

A SUMMARY OF THE SOCIAL AND ENVIRONMENTAL IMPACTS OF THE PROPOSED ARENG VALLEY HYDROELECTRIC DAM, SOUTHWEST CAMBODIA

SUMMARY

The upper Areng Valley consists of a matrix of evergreen forest, grasslands, swamps and lakes, rivers and associated riparian forest, interspersed with small indigenous communities. These local families, many of which have lived in the Areng Valley for centuries, live in harmony with nature. Land cleared by the Khmer Rouge for rice cultivation has since been returned to their natural marshland habitat that abounds with wildlife. These villagers are the original protectors of the valley's habitats and wildlife. Their sacred forests abound with some of the largest trees in southwest Cambodia and teem with animals, and the traditional conservation beliefs of the villagers are the main reason why the world's largest population of one of the world's most endangered crocodiles, the Siamese Crocodile, has managed to survive where almost all other populations have been driven to extinction.

The upper Areng Valley is threatened by plans to build a hydroelectric dam that will inundate nine villages, 1500-2000 ha of indigenous lands including sacred forests covering over 500 ha, and at least 39 faunal species that are globally threatened or nationally protected. Unlike other dams proposed for the region, this dam will flood a broad, flat valley that is densely populated and includes the richest agricultural land in southwest Cambodia as well as some of Cambodia's rarest and most threatened wildlife. The environmental and social damage relative to the amount of power generated is therefore disproportionately high.

The effects of this dam on the downstream biome will also be extremely severe. Changes to the flow regime of the Areng River will stop the annual freshwater flush of the brackish and saline water that enters the river system during the dry season. This has the potential to drastically reduce rice yields in approximately 1500 ha of paddy in the coastal zone. This will directly affect the livelihoods of at least 1800 people. Reduced wet season flooding will also reduce the fish production, which depends on spawning in the seasonally inundated swamp forests in the lower Areng Valley. These forests also support populations of many globally threatened and nationally protected species which will be locally extirpated if the dam is built. Within the mid-reaches of the Areng River, alterations to flow regime will have devastating effects on a unique fish fauna due to disrupted breeding cycles and alterations to the turbidity, salinity and oxygen content of the river.

This report summarises the social and biological impacts of the proposed Areng River hydroelectric dam.

1. SOCIAL IMPACTS

1.1 The Upper Areng Valley Inundation Zone

The Areng inundation zone is presently home to over 1500 people, many of whom consider the area their ancestral home. These indigenous people, the Khmer Daeum (or 'old Khmer'), are thought to be the original descendents of the Khmer race and have existed in the area for at least 600 years. The communities living in the Areng Valley depend on the natural resources of the area for their survival, including productive rice paddies, forest gardens (chamkars), fish from the Areng River and the harvesting of non-timber forest products from the nearby evergreen forest.

These communities are very close-knit, with links that run through the landscape which are bound to village life by local Buddhist and animist beliefs. This is emphasised by the role and importance of 'spirit forests' and local forest deities, such as Neck Ta, who is thought to inhabit the forest and waterways of the valley. Any forced migration instigated by the creation of a dam and lake will break this connection and have deep social repercussions for a people who feel spiritually linked to the forest and the valley.

It should be noted that the inhabitants of the upper Areng Valley suffered severely during the Khmer Rouge period and in the years immediately after the fall of this regime. In 1979 most of the villagers in the valley,

for example, were forced out of the area by the Vietnamese army and were moved to Chi pat, while others fled to Thailand. In subsequent post-conflict years the villagers have slowly returned to the valley; however, any activities that result in their forced migration, again, will result in the re-traumatisation of a people who have already suffered tremendously over Cambodia's recent past.

1.2 The Downstream Biomes

The downstream village of Trapeang Rung has an approximate population of 500 families, comprising over 2500 people. These people depend on the inundation of over 600 ha of rice paddies, much of which will not be inundated due to changes in flow regimes by the hydroelectric dam. Most of this village also relies on the riverine fishery for their protein needs, with excess being sold in nearby markets to neighbouring towns. Alterations to the flow regime of the river means that this livelihood activity would be jeopardised as a result of the impacts on water levels and associated impacts on spawning grounds and fish feeding areas.

2. BIOLOGICAL IMPACTS

2.1 The Upper Areng Valley Inundation Zone

The upper Areng Valley contains over 20,000ha of pristine habitats including grasslands, deciduous forest, evergreen forest, rivers and streams, and standing wetlands (lakes and marshes). The Areng River is the largest of only a handful of Cambodian rivers that are not connected to the Mekong River and its tributaries. For this reason the Areng River has been found to harbour a unique fish fauna that does not occur anywhere else in Cambodia, including globally threatened and endemic species. Most of these species only occur in the upper reaches of the Areng River, so their habitat will be almost entirely lost if the Areng Valley dam is built.

As shown by Table 1, the upper Areng Valley contains an extremely diverse fauna - almost 300 known species including at least 31 mammals, birds, reptiles, fish and amphibians that are globally threatened with extinction (IUCN, 2007). An additional eight species are classified as nationally threatened with extinction (MAFF Wildlife Prakas, 2007). Appendix 1 lists these species and their global and national conservation status.

Table 1: Numbers of globally threatened and nationally protected species in the upper Areng Valley

	Total number of species recorded in the upper Areng Valley*	Globally threatened species (IUCN, 2007)	Nationally protected species (MAFF, 2007)
Mammals	57	14	4
Birds	93	7	1
Reptiles	55	8	3**
Amphibians	29	1	0**
Fish	43	1	0**
Total	277	31	8

* Emmett, D.A. & Olsson, A. (Editors) (2005). Biological Surveys in the Central Cardamom Mountains. Conservation International (CI) Cambodia Program and Forestry Administration (FA), Phnom Penh

** The National Fisheries Red List for threatened Cambodian fish, turtles and amphibians has not yet been passed as law

The upper Areng Valley is therefore one of the most important areas for biological conservation in Cambodia and indeed the Indo-Burma Hotspot. Crucial habitats for conservation of the species listed in Table 1 and Appendix 1 will be lost if the valley is inundated, and the species populations themselves will be locally extirpated. This will have serious impacts on the national and global status of these species. For example, the upper Areng Valley contains approximately 30% of the global hatchling recruitment of the critically endangered Siamese Crocodile (see below), so the loss of this population would represent a global crisis for this species.

2.1.1 Priority Taxa

Taxa of exceptionally high conservation importance that are threatened by the hydroelectric dam are described in detail below.

Siamese Crocodile: The Siamese Crocodile (*Crocodylus siamensis*) is one of the rarest crocodile species in the world, and is listed as critically endangered by the IUCN. Global populations number considerably fewer than 200 individuals, with only 6 breeding sites known. The upper Areng River represents the most significant and secure Siamese Crocodile site in the world. This population has been the centre of international conservation efforts since 2002, and the focus of documentaries by the BBC and National Geographic, as it is the only location in the world where these crocodiles can be readily seen and studied. This is the largest breeding population known, yet only contains an estimated 40-50 individuals composed of adults, juveniles and young crocodiles. If the Areng River is dammed, this fragile population will be seriously reduced or wiped out. The inundation will destroy vital lakeside nesting areas, shallow feeding zones, sandy basking areas along the river, and essential lakeside burrows used for shelter.

Asian Elephant: The Asian Elephant (*Elephas maximus*) is classified by IUCN and the Cambodian National Red List as endangered. The upper Areng Valley is an important site for elephants as it is within the home range of several herds. Elephants are often sighted in the valley. The inundation will flood an important part of the species' range and disrupt the annual migratory route of this endangered species.

White-winged Duck: The White-winged Duck (*Cairina scutulata*) is classified as endangered by IUCN and the Cambodian National Red List. The species is in rapid global decline due to deforestation, wetland drainage and hunting. An assessment in 2002 indicated that fewer than 800 remain in the wild (IUCN, 2007). However, breeding pairs are frequently observed in the upper Areng Valley, including a recent sighting of two pairs and a single bird at one wetland site. Estimates suggest the upper Areng Valley may provide vital habitat for as many as 30-40 White-winged Ducks. All suitable habitat for this species (small densely forested wetlands) will be lost if the dam is built.

Tortoises and Freshwater Turtles: Six species of turtle and tortoise are known to occur in standing wetlands and forested areas along the upper Areng Valley. The Elongated Tortoise (*Indotestudo elongata*) and Yellow-headed Temple Turtle (*Heosemys annandalii*) are classified by IUCN as endangered, and the Asiatic Softshell Turtle (*Amyda cartilaginea*), Black Marsh Turtle (*Siebenrockiella crassicollis*), Asian Box Turtle (*Cuora amboinensis*) and Giant Asian Pond Turtle (*Heosemys grandis*) are classified as vulnerable. Five of these species rely on shallow weed-filled wetland habitats; the sixth, the Elongated Tortoise, is restricted to lowland grassland and open forest in the valley. All of these habitats will be lost if the valley is inundated, and the resultant reservoir with its wide draw-down zone will provide an entirely unsuitable habitat for freshwater turtles. These six globally threatened species are all predicted to become locally extinct if the dam is built.

Asian Arowana: The Asian Arowana (*Scleropages formosus*) is listed as endangered by IUCN due to loss of habitat and over-collection for the pet trade. In Cambodia, these fish are only known to occur in the slightly acidic streams that drain into the Gulf of Thailand. The species is possibly extinct in Thailand and Vietnam (IUCN, 2007) and remaining populations in Indonesia and Malaysia are highly fragmented and under extremely high threat. The largest known population in Cambodia occurs in the upper Areng Valley. This population is globally important for the conservation of this rare species and has been the focus of a successful community-based government conservation program. The entire population of this fish will be destroyed if the dam is built because it cannot survive in the resultant reservoir as its life-cycle is adapted to clear fast-flowing rivers. A smaller population of Asian Arowana that is located in the Areng River downstream of the proposed dam site will almost certainly be driven to extinction because their breeding behaviour is closely linked to annual flow regimes which will be significantly and permanently disrupted by the dam.

2.2 The Downstream Biomes

Aquatic biodiversity in the mid-reaches and lower sections of the Areng River will also be severely threatened by the proposed hydroelectric dam due to changes in the flow regime. Seasonal flooding will be greatly reduced because the water will be used to refill the reservoir, and the annual cycle of changing water-levels will be permanently altered in order to generate electricity year round. Studies of the effects of hydroelectric dams on downstream biomes in Thailand and Laos clearly show that this has dramatic negative impacts on

the river and its biodiversity. The reduction in wet season flooding will have a devastating effect on the entire river system, as annual floods are crucial to maintain the salinity and nutrient balance in the lower reaches and to flush the river and prevent stagnation in the mid-reaches. Fish migration and breeding, which depend directly on the extent of the seasonally flooded forests, will also be severely disrupted. This will lead to the local extinction of many species whose life cycles are tied to annual changes in the river.

The sharp reduction in seasonal flooding that will result from the hydroelectric dam will dramatically impact the seasonally inundated swamp forest ecosystem in the lower Areng Valley. These ecosystems were once extensive in the deltas and lower floodplains of many rivers in the region, but are now restricted to isolated fragments (Tordoff *et al*, 2006). These ecosystems are important for a number of globally threatened species, notably large waterbirds, otters and freshwater turtles. The lower Areng Valley contains over 1,000 ha of seasonally inundated swamp forest. These forests are crucial for fisheries management in Koh Kong Province because, when inundated, they form the breeding and feeding grounds for vast numbers of fish, as well as other aquatic fauna which are essential for the freshwater ecosystem such as crustaceans. Studies have shown that these flooded forests are crucial breeding and feeding grounds for globally threatened and nationally protected species including the Smooth-coated Otter, Lesser Adjutant, the endangered Yellow-headed Temple Turtle, and five other turtle species that are classified by IUCN as vulnerable with global extinction (Som *et al*, 2005; Tordoff *et al*, 2006). The seasonally inundated swamp forests are also feeding grounds for the only known Cambodian population of the critically endangered Mangrove Terrapin (*Batagur baska*), one of the world's rarest turtles. This species has been the focus of a comprehensive conservation program since 2002. The reduction in annual floodwaters due to the proposed hydroelectric dam will prevent flooding of these seasonally inundated swamp forests which will lead to the loss of this rare ecosystem, a dramatic reduction in the productivity of the downstream fishery, and the loss of crucial breeding and feeding grounds for some of Cambodia's most endangered species.

2.3 The Construction Period

The construction period will lead to a massive influx of workers into the Areng Valley for the duration of the dam's construction, which is likely to last several years. This will lead to vastly increased levels of illegal fishing and hunting, especially within the Central Cardamoms Protected Forest (CCPF). In addition, legal tree removal within the inundation zone is likely to lead to additional, illegal logging in areas surrounding the inundation zone. There will also be high levels of hunting within and around the inundation zone during this period, which is a very serious concern as over half of the inundation zone lies within the CCPF, a sanctuary for rare and threatened species.

This massive and prolonged pressure on the wildlife and forests surrounding the dam construction area by workers at the site will have severe impacts on the biological diversity of the area, particularly on the rare wildlife which lives in the CCPF.

2.4 The Post-Construction Period

When the dam is complete and the reservoir is fully inundated, it will provide easy access to the core protection zone of the CCPF. Hunters will be able to travel quickly across the reservoir by boat to areas that were previously inaccessible. The large reservoir, with its long periphery, will be very difficult to patrol.

This will lead to vastly increased levels of illegal logging and hunting within the CCPF which will put many rare species (e.g., clouded leopards, bears, gaur) at increased risk. Access roads for the dam will also provide easy routes for hunters and illegal loggers to use. This dramatic increase in access to the CCPF is certain to have serious consequences for its wildlife and forests.



Location	Land_Use	Hectar
Chumnoab	Lowland Rice	10.229
	Old Lowland Rice	282.823
	Rotational Agriculture	193.271
	Shifting Agriculture	7.369
	Sub-total	493.692
Pralay	Field	1828.483
	Rice Field	1550.353
	Sub-total	3378.836
Thmar Donpov	Rice Field	120.494
	Veal	84.841
	Cham Kar	79.221
	Field	473.292
	Sub-total	757.848
Total		4630.376

Legend

Elevation Value

1 - 31
31 - 67
67 - 101
101 - 139
139 - 190
190 - 254
254 - 326
326 - 407
407 - 498
498 - 593
593 - 690
690 - 797
797 - 921
921 - 1,070
1,070 - 1,277
1,277 - 1,805

Central Cardamom Protected Forest

20637.88 ha



Communes	Families	Population
Chumnoab	60	272
Thma Donpov	81	319
Pralay	170	663

Figure 1: A map of the area which will be inundated if the proposed hydroelectric dam is built

Appendix 1: Globally or nationally threatened wildlife recorded in the upper Areng Valley inundation zone

Species	Common name	IUCN or National Status*
<u>Mammals</u>		
<i>Elephas maximus</i>	Asian Elephant	IUCN: Endangered National Red List: Endangered
<i>Neophelis nebulosa</i>	Clouded Leopard	IUCN: Vulnerable National Red List: Endangered
<i>Pardofelis marmorata</i>	Marbled Cat	IUCN: Vulnerable National Red List: Rare
<i>Catopuma temminckii</i>	Asian Golden Cat	IUCN: Vulnerable National Red List: Rare
<i>Hylobates pileatus</i>	Pileated Gibbon	IUCN: Vulnerable National Red List: Rare
<i>Ursus tibetanus</i>	Asiatic Black Bear	IUCN: Vulnerable National Red List: Endangered
<i>Bos frontalis</i>	Gaur	IUCN: Vulnerable National Red List: Rare
<i>Neamorhedus sumatraensis</i>	Southern Serow	IUCN: Vulnerable National Red List: Rare
<i>Lutrogale perspicillata</i>	Smooth-coated Otter	IUCN: Vulnerable
<i>Cuon alpinus</i>	Dhole	IUCN: Endangered National Red List: Rare
<i>Macaca nemestrina</i>	Pig-tailed Macaque	IUCN: Vulnerable
<i>Arctictis binturong</i>	Binturong	IUCN: Vulnerable
<i>Viverra zibetha</i>	Large-spotted civet	IUCN: Vulnerable
<i>Hystrix brachyura</i>	East Asian Porcupine	IUCN: Vulnerable
<i>Manis javanica</i>	Sunda Pangolin	National Red List: Rare
<i>Ursus malayanus</i>	Sun Bear	National Red List: Rare
<i>Arctonyx collaris</i>	Hog Badger	National Red List: Rare
<i>Nycticebus coucang</i>	Slow Loris	National Red List: Rare
<u>Birds</u>		
<i>Arborophila cambodiana</i>	Chestnut-headed Partridge	IUCN: Vulnerable National Red List: Rare
<i>Cairina scutulata</i>	White-winged Duck	IUCN: Endangered National Red List: Endangered
<i>Oriolus mellianus</i>	Silver Oriole	IUCN: Vulnerable National Red List: Rare
<i>Pavo muticus</i>	Green Peafowl	IUCN: Vulnerable National Red List: Rare
<i>Leptoptilos javanicus</i>	Lesser Adjutant	IUCN: Vulnerable National Red List: Rare
<i>Heliopais personata</i>	Masked Finfoot	IUCN: Vulnerable National Red List: Rare
<i>Mycteria cinerea</i>	Milky Stork	IUCN: Vulnerable National Red List: Rare
<i>Buceros bicornis</i>	Great Hornbill	National Red List: Rare
<u>Reptiles</u>		
<i>Crocodylus siamensis</i>	Siamese Crocodile	IUCN: Critically endangered
<i>Indotestudo elongata</i>	Elongated Tortoise	IUCN: Endangered
<i>Manouria impressa</i>	Impressed Tortoise	IUCN: Vulnerable
<i>Amyda cartilaginea</i>	Asiatic softshell turtle	IUCN: Vulnerable
<i>Cuora amboinensis</i>	Asian box turtle	IUCN: Vulnerable
<i>Siebenrockiella crassicollis</i>	Black Marsh Turtle	IUCN: Vulnerable
<i>Heosemys grandis</i>	Giant Asian Pond Turtle	IUCN: Vulnerable
<i>Heosemys annandalii</i>	Yellow-headed Temple Turtle	IUCN: Endangered
<i>Ophiophagus hannah</i>	King Cobra	National Red List: Rare
<i>Naja kouthia</i>	Monocled Cobra	National Red List: Rare
<i>Lycodon cardamomensis</i>	Cardamom Wolf Snake	National Red List: Rare
<u>Amphibians</u>		
<i>Paa fasciculispina</i>	Giant Spiny-breasted Frog	IUCN: Vulnerable
<u>Fish</u>		
<i>Scleropages formosus</i>	Asian Arowana	IUCN: Endangered

* MAFF Wildlife Pracas, 2007