, 1956). The extant crocodylians are divided among three families, Alligatoridae, Crocodylidae, and Gavialidae. The placement of Gharial on the crocodilian tree and its relation to the false gharial, *Tomistoma schlegelli*, have attracted considerable interest due to incongruences in phylogenies based on the morphological and molecular data (McAliley et al. 2006; Willis et al. 2007). Morphological studies have favoured a placement of the two species in different families, the Gharial in the Gavialidae and the false Gharial in the Crocodylidae; and Gharial is placed basal to all other recent crocodiles. In contrast, molecular data consistently support a close phylogenetic relation between gharial and false gharial (Densmore and Owen 1989; McAliley et al. 2006; Willis et al. 2007). The widely accepted and established systematics of order Crocodylia recognizes gharial as a sole extant member of family Gavialidaea under monotypic genus Gavialis as follows:

Kingdom	Phylum	Class	Order	Family	Genus	Taxon name
Animalia	Chordata	Reptilia	Crocodylia	Gavialidae	Gavialis	*Gavialis gangeticus*

Species name and author: *Gavialis gangeticus*, Gmelin in Linnaeus, 1789

Common names: Gharial

Local name: Lamthori gohi (Tharu communities),
Gharial (Hindi)

1.2 Distribution and population status:

The species is listed as Critically Endangered under criteria A2bce in the IUCN Redlist.

Currently, gharial distribution is limited to few restricted areas of India and Nepal. In India, the largest gharial population reside in protected National Chambal Sanctuary in north India which contains 77% of global adult population (Lang, Chowfin and Ross 2019). The remaining populations in India inhabit the Katarniaghat Wildlife sanctuary in Uttar Pradesh, Gandak river at Indo-Nepal boarder, Corbett National Park, Son River, Mahanadi, and Hastinapur sanctuary. Small populations (perhaps just some individuals) have been encountered in the Ken River, Brahmaputra, Ghaghara River and Bhagirathi-Hoogly River, as well as in Jamuna River in Bangladesh. In Nepal, the gharial is found in the Rapti-Narayani river system in central part and Babai river in western part of the country. Both of these are breeding populations and exist inside the protected area. Only one gharial was observed during surveys in the Karnali between 2015 and 2019 (Acharya et al. 2017; Bashyal et al. 2021). Up to 3–4 gharials were regularly reported in channels of the Geruwa and the Karnali by nature guides and park rangers especially during the monsoon (Bashyal et al. 2021). In June 2022, one gharial nest and approximately 28 hatchlings were seen in one of the smaller channels of the Geruwa (eastern channel of the Karnali) showing that these channels could be an important area for gharial recovery.

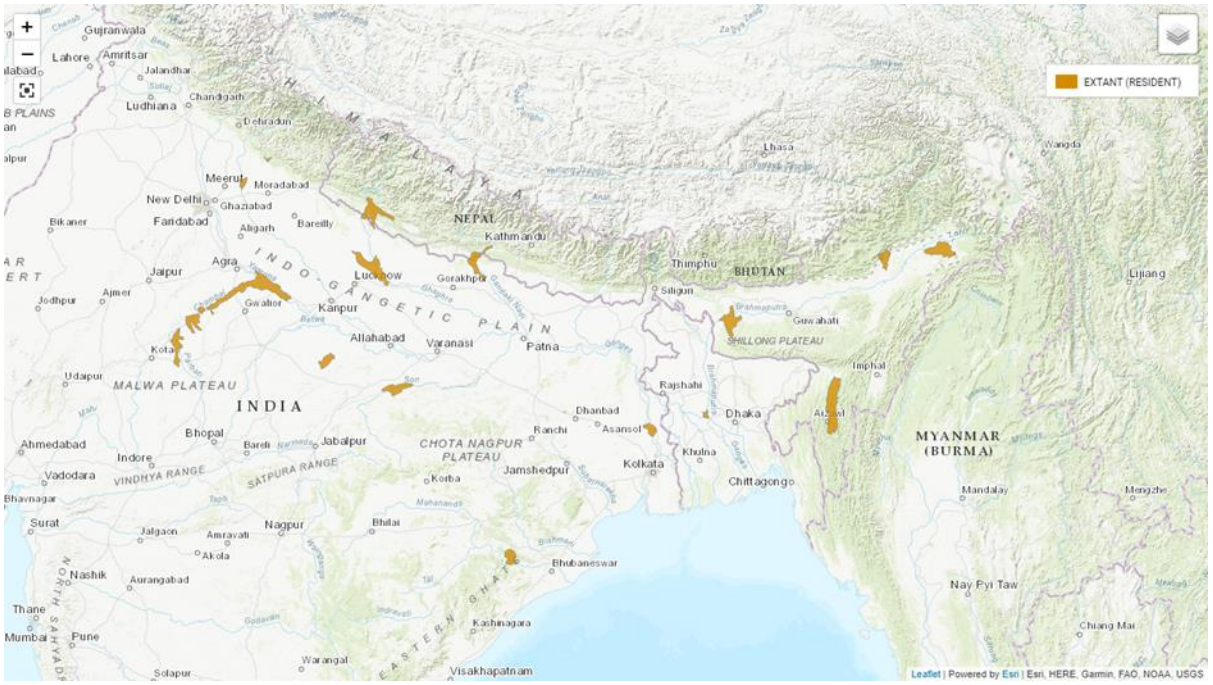

Figure 1. Map showing distribution localities (in light-orange) of 14 sub-populations of gharial (*Gavialis gangeticus*) across India, Nepal and Bangladesh. Political boundaries of countries indicated by light grey line. Source: Lang et al. 2019.

1.2.1 Global distribution:

Gharials are endemic to Indian sub-continent and currently distributed only in India, Bangladesh and Nepal (Fig.1; Lang et al. 2019).

Country	Population estimate (plus references)	Distribution	Population trend (plus references)	Notes
India	Total - 2393-2633 Adult male =126 Adult female=777	Chambal, Girwa, Gandak, Ghaghara, Bhagirathi-Hooghly, Brahmaputra / Barak, Ramganga, Son, Ken & Mahanadi Rivers	Increasing (GEP 2021- adult count in Jan-Feb 2021, 414 km NCS, Lang et al. 2019, and Sinha et al. 2020)	Population estimate for nine sub-populations based on studies from 2017 and for one sub-population based on study on 2020
Nepal	Total =234 Adult male =8 Adult female =65	Narayani, Rapti, Karnali & Babai Rivers	Increasing (Lang et al. 2019)	Population estimate for Narayani and Rapti from 2018 and for Babai from 2021
Bangladesh	Total =35	Jamuna & Padma Rivers	Decreasing (Lang et al. 2019)	Information not available for size-class categories

1.2.2 Local distribution:
Gharials are currently distributed in only 14 widely spaces sub-populations in India (*n*= 10), Nepal (n = 3) and Bangladesh (*n* = 1; Fig. 1; Lang et al. 2019). These 14 sub-populations are categorized into major (*n* = 6; first six sub-populations in the table below) and minor (n = 8; Lang et al. 2019). Recent reproduction has been reported from six major sub-populations (Bashyal et al. 2019; Lang et al. 2019) as well as more recently from minor sub-populations (n=3).

Country	Region / province	Site	Level of Protection	Population size	Reference(s)	Notes
India	Rajasthan, Madhya Pradesh, and Uttar Pradesh	Chambal River, Chambal Wildlife Sanctuary	Wildlife Sanctuary (Total = 723km; protected = 425km)	Total 1709–1880 Adult male =102 Adult female=671	GEP 2021 -adult count in Jan-Feb 2021, 414 km NCS	Reproduction ongoing; the Largest population of gharial throughout its entire range
India	Uttar Pradesh	Girwa River, Katerniaghat Wildlife Sanctuary	Wildlife Sanctuary (Total = 20km; all protected)	Total =43; Adult Male =6; Adult Female =37	G. Vashistha 2017, pers comm. in Lang et al. 2019	Reproduction ongoing; Information on other size-class not available. This population is connected to the Karnali population in Nepal.
India	Assam	Kaziranga National Park	National Park	Not known. One sighting in March 2022		https://www.hindustantimes.com/india-news/in-a-first-evidence-of-endangered-gharial-recorded-in-kaziranga-101646333295325.html
Nepal	Chitwan & East Nawalparasi districts, Bagmati Province	Narayani and East Rapti Rivers; Chitwan National Park	National Park (Total = 150km; left bank protected but right bank not protected)	Total =219; Adult Male =3 (2018) – 6(2020); Adult Female =54; Others=165	Paudyal et al. 2018; Khadka 2020	Reproduction ongoing; Supplemented by captive release. This population is connected to the Gandak population in India through a porous barrage.
India	West Champaran, Bihar	Gandak River (known as Narayani in Nepal), Valmiki Tiger Reserve	Tiger Reserve (Total = 322km; protected = 55km)	Total =259; Adult Male =5; Adult Female=24; Others= 230	WTI 2020	Reproduction ongoing; A very high percentage of yearlings reported (57%), likely primarily from the Nepal population

						upstream. There is a porous barrage between these populations.
India	Uttarakhand	Corbett National Park and Tiger Reserve	National Park	Total =90	Chowfin and Leslie 2016.	Reproduction ongoing; Information on size- class not available
Nepal	Bardia district, Lumbini Province	Babai River, Bardia National Park	National Park (Total= 46km; all protected)	Total =14 Adult Male =2; Adult Female=10; Others=2	Bashyal 2021	Reproduction ongoing
India	Uttar Pradesh	Ghaghara River	165km non-protected	Total =20; Adult Male =1; Adult Female=9; Others= 10	WTI 2017	
India	West Bengal	Bhagirathi-Hooghly River	500km non-protected	Total = 3-82 Total adults = 2-21	T. Ghosh 2017, pers comm. In Lang et al. 2019	Robust information not available
Nepal	Bardia district, Lumbini Province	Karnali River; Bardia National Park	National Park (Total = 70km; Protected = 30km)	Total =1; Adult female =1		Total count could be up to 3–4 gharials based on pers. Comm. And field observation (Bashyal et al. 2021). This population is connected to the Katerniaghat population in India. Recent reproduction reported in 2022.
Banglad esh	West Bengal	Jamuna & Padma Rivers	270km non-protected	Total = 35	IUCN Banglades h 2016	Information not available for size class categories
India	Manipur, Nagaland, Mizoram & Assam	Brahmaputra / Barak Rivers	Non-protected	Population estimate not available		
India	Madhya Pardesh & Bihar	Son River	260km; all protected	Total =12; Adult Male =2; Adult Female =8	T. Nair 2017, pers. Comm. In	Reproduction occurred in 2022 following translocation of an

					Lang et al. 2019	adult male to the site.
India	Madhya Pradesh & Uttar Pradesh	Ken River	175km; right bank protected; left bank unprotected	Total =1	T. Nair 2017, pers. Comm. In Lang et al. 2019	
India	Chhattisgarh & Odisha	Mahanadi River (Satkosia Gorge)	Total = 35km; all protected	Total =9 Adult Male = 1 Adult Female =2	Palei and Rath 2017	Limited reproduction reported in 2021/22.

1.3 Protection status:

CITES: Appendix I
India: Schedule I (list of protected species) of Indian Wildlife Protection Act 1972.
Nepal: The species is included in the Wildlife Conservation (NPWC) Act, 1973 in Nepal (DNPWC 2018). The NPWC Act 1973 has provisioned a fine of NRs. 100,000–500,000 or 1–10 years of imprisonment or both for killing or hurting gharial (DNPWC 2018).

1.4 Ecology, behaviour, and habitat requirements:

The gharial is a river dwelling crocodilian (Whitaker and Basu 1983) with adult gharial showing widespread use of river systems with seasonal migratory behaviours and social hierarchies (Lang and Kumar 2013, 2016). Gharial is an iconic species with sexual dimorphism as the male consists of bulb like structure at the tip of snout called “ghara”, and unusual and interesting behaviours such as ‘fencing’ (Maddock 2010) and use of ‘POP’ sound for communication (Lang and Jailabdeen 2017). Gharials congregate for mating and nesting during the dry season in these highly seasonal, monsoonal rivers. Courting and mating occurs in mid–February followed by nesting and egg laying in mid–March to early–April. During courtship, male Gharial produces a loud audible sound which is called “POP” to attract females for mating. The ghara acts like a sound resonator for POP inside the water. Male Gharial also uses the POP sound for communication and habitat patrolling. Female gharial nest in seasonally exposed sandbanks along slow-moving sections of medium- to large-sized rivers and lay an average of 40 eggs. Incubation takes 2-2.5 months with mostly females guarding nest sites. Hatching occurs from late May to early July (Stevenson and Whitaker 2010; Khadka et al. 2020; Lang et al. 2019).

Adult care is well-documented. Females open the nests at the time of hatching but do not transport the young to the water. Females, and typically a single large male, guard hatchling crèches from potential predators for 1- 2 months. Once monsoon waters start to rise, the guarding adults make long distance seasonal movements or shift to local feeding sites (depending on the population), and the crèches break up with hatchlings dispersing widely into aquatic shoreline habitats. Adult gharial are seasonal migrants in large, open river drainages, with movements of 50-200+ km recorded in Chambal. Upon release, non-resident, captive-reared individuals appear highly mobile, and some have moved in excess of 1,000km. In the Chambal subpopulation, the largest females nest every year (reproductive frequency >90%; Thorbjarbnarson 1996, Lang and Kumar 2016). Similar values appear to apply to other subpopulations, e.g., Katerniaghat subpopulation, but may not apply to the most northerly

subpopulation, e.g. at Chitwan. Additional references on gharial ecology are noted in Groombridge (1982), Maskey (1989), Rao et al. (1995), Wildlife Institute of India (1999), Choudhury et al. (2007) and Stevenson (2015).

1.5 Threat analysis:

Threat	**Description of how this threat impacts the species**	**Intensity of threat** *(critical, high, medium, low, or unknown)*	**IUCN Threat category**
River material extraction	• Sand and boulder removal operates on an industrial scale at some localities on the Chambal River, which removes critical riverside substrate for nesting and changes the river sedimentary level eventually affects the natural flow of the river • The nesting habitats are degraded by sand mining and gravel collection. Industrial scale mining occurs in Chitwan which left very few nesting banks • The 46 km stretch of the Babai which gharials currently inhabit is fully protected and any extraction of river material is prohibited. However, extraction of river material (rock, boulder, sand etc.) may occur.	• Critical • Critical • Low	5 Biological resource use 5.4 Fishing & harvesting aquatic resources • 5.4.2 Intentional use: large scale (species being assessed is the target)[harvest] • 5.4.1 Intentional use: subsistence/small scale (species being assessed is the target) [harvest]
Water extraction/ siphoning for agriculture	• Irrigation Lift stations on the Chambal threaten gharial survival because during the dry season, water flow and consequently river connectivity is greatly reduced. Meanwhile there are 2 more water extraction projects sanctioned by Madhya Pradesh and Rajasthan states respectively • The East Rapti irrigation project had been built at the upstream of Rapti River which reduced significant water flow in downstream. Recently, Rapti has been major breeding habitat of Chitwan population. So large Gharial population exists here and reduced water flow will threat this population. Although, Narayani (snow fed) is way larger than Rapti (ground and stream fed) River, gharial population may be more in Rapti because of intense human pressure in Narayani or the proximity of the Gandak Barrage, however, the exact threats driving these population differences are not well understood. • Significant volume of water from the Babai is siphoned via irrigation canal from the eastern	• High • High • High	7 Natural system modifications 7.2 Dams & water management/use • 7.2.3 Abstraction of surface water (agricultural use)

	flank of the weir. Volume of siphoned water is much higher during the dry season (November–April) leaving very low level of water in the downstream Babai. There is perennial deep water pool immediate downstream of this weir but there is less than one meter deep water in the Babai downstream from this pool in the dry season. The water level and fish abundance in the pool is seemingly adequate for gharial survival but lack of water downstream halts movement of gharials downstream during the dry season. ● At Chepang (upstream point at which the Babai enters the jurisdiction of BNP), villagers use motorized pumps to extract water from the Babai for drinking and irrigation. Currently, the settlement is small and the impact of water extraction may not be significant, however, as the settlement increases impacts of such water extraction on the freshwater ecosystem of the Babai could be detrimental.	● Low	
Illegal fishing	● As legal and illegal net fishing, especially with monofilament gill nets, has intensified in large rivers, gharial losses to entrapment are increasing. On the Chambal, fishing in the National Chambal Sanctuary is prohibited, but persists, especially in the lower reaches near the Yamuna confluence, and in the Yamuna stretches above and below the Chambal confluence. Young animals are susceptible to being caught in nets, and either drown or are killed or injured deliberately or accidentally. Older gharials appear to be "net savvy" and tend to not be captured in nets. Near the Yamuna confluence, gharial of all sizes with damaged snouts are more often encountered than elsewhere in the NCS. ● Illegal fishing using monofilament gill nets is intense in Rapti and Narayani Rivers. These nets entrap gharial leading to death. In Chitwan, from 2019 to 2020, eight radio tagged Gharials had been died by gill net entanglement and there were more numbers of untagged Gharial. Most Gharials were killed deliberately once they were trapped in net. We conservatively estimate that more than 5% of the current population die every year, and a greater number of recent head start releases. Deaths can be deliberate killing to recover the net, drowning in the net, or starvation following the jaw becoming	● High ● Critical	5 Biological resource use 5.4 Fishing & harvesting aquatic resources ● 5.4.2 Intentional use: large scale (species being assessed is the target)[harvest] ● 5.4.2 Intentional use: large scale (species being assessed is the target)[harvest]

	extensively tangled in a net. The death of Gharial by gill net is never a topic of discussion and there is no published data on it. Use of gill net and fishing hooks is very intense in Narayani River. In downstream of the River, people have no clue about the threats of gill net and they deploy gill net and fishing hooks overnight in the river to trap more fish. This has intensified the threats to the Gharial. ● The 46 km stretch of the Babai which gharials currently inhabit is fully protected. There are six range posts in close vicinity of the river which regularly patrol the Babai and its surroundings. However, during the surveys I have observed some signs of illegal fishing in this protected stretch. The forest is dense and despite of the regular patrolling, it is possible to reach the Babai from surrounding villages for fishing. The intensity and extent is much higher in the unprotected stretch upstream and downstream of this 46 km long protected stretch. Although most of this fishing is sustenance fishing using traditional methods and nets, higher prevalent of fishing could result in significant decline in food base for gharials.	● Medium	● 5.4.1 Intentional use: subsistence/small scale (species being assessed is the target)[harvest]
Decreased fish stock	● As per local people and park authorities, the fish stock in Narayani has drastically declined in last 10 years. This may be caused by extensive use of gill nets and illegal fishing at the night time (which has additional issues, see section illegal fishing). Moreover, intrusion of urban and industrial effluent from Narayanghat area has altered the water quality that has negatively impact the fish stocks. Plastic pollution is a growing issue. The presence of the barrage may also be hampering the movements of migratory fishes e.g. Mahseer. The degradation of small tributary rivers, including pollution from extensive agriculture, is likely impacting these fish and gharial habitats.	● Critical	5 Biological resource use 5.4 Fishing & harvesting aquatic resources ● 5.4.2 Intentional use: large scale (species being assessed is the target)[harvest]
River inter-linking	● The proposed Ganges-Brahmaputra inter-link canal and dam project, envisioned under the Indian National Waterways Act 2016, is intended to convert 111 reaches of 106 rivers to inland waterways for transport of cargo, coal, industrial raw materials, and for tourism, without government seeking environmental approvals for bulk of the waterways (Hindustan Times, 2018). The cumulative effects of these projects will	● High	7 Natural system modifications 7.2 Dams & water management/use ● 7.3 Other ecosystem modifications

	severely affect the remaining extant populations of gharial which persist in the few remaining remnants of natural riverine habitat, presently under governmental and legal sanctions as protected areas, etc. ● River inter-linking project (Bheri-Babai Diversion Multipurpose Project) that aims to siphon water from the Bheri River into the Babai is under construction and is scheduled to complete by 2023 (BBDMP 2019). Such interlinking can bring drastic change in freshwater ecosystem of the Babai River and negatively affect gharials and many other river-dependent wildlife. However, such impacts have not been adequately considered during the construction of this interlinking project (DNPWC 2018). Intermixing of cold water from the Bheri (whose average water temperature is 2–6.8 °C lower than that of the Babai) into the warm-water of the Babai can change water temperature as well as many other physio-chemical and biological characteristics of the Babai River (Yadav 2002; DNPWC 2018). One serious negative impact to gharials post-diversion could potentially be caused due to change in thermal regime of water and soil temperature. Gharials exhibit temperature-dependent sex determination, wherein the sex of an individual is determined irreversibly by incubation temperatures during embryonic development (Lang and Andrews 1994). Thus, any change in water temperature of the Babai and adjacent soil temperature of the sand bank which gharial uses for nesting post-diversion can seriously affect nest temperature and have harmful effects on hatching success and sex ratio in Gharials. Similarly, change in water temperature will likely affect basking and swimming behaviour of gharials. Furthermore, intermixing of different rivers could affect physio-chemical parameters such as dissolved oxygen, Biological and Chemical Oxygen Demand, total hardness and Calcium which could negatively affect wellbeing of gharials and entire freshwater ecosystem of the Babai.	● Critical	
Physical infrastructure (Barrage, bridge & weir)	● There are many new river crossing bridge constructions happening in Chambal River. These projects create local fragmentation of river during 9 months of the year except monsoon. It takes around 5-10 years to	● Medium	7 Natural system modifications 7.2 Dams & water management/use

	complete one crossing bridge project for which the river suffers the fragmentation and pollution issues.		7.3 Other ecosystem modifications
	● The Gandak barrage in Narayani River at Indo-Nepal border is the major water controlling structure. During monsoon, the water flow to downstream be lowered which results upstream inundation. This upstream flood wash away high sand banks used for nesting. Moreover, reduced downstream flow inundates the nests before they are hatched, resulting nest failure. In 2020, all the nests were flooded before they hatched in Narayani. This year also nests in Narayani have been already inundated. The barrage also reduce the upstream and downstream seasonal movement of Gharial. Once the Gharials are swept beyond the barrage in monsoon, they rarely get chance to move upstream. This is likely a major issue for hatchlings and yearlings, thought to travel substantially downstream in their first monsoon.	● Critical	
	● The protected 46 km stretch of the Babai River is bounded by a major irrigation weir downstream at Parewa Odar just outside the jurisdiction of BNP. There is approximately 50 km stretch of the Babai downstream from this weir to Nepal-India border. There is a deep water pool (resembling reservoir) immediate downstream of the weir which is inhabited by a small group of gharials. This irrigation weir has been a major hindrance for upstream migration of gharials which have poor locomotion. I have found two adult female gharials in this pool along with 2–3 sub-adults and juveniles but no any adult male in 2020 and 2021. In addition to hindering regular up- and down-stream movement of gharials in the Babai, this weir has been a major barrier isolating adult female gharials from adult males and thus hindering any chance of mating and consequently nesting.	● Critical	

1.6 Stakeholder analysis:

Country	**Stakeholder**	**Stakeholder's interest in the species' conservation**	**Current activities**	**Impact** *(positive, negative or both)*	**Intensity of impact** *(low, medium, high or critical)*
India (Chambal)	Gharial Ecology Project, Madras Crocodile Bank Trust	Project results directly contribute to species conservation and management	- Survey and its techniques - Radio telemetry - DNA study - Acoustic study - Pheromone Study - Collaboration with other projects as advisor across all the major population - Community programs	Positive	High
India (Chambal)	Forest Department all the 3 states and central – Uttar Pradesh, Madhya Pradesh, Rajasthan, and MOEFCC	All forest department plays vital role in Management of the Sanctuary	- Survey - Routine patrolling - Awareness raising	Positive	High
India (Chambal)	Local riverine communities	Project community-based programs fulfils their interest	- Cooperating in residence and local resources	Both	Medium
India and Nepal	Other Gharial researchers (In-country and foreign researchers including other 2 EDGE fellows from Nepal)	Project results directly contribute to their interest	- Survey - Awareness raising - Inputs for management - Implementing research approach	Positive	High
Nepal (Chitwan and Bardia)	Ministry of Forest and Environment (MoFE)	MoFE is interested in conservation of all endangered wildlife of Nepal including gharials and their habitat	- Facilitation of designing of Gharial Action Plan	Positive	High (Chitwan); Medium (Bardia)
Nepal (Chitwan and Bardia)	DNPWC	DNPWC is a central body under the Ministry of Forest and Environment that manages all protected areas in Nepal. It is interested in long-term conservation of gharials in BNP and Nepal	- Designing of Gharial Action Plan - Facilitation of gharial survey and monitoring	Positive	High (Chitwan); Medium (Bardia)

Nepal (Chitwan and Bardia)	Chitwan National Park (CNP)	CNP is home to the largest population of gharial in Nepal. It is interested to increase the number of Gharial in the wild through habitat management, threat reduction and community-based conservation	- Survey - Monitoring - Captive breeding and rearing - Awareness raising	Positive	High (Chitwan) Medium (Bardia)
India & Nepal (Chambal, Chitwan and Bardia)	Zoological Society of London (ZSL)	ZSL has been implementing long-term project on gharials in CNP (via ZSL-Nepal) and supporting EDGE fellows working on gharials in India & Nepal (via EDGE Fellowship Programme)	- Survey - Monitoring - Awareness raising - Community support - Funding - Capacity building - Alternative livelihood	Positive	Medium
Nepal (Chitwan and Bardia)	National Trust for Nature Conservation (NTNC) – Bardia program	NTNC is interested in long-term conservation of gharials in Nepal including the BNP	- Survey - Monitoring - Awareness raising	Positive	Low
Nepal (Chitwan)	Buffer Zone Management Committees (BZMC)	Community based conservation	- Involving local people in conservation forming Community Based Anti-Poaching Unit	Positive	Low
Nepal (Chitwan)	WWF Nepal	Research, Conservation and sponsoring different conservation activities	- Research	Positive	Medium
Nepal (Bardia and Chitwan)	Biodiversity Conservancy Nepal (Biocon)	Biocon has been implementing long-term project on gharials in Nepal including BNP. Biocon is interested in establishing healthy and protected population of gharials in BNP	- Survey - Monitoring - Capacity building of BNP park rangers and local conservationists - Awareness raising	Positive	Medium

Nepal (Bardia)	Community-based anti-poaching unit (CBAPU)	CBAPU aims to curb wildlife poaching and are interested in protection of wildlife including gharials	- Routine patrolling - Awareness raising	Positive	Low
Nepal (Bardia)	Local riverine communities	Communities are interested in sustainable fishing practice and wellbeing of the Babai River	- Participation in citizen science program - Information sharing - Fishing - Water extraction - Waste disposal	Positive and negative	Medium
Nepal (Bardia)	Kathmandu University (KU)	KU is one of the collaborators of Biocon on gharial project. It is interested in long-term conservation of gharials in BNP and involvement of its students in gharial surveys	- Collaboration - Technical input	Positive	Low

1.7 Context and background information that will affect the success of any conservation action for this species:

	Region	Description	Barriers to conservation	Opportunities for conservation
Socio-cultural effects and cultural attitudes	Chambal	● Local riverine communities have both positive and negative attitude towards gharial. Some consider that because of gharials and other riverine species only they cannot be able to use the river to their own use while the other half are happy to share the river and its resources with gharials	● Gaining support of local communities which is critical for gharial conservation could be challenging ● Getting support during community programs could be challenging and critical	● Local communities could be key for gharial conservation. ● They could actively participate in any research programs as staffs with some training and practise
	Chitwan	● River system in Chitwan is the source of livelihood for some indigenous groups such as Bote, Kumal and Musahar who depend on fishing in the River. Fishing is not only an economic source but also their culture. Many of their cultural and religious rituals are incomplete without the fish from the river.	● Buffer zone near the river is home to not only tribal groups but also many other people. Fishing by indigenous is not a critical threat because they are well known on Gharial and sustainable fishing methods like hand nets. But fishing from other community people who do not have knowledge on hand netting and Gharial put significant impacts. People from other communities think if Bote people can go fishing then why they can't. This perception, which is due to lack of knowledge, has increased the illegal fishing and use of gill nets. More the gill nets in the river, more threats to Gharial. This has increased the conflicts among tribal people, other community people and national park when	● There is a lack of knowledge and awareness among people on Gharial's ecology and conservation. Enhancing knowledge among local people and involving them in conservation can help to minimize threats and habitat management that will secure the long term conservation of Gharial.

			the national park imposes strict rules on fishing.	
	Bardia	● Local riverine communities have both positive and negative attitude towards gharial. Some consider gharials as competitor of fish. Others that are aware of situation of gharial are happy that gharials live in their river and think that gharials should be conserved	● Gaining support of local communities which is critical for gharial conservation could be challenging ● Extracting unbiased responses from locals during questionnaire surveys and interviews could be challenging ● Finding support and volunteers for citizen science programs and formation of gharial watch/patrol group could be challenging	● Local communities could be key actor in gharial conservation. They could actively participate in awareness campaigns, questionnaire surveys and citizen science programs ● They would also be vital in formatting and functioning of gharial watch/patrol groups (gharial stewards)
Economic implications	Chambal	● Eco tourism is a successful model that is running in Uttar Pradesh state, which must be implemented in Other 2 states.	● Gaining permits, funding and collaboration for such activities could be critical and challenging	● This creates jobs for local communities, so they don't have to rely on illegal activities
	Chitwan	● There is high market demand for fish in Chitwan. This leads to the fishing pressure in the river. ● Chitwan occupies a major part in the tourism industry of Nepal. Gharial receives major attractions for Chitwan's river tourism. So river tourism can be promoted in a sustainable way. ● Sand mining boulders removal from river banks are reducing the substrate from nesting banks, reducing the area for nesting.	● These indigenous people do not want to change their profession away from the river. It would be challenging to convince and engage them to other alternative livelihood options. On the other hand, there is a good market price for fish in Chitwan and fishing is an easy and immediate option for earning. This is the reason why everyone from the village wants to go to the river for fishing using gill nets. Lack of awareness among local people about the lethal impacts of gill nets and fishing hooks on Gharial. Due to lack of knowledge, people are indifferent towards conservation activities.	● Aquaculture can be promoted as a livelihood option. Other alternative livelihood options and skill training that goes along with their interest can be identified and these people can be engaged in community based conservation programs. ● River tourism based on canoe boating and aquatic animal sightings including crocodiles can be started, which will provide opportunities to the local economy as well as conservation of the river system. River tourism can be promoted via local homestay and ethnic culture.

			• Use of gill nets by other (non-indigenous) people using gill nets leads to reduced fishing opportunities for indigenous groups who rely on fishing for their livelihood and culture. Moreover, lack of awareness/ability of non-indigenous people on how to release gharial from gill nets if they do accidentally catch one increased probability of gharial mortality. • Controlling river mining is very challenging as it is operated at industrial scale.	• Conducting awareness programs to bring people in conservation programs • Implementation of strict regulation on use of gill nets • The mining activities should be limited in the areas not used by Gharial.
	Bardia	• There are examples of crocodilian-centric sustainable eco-tourism across the globe. Eco-tourism activities such as gharial tracking, rafting, kayaking, forest camping etc. focused on gharials can be designed by local communities and hotels around the buffer zone of BNP. Such activities could provide economic incentives to locals and further encourage them in crocodilian conservation	• Tourists may not be interested in pursuing crocodilian-centric eco-tourism activities as compared to other wildlife such as tiger or elephant • Locals may lack capacity and/or interest to get involved in such eco-tourism • Maintaining balance between business and conservation could be challenging	• Crocodilian-centric eco-tourism could be popular among tourists. It could help generate employment opportunities for locals • It could also results in increased appreciation for crocodilians among both tourists and local communities
Existing conservation measures	Chambal	• GEP and all FD department having long term conservation plans for gharials in NCS	• Collaborative initiatives could be challenging since each state are in race with other 2 and doing activities on their own terms	• Collaborative conservation form all the FD and GEP can be effective and can save lots of resources which can help for further conservation
	Chitwan	• The species is listed as a national protected species in the National Parks and Wildlife Conservation Act.	• The conservation action plan is not fully implemented. The primary focus of the park should be on addressing threats and habitat	• Conservation focus should be on habitat management and threat reduction. Education and awareness among local people to generate

		● The government has prepared the Gharial Conservation Action Plan for Nepal (2018-2022) prioritizing community based in-situ conservation. ● There is regular head starting program run by Gharial conservation and breeding centre in Chitwan ● The national park has collaborated with NTNC and ZSL Nepal for community based conservation. ZSL Nepal has constructed a few fishing ponds in Rapti River to reduce the fishing pressure in river. These ponds are operated and managed by women groups.	management in addition to the head start program. ● There is no proper monitoring of released Gharial and their movement.	citizen scientists for sustainable community based conservation. ● The buffer zone community forest management committee and user groups should be mobilized effectively for conservation.
	Bardia	● BNP and NTNC conduct annual or biennial monitoring and survey of gharials in the Babai and the Karnali Rivers within the jurisdiction of BNP ● Biocon has been conducting regular monitoring and surveys during breeding, nesting and hatching seasons of gharials since 2017	● Lack of clear strategy for regular monitoring of gharials at regular intervals has resulted in irregularities in gharial monitoring ● Occasionally, lack of coordination between major stakeholders have resulted in duplication of surveys	● There are opportunities for collaboration among major stakeholders involved in gharial monitoring in the BNP to conduct coordinated and effective long-term gharial monitoring and surveys with mechanisms for information sharing
Administrative/ political set-up	Chambal	● NCS is the only Tri state sanctuary, which is one critical thing for conservation	● All states do not take care of other states river stretches is a critical challenge for conservation	● A private institution or NGO can play a vital role in collaboration of all the states admin and political departments

			● There is lot of political invisible threads that controlling illegal activities in NCS acts as barrier for conservation	
	Chitwan	● The Rapti River lies in Chitwan and Makawanpur districts and Narayani River encompasses Nawalparasi districts. CNP is the major governing body that manages the river system through sector offices in different districts. Buffer zone area is managed by the Buffer Zone Management Committee (BZMC) formed under CNP. ● Currently the federal government is also involved in prioritising plans and management processes such as resource extraction from the river (like mining).	● The coordination between different governing bodies, such as the national park and buffer zone management committee, is very poor and affects communication, monitoring and effective management. ● Buffer zone committees could be mobilised effectively	● A proper coordination and cooperation between park, buffer zone and municipalities to control the illegal ● Coordination and cooperation to ensure sustainable sand mining that causes minimised disturbance to gharial nesting. This could be by development of a sustainable programme to regulate sand mining that is 'gharial friendly' or declaration of no mining zones at the nesting sites.
	Bardia	● Babai River encompasses four districts (administrative units) and flows though the protected area, buffer zone and unprotected region. The 46 km stretch of the Babai River that gharials currently inhabit is fully protected and in within the jurisdiction of BNP. Additionally, 12 km (approximately) stretch downstream and 10 km stretch up stream of this protected stretch lies in the buffer zone of BNP where regulations are a bit relaxed in comparison to that in	● Regulating anthropogenic activities such as fishing and river-bed material extraction will be challenging outside the protected stretch ● Potential lack of timely coordination and consensus among various government bodies in different districts and BNP could affect gharial conservation	● At least 46 km stretch of the Babai within the BNP is fully protected. The BNP has full jurisdiction in this stretch and can implement conservation and management interventions

		protected area but stringent than outside the buffer zone		
Local expertise and interest	Chambal	● All states have frontline forest staff and all villages' schools have teachers who actively participate in capacity building program that arranged by GEP	● FD staff and teachers can lose their interest in such programs	● Local FD staff can play vital role in monitoring any conservation actions ● Teachers from village schools can bring up conservation minds next generation in the local riverine communities
	Chitwan	● The indigenous people Bote, Darai and Kumal have a wide range of knowledge on the river system and Gharial. This knowledge could be used in conservation of this species. Some people from the Bote community are working as keepers at GCBC. ● Local tourist guides have a wide range of knowledge on the species who help to spread a positive message on Gharial in the community. ● CNP has formed Gharial and river conservation sub-committees under the buffer zone management Committees and these sub-committees implement Smart River Rangers program.	● Little involvement of local people in conservation. ● The Gharial and river conservation sub-committees are at the state of "non-functional". They are just identified in the action plan.	● Capacity building training to the local people on Gharial conservation and community based conservation and using these people as citizen scientists.
	Bardia	● The BNP and NTNC have technical expertise to survey and monitor gharial populations. Additionally, researchers from Biocon are well experienced in gharial survey and monitoring. They have also been building capacity of park	● Although these technicians are able to conduct gharial census, studying other equally important aspects such as breeding, nesting and hatching will require more training and experience	● There is availability of technicians, park rangers and local conservationists whose capacity could be built and strengthened for comprehensive gharial research

		rangers and local conservationists in scientific techniques of surveying gharials		● There is significant interest especially in gharial conservation among local youths who are nature guides and members of community-based anti-poaching units. Their interest and knowledge can be harnessed to design community-based gharial monitoring, conduct awareness programs and implement citizen science programs
Resources	Chambal	● Researchers and FDs from all the 3 states having their own resources and budget planning separately which results in lots of replica work	● Collaborating financially between all the 3 FDs could be critical and challenging	● Can save lots of resources that can be used differently for community well being
	Chitwan	● Very small budget is allocated for habitat management and capacity building for local people. The GCBC is run by revenue from tourist visits and a small fund from the government.	● Least priority for Gharial conservation at habitat level	● More focus on in-situ conservation by addressing threat reduction and habitat management. ● Proper and healthy management of captive breeding centre thereby reducing over crowded Gharials
	Bardia	● Gharials are often overlooked and receive less conservation attention and funding in comparison to charismatic mammals such as tiger, elephant, rhino and snow leopard.	● Less funding and conservation attention have resulted in lack of conservation and management intervention for gharials in Bardia	● Recent confirmation of breeding and natural recruitment of gharials in Babai River and classification of Babai population as one of the six major sub-populations of gharials throughout their range have highlighted the importance of Babai population for long-term gharial conservation. This can be used lobbying funds from national and international donors.

2. ACTION PROGRAMME

Vision (30-50 years): To secure the future of Gharials and expand its distribution ranges	
Goal(s) (5-10 years): To enhance protection mechanism for Gharial with improved knowledge in India and Nepal	
Objectives	**Prioritisation** *(critical, high, medium or low)*
1. To enhance ecological knowledge of Gharial throughout its range	Critical
2. To reinforce population in sites with smaller population	Critical
3. To develop conservation policies for trans-boundary collaboration between India and Nepal	Critical
4. To raise conservation outreach for Gharials and promote sustainable livelihood in Gharial sites	High
5. To develop strategies to declare sites as 'Important Gharial Area' with reintroduction programme	Medium

Country/Region: India/ National Chambal Sanctuary **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 1: To enhance ecological knowledge of Gharial throughout its range					
Activity 1.1 Using radio telemetry as tool to monitor the wild population and habitat usage	Critical	● GEP/MCBT ● MOEFCC ● UP FD, MP FD and RAJ FD	● Peer-reviewed scientific papers on gharial movement ecology ● Maps and videos to illustrate movement patterns ● Online information about gharial movement on website ● Locally-appropriate outreach materials to share known information ● Multi-lingual recommendations and reports for managing authorities	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Research
Activity 1.2 Implementing aerial survey technique in monitoring dynamics of the habitat	Critical	● GEP/MCBT ● MOEFCC ● UP FD, MP FD and RAJ FD	● Maps produced ● Locally-appropriate outreach materials to share known information ● Multi-lingual reports for stakeholders and interested groups	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Research and survey
Objective 2: To reinforce population in sites with smaller population ***Not applicable***					
Objective 3: To develop conservation policies for trans-boundary collaboration between India and Nepal ***Not applicable***					

Country/Region: India/ National Chambal Sanctuary **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 4: To raise conservation outreach for Gharials and promote sustainable livelihood in Gharial sites					
Activity 4.1 Developing community education centre to upscale the ecological knowledge of local community	High	● GEP/MCBT ● Other NGOs working in NCS	● Syllabus for locally-appropriate environmental education developed with supporting education materials ● teacher training programme developed ● Programme implemented in 10 schools as a pilot	● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Community and education
Activity 4.2 Establishing and implementing model village program throughout NCS	High	● GEP/MCBT ● Other NGOs working in NCS	Education materials and wok sheets ● Data set of each village involved	● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Community and education
Objective 5: To develop strategies to declare sites as 'Important Gharial Area' with reintroduction programme					
Activity 5.1: Develop Action committee for NCS including all stake holders as members to avoid any anthropogenic threats	Medium	● GEP/MCBT ● Other NGOs working in NCS ● MOEFCC ● UP FD, MP FD and RAJ FD ● Village community heads/leaders ● Head-water Dam authorities	● Action committees developed and membership and funding agreed ● First meeting held, with at least one annual meeting scheduled	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Management interventions

Country/Region: India/ National Chambal Sanctuary **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Activity 5.2: Create ravines restoration model to bring back the native flora to avoid erosion	Medium	● GEP/MCBT ● Other NGOs working in NCS ● MOEFCC ● UP FD, MP FD and RAJ FD ● Village community heads/leaders	● Meeting reports ● Vegetation survey reports ● MoU between stakeholders ● publication of research recommendations for ravine restoration model ● planning of suitable MSc projects to feed into restoration research	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness Staff insufficiency	Management interventions

Country/Region: India/ katarniaghat wildlife sanctuary & Ramganga river, Corbett National Park **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 1: To enhance ecological knowledge of Gharial throughout its range					
Activity 1.1 Annual surveys to monitor population and nesting counts	Critical	● UP FD ● UK FD ● Gharial Conservation Programme, Katerniaghat ● Other local NGOs	● Data sheets ● Survey reports including appropriate modelling to estimate population size ● Maps produced	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Research and survey

Country/Region: India/ katarniaghat wildlife sanctuary & Ramganga river, Corbett National Park **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Activity 1.2 In-situ habitat restoration to recover old nesting sites and to create new nesting sites	Critical	● UP FD ● UK FD ● Gharial Conservation Programme, Katerniaghat ● Other local NGOs	● At least one trial nesting site developed in each location, and monitored for success over at least 2 years ● Publication of trial results, with maps and photo documentation ● Data sheets	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Research
Objective 2: To reinforce population in sites with smaller population					
Activity 2.1 Using radio telemetry as tool to identify the efficiency of protect and release programme	High	● UP FD ● UK FD ● Gharial Conservation Programme, Katerniaghat ● Other local NGOs	● Data sheets ● At least 10% of released juveniles tagged and followed up for 2 years ● Survey reports	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Research
Activity 2.2 If activity 2.1 finds release programme is effective, support the continuation/development of protect and release programmes, with ongoing monitoring and an adaptive management approach	Medium	● UP FD ● UK FD ● Gharial Conservation Programme, Katerniaghat ● Other local NGOs	● Production of adaptive management procedure for release site ● Continued monitoring of released gharial ● Increasing population indicated by ongoing surveys	● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Research

Country/Region: India/ katarniaghat wildlife sanctuary & Ramganga river, Corbett National Park **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 3: To develop conservation policies for trans-boundary collaboration between India and Nepal (only for KWS)					
Activity 3.1: Periodic meetings with cross-country stakeholders to develop MoU between various stakeholder for gharial works 3.2 Involve higher management to develop policy, collaborative monitoring protocol, develop anti -poaching strategies	Medium	● UP FD ● Gharial Conservation Programme, Katerniaghat ● MOEFCC ● Biocon ● BNP ● MoFE & DNPWC	● Meeting reports ● Publication of trans-boundary management plans and/or recommendations ● Joint publications produced by cross-county stakeholders	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Management interventions
Objective 4: To raise conservation outreach for Gharials and promote sustainable livelihood in Gharial sites					
Activity 4.1 Develop Interpretation / Information centre for local information sharing and dissemination	High	● UP FD ● UK FD ● Gharial Conservation Programme, Katerniaghat ● Other local NGOs	● Permanent information centre established ● Education materials/ presentations ● Language-appropriate information boards/hoardings ● Committee established to run and update centre	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Community and education

Country/Region: India/ katarniaghat wildlife sanctuary & Ramganga river, Corbett National Park **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 5: To develop strategies to declare sites as 'Important Gharial Area' with reintroduction programme					
Activity 5.1 Periodic meeting with Dam authorities to develop water release protocols	Low	● UP FD ● UK FD ● Gharial Conservation Programme, Katerniaghat ● Other local NGOs ● Dam Authorities	● Minutes of Meetings ● Meeting report ● development and publication of water release protocols ● confirmed adoption and use of water release protocols	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Management interventions

Country/Region: India/ Son Gharial Sanctuary, Mahanadi river and Gandak river **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 1: To enhance ecological knowledge of Gharial throughout its range					
Activity 1.1 In-situ habitat restoration to recover old nesting sites and to create new nesting sites	Critical	● MP FD ● Orissa FD ● Bihar FD ● Wildlife Trust of India (WTI) ● Other local NGOs	● Data sheets ● Maps produced ● Photo documentations ● at least one trial nesting site developed in each location, and monitored for success over at least 2 years	● Securing funds could be critical ● Injuries or illness ● Technical difficulties/equip ment failure	Research

Country/Region: India/ Son Gharial Sanctuary, Mahanadi river and Gandak river **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Activity 1.2 Using radio telemetry in wild Population to know more about the habitat usage and natural history	Critical	● MP FD ● Orissa FD ● Bihar FD ● WTI ● Other local NGOs	● Data sheets ● Tracking reports ● Maps produced ● At least 10% of estimated population tagged and researched for 2 years ● Peer-reviewed papers on gharial movement ecology at each site	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Research
Activity 1.3 Annual surveys to monitor population and nesting counts	High	● MP FD ● Orissa FD ● Bihar FD ● WTI ● Other local NGOs	● Data sheets ● Survey reports including appropriate modelling to estimate population size ● Maps produced	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Research and survey
Objective 2: To reinforce population in sites with smaller population					
Activity 2.1 Using radio telemetry as tool to identify the efficiency of protect and release programme	High	● MP FD ● Orissa FD ● Bihar FD ● WTI ● Other local NGOs	● Data sheets ● At least 10% of released juveniles tagged and followed up for 2 years ● Survey reports	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Research

Country/Region: India/ Son Gharial Sanctuary, Mahanadi river and Gandak river **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Activity 2.2 If activity 2.1 finds release programme is effective, support the continuation/development of protect and release programmes, with ongoing monitoring and an adaptive management approach	Medium	● MP FD ● Orissa FD ● Bihar FD ● WTI ● Other local NGOs	● Production of adaptive management procedure for release site ● Continued monitoring of released gharial ● Increasing population indicated by ongoing surveys	● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Research
Objective 3: To develop conservation policies for trans-boundary collaboration between India and Nepal (only for Gandak river)					
Activity 3.1: Periodic meetings with cross-country stakeholders to develop MoU between various stakeholder for gharial works	Medium	● Bihar FD ● WTI ● MOEFCC ● MoFE & DNPWC ● Care for Nature (CFN) ● GCBC ● DNPWC ● Chitwan NP ● NTNC	● Meeting reports ● Publication of trans-boundary management plans and/or recommendations ● Joint publications produced by cross-county stakeholders	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Management interventions

Country/Region: India/ Son Gharial Sanctuary, Mahanadi river and Gandak river **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 4: To raise conservation outreach for Gharials and promote sustainable livelihood in Gharial sites					
Activity 4.1 Develop Interpretation / Information centre for local information sharing and dissemination	High	● MP FD ● Orissa FD ● Bihar FD ● WTI ● Other local NGOs	● Permanent information centre established ● Education materials/ presentations ● Language-appropriate information boards/hoardings ● Committee established to run and update centre	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Community and education
Objective 5: To develop strategies to declare sites as 'Important Gharial Area' with reintroduction programme					
Activity 5.1 Periodic meeting with Dam authorities to develop water release protocols	Medium	● MP FD ● Bihar FD ● Orissa FD ● WTI ● MOEFCC ● MoFE & DNPWC ● CFN ● GCBC ● DNPWC	● Minutes of Meetings ● Meeting report ● development and publication of water release protocols ● confirmed adoption and use of water release protocols	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Management interventions

Country/Region: India/ Son Gharial Sanctuary, Mahanadi river and Gandak river **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
		● Chitwan NP ● NTNC ● Dam Authorities			
Activity 5.2 (Not for Son river) Evaluate the unprotected stretch to declare as sanctuary for long-term sustainable conservation	High	● Bihar FD ● Orissa FD ● WTI ● MOEFCC ● Revenue Department ● Local Politicians	● Minutes of Meetings ● Meeting report ● Full stretch of potentially gharial suitable habitat evaluated ● Feasibility study for declaration of sanctuary on recommended stretch published	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Management interventions

Country/Region: Nepal/ Chitwan **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 1: To enhance ecological knowledge of Gharial throughout its range					
Activity 1.1 Radio telemetry in the wild and captive gharials to identify the breeding frequency of adult females, survival and movement of wild juveniles as well as captive released gharials. Radio telemetry study is an important way to determine the	Medium	● CFN ● GCBC ● DNPWC ● Chitwan NP ● NTNC	● 10 to 20 adult females radio tagged and monitored for 3-5 years ● data and information on the reproductive frequency of individual tagged females	● Securing funds could be critical ● Injuries or illness during field work ● Technical difficulties or	Research

Country/Region: Nepal/ Chitwan **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
transboundary movement of wild-hatched gharials in Narayani River which is close to the Gandak river.			● information on survival of wild-hatched as well as captive released gharials can be developed ● Transboundary movement as well as seasonal/ annual home ranges of gharials identified and applied to river-level conservation planning and mapping	equipment failure	
Activity 1.2 Regular monitoring of nesting, hatching, hatchling survival and natural recruitment rate	High	● CFN ● GCBC ● DNPWC ● Chitwan NP ● NTNC Local communities (fishermen from ethnic Bote community)	● Efficiency of wild reproduction and natural population recruitment identified that can be used for planning future in-situ strategy	● Securing funds could be critical ● Injuries or illness during field work ● difficulty in locating nerdy hatchlings after dispersal from the creche	Research and survey
Activity 1.3 Regular annual survey of gharial population using scientific methods with high detectability of gharial	High	● CFN ● GCBC ● DNPWC ● Chitwan NP NTNC	● Scientific information on size class, sex ratio and distribution of gharial ● alternative survey methodologies (e.g. drone surveys) trialled and verified ● annual reports include modelling to give a more accurate estimate of gharial populations and trends	● Securing funds could be critical ● Injuries or illness during field work ● Technical difficulties	Research and survey

Country/Region: Nepal/ Chitwan **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Activity 1.4 Design and implementation of sustainable river mining strategy to regulate sand mining that is 'gharial friendly' and declaration of no mining zones at the nesting and basking sites	Critical	● Ministry of Forests and Environment ● DNPWC ● Chitwan NP ● GCBC ● Buffer zone community forests	● degradation of sand banks can be reduced and ● increased availability of sand banks for nesting and basking with declaration of "no mining zones" in the river ● Bank erosion can be reduced and increased stability ●	● It can be difficult to implement as mining is interconnected from industry to politics. So there can be huge pressure against the strategy. ● Lack of interest to implement from government	Management intervention
Activity 1.5 In-situ habitat restoration to recover old nesting sites and to create new nesting sites	Medium	● Care for Nature (CFN) ● GCBC ● DNPWC ● Chitwan NP ● NTNC	● Availability of nesting sites making less crowded nesting area, thereby increasing the reproductive success ●	● Securing funds could be critical ● Injuries or illness ● Technical difficulties or equipment failure	Management intervention
Objective 2: To reinforce population in sites with smaller population ***Not applicable***					

Country/Region: Nepal/ Chitwan Activities	Priority *(low, medium, high or critical)*	Responsible stakeholders	Indicators	Risks	Activity type
Objective 3: To develop conservation policies for trans-boundary collaboration between India and Nepal					
Activity 3.1: Periodic meetings with cross-country stakeholders to develop cross-country research and communication networks	High	● CFN ● MoFE & DNPWC ● GCBC ● Chitwan NP ● Bihar FD ● UP FD ● MOEFCC ● WTI	● Meeting reports ● Publication of trans-boundary management plans and/or recommendations ● Joint publications produced by cross-county stakeholders	● Lack of collaboration between various stakeholders ● Securing funds could be critical ● Injuries or illness ● Staff insufficiency	Management interventions
Activity 3.2: Develop a transboundary communication network system that will regularly monitor the transboundary movement of gharial including hatchlings from upstream Narayani to Gandak river, regular communication, information sharing and coordinated consultation for effective conservation	High	● CFN ● MoFE & DNPWC ● GCBC ● Chitwan NP ● ZSL-Nepal ● WWF ● Bihar FD ● UP FD ● MOEFCC ● WTI	● two communication network teams, one in Nepal and one in India, formed to get connected for research and information sharing. ● Information on the movement of gharial up and downstream of the Gandak barrage that can feed the future management plan	● Lack of collaboration between stakeholders ● Securing funds could be critical ● Staff insufficiency ● indifference in attending meetings, sharing information	Management intervention
Activity 3.3:	High	● MoFE & DNPWC	● MoU developed for transboundary conservation approach	● Two different government	Management intervention

Country/Region: Nepal/ Chitwan Activities	Priority *(low, medium, high or critical)*	Responsible stakeholders	Indicators	Risks	Activity type
Organise meetings and workshops at the government level of Nepal and India to develop the collaborative conservation approach		● GCBC ● Chitwan NP ● Bihar FD ● UP FD ● MOEFCC	● Transboundary conservation approach will secure the up and downstream movement and survival of gharial thereby contributing to population stabilisation.	authorities might have different interests and approach for conservation that could create conflicts and mis-understanding ● Securing funds could be critical ● Staff insufficiency ● indifference in attending meetings, sharing information	

Country/Region: Nepal/ Chitwan Activities	Priority *(low, medium, high or critical)*	Responsible stakeholders	Indicators	Risks	Activity type
Objective 4: To raise conservation outreach for Gharials and promote sustainable livelihood in Gharial sites					
Activity 4.1 Design and implement citizen science programs in local communities to actively involve them in gharial monitoring and conservation	Critical	● CFN ● CNP ● DNPWC ● ZSL-Nepal ● WWF Nepal ● NTNC	● At least 1000 locals involved in citizen science program along Rapti-Narayani river system ● At least 100 capacity building trainings to local people on gharial monitoring and conservation ● Database compiled on gharial sightings by collecting information from citizen scientists ● Effectiveness of this program evaluated after 5 years and future action plan designed	● Lack of interest in local people ● long term sustainability of the program could be very challenging	Community awareness & Participation
Activity 4.2 Implement community outreach and educational programs to raise awareness on the importance of gharial, unsustainable fishing including the use of gillnets and to involve community in conservation	Critical	● CFN ● GCBC ● DNPWC ● Chitwan NP ● ZSL-Nepal ● NTNC ● WWF	● Syllabus designed for outreach programs ● Community awareness programs implemented across the minimum of 30 villages ● Educational programs conducted in >50 schools	● Lack of interest among people to participate in outreach programs ● Difficulty in securing funds to conduct the programs	Community awareness and participation
Objective 5: To develop strategies to declare sites as 'Important Gharial Area' with reintroduction programme					
Activity 5.1	Medium	● CFN ● GCBC	● Gharial habitat mapping outside the core protected areas	● Securing funds could be critical	Research and survey

Country/Region: Nepal/ Chitwan **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Survey to identify the rivers and tributaries used by gharials for feeding, basking and seasonal movement outside the protected area		● DNPWC ● Chitwan NP ● NTNC ● ZSL-Nepal ● WWF Nepal	● habitat range of gharial outside the protected areas to be prioritised in future conservation action plan	● Injuries or illness during field work	
Activity 5.2 Development and implementation of integrated approach of habitat management and threats reduction programs by involving local communities	Medium	● CFN ● GCBC ● DNPWC ● Chitwan NP ● NTNC ● ZSL-Nepal ● WWF Nepal	● effective management of river system outside the protected areas	● Securing funds could be critical ● lack of interest among local people to involve in conservation	Management intervention
Activity 5.3 Declaration of "Gharial Important Area" to conserve the habitat and secure sustainable population outside the protected area	Medium	● CFN ● GCBC ● DNPWC ● Chitwan NP ● NTNC ● ZSL-Nepal ● WWF Nepal	● Extended habitat for gharial ● Reduced threats and improved habitat quality of river system because of integrated conservation program	● People might oppose the declaration of Important Gharial Area as it might put restriction on river use ● Lack of people's involvement in conservation program	Management intervention

Country/Region: Nepal / Bardia / Babai and Karnali Rivers **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Objective 1: To enhance ecological knowledge of Gharial throughout its range					
Activity 1.1: Regular monitoring of gharial populations to investigate their breeding, nesting, reproduction and recruitment	Babai = Critical Karnali = Critical	● Biocon ● Bardia NP ● DNPWC ● ZSL-Nepal ● NTNC ●	● Comprehensive information generated on breeding, nesting and reproductive ecology of gharials ● Information generated on size, age class and sex ratio of gharials ● Maps produced on location of breeding groups, nesting and basking areas	● Securing funds could be challenging ● Inclement weather (fog, rain etc.). ● Injury/ Illness during field work	Research (Survey & Monitoring)
Activity 1.2: Establish baseline on water quality and temperature profile pre- and post- river linking between the Bheri and the Babai Rivers	Babai = High Karnali = N/A	● Biocon ● Bardia NP ● DNPWC ● ZSL-Nepal ● NTNC KU	● Database established on various water quality parameters and seasonal flow regimes of the Babai pre- and post- river interlinking ● Long-term database established on soil, water & air temperature in basking/nesting areas ● Potential and actual impacts on gharials identified and evaluated, and mitigation measures designed	● River interlinking might occur before the survey ● Difficulty in resampling certain sites during monsoon ● Device may malfunction	Research (Survey & Monitoring)
Objective 2: To reinforce population in sites with smaller population					
Activity 2.1: Establish reinforcement program by regularly releasing captive-reared juvenile gharials in appropriate number and seasons	Babai = Critical Karnali = N/A for now	● Biocon ● Bardia NP ● Chitwan NP ● DNPWC ● ZSL-Nepal	● Reinforcement program established ● Protocol established and mechanisms secured for regular release of captive-reared gharials in the Babai	● Lack of from interest from relevant stakeholders to	Management Intervention

Country/Region: Nepal / Bardia / Babai and Karnali Rivers Activities	Priority *(low, medium, high or critical)*	Responsible stakeholders	Indicators	Risks	Activity type
		● NTNC		implement program ● Lack of coordination among stakeholders ● Lack of fund for continuation of program	
Activity 2.2: Assess survival, well-being and habitat use of released gharials by radio/ satellite tagging and direct observation surveys	Babai = Critical Karnali = N/A for now	● Biocon ● Bardia NP ● DNPWC ● ZSL-Nepal ● NTNC	● Released gharial regularly monitored and their survival rates assessed ● Areas frequented by released gharials identified and mapped ● Effectiveness of reinforcement program evaluated and future actions identified	● Lack of fund for continuation of program	Management Intervention
Objective 3: To develop conservation policies for trans-boundary collaboration between India and Nepal (only for Gandak river)					
Activity 3.1: Periodic meeting of stakeholders from Nepal and India to develop and implement collaborative efforts for gharial conservation	Babai = Low Karnali = High	● Katarniaghat WS ● Bardia NP ● DNPWC ● MoFSC	● Common and collaborative actions for gharial conservation identified and road map designed for program implementation	● Lack of interest and/or coordination among relevant stakeholders	Management Intervention

Country/Region: Nepal / Bardia / Babai and Karnali Rivers **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Activity 3.2: Development and implementation of joint-monitoring program for gharial population that exists in the Karnali/Girwa River system shared by the Bardia NP and Katarniaghat WS	Babai = N/A Karnali = High	● Katarniaghat WS ● Bardia NP ● DNPWC ● MoFSC ● BioCon	● Joint-monitoring protocol established and gharial population monitored regularly ● Data sharing mechanism established	● Lack of interest and/or coordination among relevant stakeholders	Management Intervention
Objective 4: To raise conservation outreach for Gharials and promote sustainable livelihood in Gharial sites					
Activity 4.1: Design and implement citizen science programs in local communities to actively involve them in gharial monitoring and conservation	Babai= Medium Karnali= High	● Biocon ● Bardia NP ● DNPWC ● ZSL-Nepal ● NTNC ● KU	● At least 1000 locals involved in citizen science program in the Babai and the Karnali River basins ● Database compiled on gharial sightings by collecting information from citizen scientists ● Effectiveness of this program evaluated after 5 years and future action plan designed	● Target communities might not be interested in participating ● Sustaining program might be challenging	Community Awareness & Participation

Country/Region: Nepal / Bardia / Babai and Karnali Rivers **Activities**	**Priority** *(low, medium, high or critical)*	**Responsible stakeholders**	**Indicators**	**Risks**	**Activity type**
Activity 4.2: Implement community outreach and educational programs in the Babai and the Karnali River basins	Babai =Medium Karnali = Medium	● Biocon ● Bardia NP ● DNPWC ● ZSL-Nepal ● NTNC ● KU	• Syllabus designed for outreach programs • Community awareness programs implemented across 30 villages • Educational programs conducted in >50 schools	• Target communities might not be interested in participating • Timetable/ schedule conflict with participants	Community Awareness & Participation
Objective 5: To develop strategies to declare sites as 'Important Gharial Area' with reintroduction programme ***Not applicable***					

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