Biodiversity Impact Assessment Report for the proposed Yirga-Alem Integrated Agro-Industrial Park (IAIP) and Dilla Rural Transformation Centre (RTC)



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1. Introduction

This section provides a description of the existing biodiversity components and associated key features which include typical flora and fauna, protected areas and non protected sensitive resources that are found inside and within the vicinity of the project sites. Desk-based reviews, field surveys and public consultations were used to determine the baseline conditions of the aforementioned biodiversity and sensitive ecological features.

2. Project Area Baselines

2.1. Yirga-Alem IAIP

2.1.1.Physical Conditions

i. Location and Topography

The proposed Industrial Park covers 214.86 hectares (ha) of an area, is located 303 km south of Addis Ababa on the eastern side of the Rift Valley Lakes Basin (RVLB) in Dale Wereda, Sidama Administrative Zone of the Southern Nations Nationalities and People's Regional State (SNNPRS). Its geographic location lies between the coordinates UTM 37N 428159.231 - 428613.684 E and UTM 37 N 745139.751 - 745714.474 N (Fig. 1)'.



Fig. 1: Location of Yirga-Alem IAIP

Most of the Yirga-Alem areas are characterized by undulating plateaus and Yirga-Alem IAIP constitutes the plain and glade part of the landscape. The site is situated at an average altitude

of 1760masl and bordered by river valleys and hilly escarpments in the western and eastern directions, respectively. To the west and south the terrain falls to the Gidabo River valleys at around 1600 masl at the river bed.

ii. Climate

The mean monthly temperature lies in the range 15-20°C for most of the year, rising over 20°C in April and May. The mean annual rainfall for Yirga-Alem area is 1571mm, and the highest mean monthly rainfall occurs in May with 231mm and remains above 100mm through the summer months. The lowest mean monthly rainfall is in December with 34mm (MoWR, 2008).

2.1.2. Flora and Fauna

i. Flora

Previous assessments show that the land cover of most of the western part of Yirga-Alem Area falls into the moderately cultivated category (Fig.2).



Fig. 2: Land Cover of Yirga-Alem and Dilla Areas (Source: Habtamu & Rapprich (2014))

Taking into account the specific project site, Yirga-Alem IAIP area comprises of transformed woodland and open grassland and in both types of land cover 20 species of plants have been recorded (Table 1). The woodland is largely dominated by Eucalyptus spp. surrounded by *Ficus sycomorus, Cordia Africaan, Croton macrostachys,* and *Euphorbia candelabrum* with the undergrowth of *Coffee arabica* and *venonia amygdalina and Ananas comosus. Aloe vera, Agave sisalana* and *Euphorbia tirucalli* are also planted along the degraded areas and edge of abandoned cultivation areas to prevent erosion and mark the boundary of plots. In some patchy areas, *Podocarpus falcatus* and *Millettia ferruginea* also occurs. The dominant grass species include *Cynodon dactylon, Hyparrhenia rufa and Chrysopogon spp.*.

No.	Species Scientific Name	Amharic Name	Conservation Status (IUCN Red List Category)	Usefulness Category List*
1.	Eucalyptus grandis	Key Bahirzaf	LC	L
2.	Ficus sycomorus	Warka	LC	L
3.	Ficus vasta	Warka	LC	L
4.	Cordia Africana	Wanza	LC	L
5.	Erythrina brucei	Korch	LC	L
6.	Croton macrostachys	Bisana	LC	L
7.	Podocarpus falcatus	Zigba	LC	L
8.	Millettia ferruginea	Birbira	LC	L
9.	Euphorbia candelabrum	Kulkual	LC	NL
10.	Euphorbia tirucalli	Kinchib	LC	L
11.	Aloe vera	Eret	LC	L
12.	Agave sisalana	Katcha	LC	NL
13.	Vernonia amygdalina	Grawa	LC	L
14.	Coffea arabica	Buna	-	Cash crop
15.	Ananas comosus	Ananas	-	" "
16.	Musa paradisiaca	Muz	-	" "
17.	Cynodon dactylon	Sar	-	Grass Spp.
18.	Hyparrhenia rufa	Sar	-	" "
19.	Sporobolus spp.	Sar	-	" "
20.	Chrysopogon spp.	Sar (Senbelet)	-	" "

Table 1: Checklists of common plant species recorded at Yirga-Alem IAIP

Where, LC – Least Concern

*According to Azene Bekele (2007) categorization of 'Useful Trees and Shrubs of Ethiopia'; where L= Listed; NL= Not Listed.



Fig. 3: Atypical Land Cover of the Project Area

ii. Fauna

According to the data gathered by the Wereda Environmental Protection and Forestry Development Office, Yirga-Alem IAIP provides habitats and it is a potential home range for about eight species of larger mammals of wild animals (Table 2). The dominant bird species in project area are Silvery-cheeked Hornbill (*Bycanistes brevis*), Egyptian Goose (*Alopochen aegyptiacus*), Fan-tailed Raven (*Corvus rhipidurus*), Village Weaver (*Ploceus cucullatus*) and various species of raptors. During the field observation, a total of 21 species were recorded (Annex 1).



Fig. 4: Fan-tailed Ravens Feeding on the Open Grassland Area of Yirga-Alem IAIP

Besides, like other parts of rural areas of the region, Cattle (ox, cow) and equids are the predominant domestic animals observed in the area.

Table 2: List of Wild Mammal Species of the Project Site

Source: Dale Wereda Environmental Protection and Forestry Development Office (2016) and Field survey (2017).

No	Species Common Name	Scientific Name	Conservation Status (IUCN Red List Category)
1	Vervet Monkey	Cercopithecus aethiops pygerythrus	LC
2	Grey Duiker	Sylvicapra grimmia	LC
3	Common Bushbuck	Tragelaphus scriptus	LC
4	Spotted Hyena	Crocuta crocuta	LC
5	African Civet	Civettictis civetta	LC
6	Abyssinian Hare	Lepus habessinicus	LC
7	Porcupine	Hystrix cristata	LC
8	Anubis Baboon	Papio Anubis	LC

Where, LC – Least Concern

iii. Species of Conservation Concern

Generally, the indigenous trees are used as nesting, feeding, breeding and roosting habitats for some birds which play key role in maintaining the micro and micro ecosystem integrity. Specifically, the project site provides habitat for considerable number of avian species that require special consideration of conservation efforts. According to IUCN Red List Category, about three species of vultures (White-backed, Ruppell's and Hooded Vultures), which were observed flying over the site are critically endangered or endangered.

2.1.3. Protected and Non Protected Biodiversity Sites

i. Protected Areas and Wetlands

The area set aside for IAIP development does not lay within a designated conservation area and there are no protected areas in the vicinity. The designated forest area in the locality which covers about 520 ha of an area comprises of exclusive man-made Eucalyptus plantation and thus it is not a site of conservation concern.

Areas located around Yirga-Alem IAIP are rich both in ground and surface water. The project site has high potential of groundwater which is controlled by the rift fracture system in the eastern highlands. The eastern highlands and escarpment are a major area for groundwater recharge fed by the high levels of rainfall falling over an extensive area. There are numerous hot and cold springs and people come from long distances for healing treatments in the springs through bathing in and drinking the water (MoWR, 2008).



Fig. 5: Location of Gidabo River and the Project Area

The Aposto Spring system which is located about 3 km west of Yirga-Alem town centre is one of the springs that discharge to the Darimo River, a tributary of the Gidabo River. The Gidabo River originates from the eastern highlands and terminates in Lake Abaya in the southwest. It is the largest watershed in and around the study area covering a total area of 216,817.74 ha and comprising of four sub-watersheds. Dama, Raro,Wamole and Woyima are sub-watersheds of Gidabo watershed each covering area of 8,170.56 ha, 5,580.72 ha, 16,938.72 ha and 4,678.11 ha, respectively (Adugna and Bogale, 2015).

Therefore, Gidawo River along together with its courses including adjacent seasonal swampy areas are the main wetland areas found in the vicinity of the project site (Fig. 8). The gallery forest of this specific area is characterized by *Ficus sycomorus*, *Ficus vasta*, *Erythrina brucei* and *Maesa lanceolata* with undergrowth of *Arundo donax*, *Vernonia amygdalina and Cyprus and Typha species*. Even though no water birds count was conducted along this particular area, some water birds such as Egyptian Goose (*Alopochen aegyptiacus*), Hamerkop (*Scopus umbretta*), Sacred Ibis (*Threskiornis aethiopicus*) and Grey Heron (*Ardea melanocephala*) were reported to inhabit in the area (Adugna and Bogale, 2015).



Fig.6: View of Gidabo River and its Surroundings

Gidabo River and its tributaries fall within the Lakes Abaya-Chamo-Chew Bahir sub-catchment of the Rift Valley Lakes Basin (RVLB) and it is one of the water supply projects identified during the Phase I RVLB Integrated Resource Development Master Plan Study. Therefore, the Rift Valley Lakes Basin Authority (RVLBA), in collaboration with concerned bodies has the responsibility to implement the Integrated Resources Development Master Plan of the Basin.

3. Dilla RTC

3.1. Project Area Baselines

3.1.1. Physical Conditions

i. Location, Topography

The project site is located some 362 kms south of Addis Ababa, at immediate adjacent to the main highway that takes to Moyale. It is situated in the Dilla Zuria wereda of Gedeo Administrative Zone of the Southern Nations Nationalities and People's Regional State (SNNPRS). Its geographic location lies between the coordinates UTM 37N 423299.97 -423504.67 and UTM 37 N 704933.26 -705280.36 (Fig. 7).

The proposed site and its surroundings including Dilla town lay in the eastern escarpment of the Ethiopian Rift Valley with green mountains. They are characterized by gentle slope from east to west of Dilla town, with the 1600 m above sea level in the east dropping to 1550 above sea level at the project site. Dilla area in general is situated in the Eastern Fault Belt of the southern part of Main Ethiopian Rift where a number of extension fault zones are common (Zenas Engineering PLC, 2010).



Fig. 7: Location of Dilla RTC

ii. Climate

The climate of Dilla RTC and its environs in general is influenced by the topographic features of the country. The mean annual temperature at Dilla is 20° C. The warmest months are February to April, when mean daily maximums temperatures can rise above 30 °C. Temperature variations between day and night are in general ranging between 10 and 18°C. The annual average precipitation observed in the area is about 1253 mm. Precipitation patterns show that two distinctive rainy seasons with picks in April and September and decreases in December and February (Zenas Engineering PLC, 2010).

3.1.2. Flora and Fauna

i. Flora

A total of 26 species of plants have been recorded in the specific project site of Dilla RTC (Table 3). The site is characterized by Open grassland and Multilayer agro-forestry habitat. This site is named after *Chrysopogon spp*. (Senbelet) which is dominated by the same grass species as well as *Pennisetum spp., Cynodon dactylon* and *Hyparrhenia rufa*. The native woody species occupying the upper layer of the agro-forestry habitat include *Ficus sycomorus, Ficus sur, Cordia Africana, Croton macrostachys* and *Erythrina brucei*. The middle layer is mainly constituted by *Coffea arabica, Ensete ventricosum, Prunus persica, Musa spp.* and *Vernonia amygdalina*.

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No.	Species Scientific Name	Amharic Name	Conservation Status (IUCN Red List Category)	Usefulness Category List*
1.	Ficus sycomorus	Warka	LC	L
2.	Ficus sur	Warka	LC	L
3.	Cordia Africana	Wanza	LC	L
4.	Erythrina brucei	Korch	LC	L
5.	Croton macrostachys	Bisana	LC	L
6.	Podocarpus falcatus	Zigba	LC	L
7.	Millettia ferruginea	Birbira	LC	L
8.	Eucalyptus spp.	Key Bahirzaf	LC	L
9.	Euphorbia candelabrum	Kulkual	LC	NL
10.	Vernonia amygdalina	Grawa	LC	L
11.	Strychnos spinosa	Dokma	LC	L
12.	Arundo donax	Shembeko	LC	L
13.	Otostegia integrifolia	Tunjit	LC	L
14.	Coffea arabica	Buna	-	Cash crop
15.	Ananas comosus	Ananas	-	" "
16.	Musa paradisiaca	Muz	-	" "
17.	Persica spp.	Avecado	-	" "
18.	Ensete ventricosum	Enset	LC	L
19.	Psidium guajava	Zeituna	LC	L
20.	Prunus persica	Kock	LC	L
21.	Mangifera indica	Mango	LC	L
22.	Cynodon dactylon	Sar	-	Grass Spp.
23.	Chrysopogon spp.	Sar (Senbelet)	_	" "
24.	Hyparrhenia rufa	Sar	_	" "
25.	Sporobolus spp.	Sar	_	" "
26.	Pennisetum spp.	Sar	-	" "

Table 3: Checklists of common plant species of Dilla RTS

Where, LC – Least Concern

*According to Azene Bekele (2007) categorization of 'Useful Trees and Shrubs of Ethiopia'; where L= Listed; NL= Not Listed.



Fig 8. A typical Agro-forestry Habitat and Vegetation Layers (L) and Open Grassland (R) at the Project Area

ii. Fauna

According to the Wereda Environmental Protection and Forestry Development Office, the project site and its immediate adjacent areas provide a habitat for about 9 species of larger mammals of wild animals (Table 3). Cattle (ox, cow) and squids are among the predominantly domestic mammals owned by local community.

Table 4: List of Wild Mammal Species of the Project Site (Dilla RTC)

Source: Dilla Zuria Wereda Environmental Protection and Forestry Development Office (2016) and Field survey (2017).

No	Species Common Name	Scientific Name	Conservation Status (IUCN Red List Category)
1	Vervet Monkey	Cercopithecus aethiops pygerythrus	LC
2	Guereza	Colobus guereza	LC
3	Grey Duiker	Sylvicapra grimmia	LC
4	Common Bushbuck	Tragelaphus scriptus	LC
5	Spotted Hyena	Crocuta crocuta	LC
6	African Civet	Civettictis civetta	LC
7	Common Jackal	Canis aureus	LC
8	Abyssinian Hare	Lepus habessinicus	LC
9	Porcupine	Hystrix cristata	LC

Where, LC – Least Concern

Besides, this area is a location for significant number of bird's species. During the survey, 31 species were recorded in the site and its adjacent areas (Annex1). The dominant bird species in

project area are Silvery-cheeked Hornbill (*Bycanistes brevis*), Egyptian Goose (*Alopochen aegyptiacus*), Wattled Ibis (*Bostrychia carunculata*), Thick-billed Raven (*Corvus crassirostris*), Hooded Vulture (*Necrosyrtes monachus*) and Abyssinian Slaty Flycatcher (*Melaenornis chocolatinus*).



Fig. 9: Some of the Commonly Observed Birds (Wattled Ibis, Abyssinian Slaty Flycatcher and Hooded Vulture) at Dilla RTC

iii. Species of Conservation Concern

There is considerable deficiency of data on reptiles and amphibians inhabiting in the area and thus their status is not yet known. In this specific project site, no threatened wild mammal is found. However, among the avian species observed at the proposed Dilla RTC about 4 species of birds (all vultures) are critically endangered or endangered and one species (Bateleur) is near threatened though they are found abundantly throughout Ethiopia (Table 5). Moreover, Wattled Ibis (*Bostrychia carunculata*) and Thick-billed Raven (*Corvus crassirostris*) are considered as near endemic since they are only found in limited range of Ethiopia and Eritrea.

No.	Species Common Name	Scientific Name	Conservation Status (IUCN Red List Category)
1	White-backed Vulture	Gyps africanus	CEN
2	Ruppell's Vulture	Gyps rueppellii	CEN
3	White-headed Vulture	Trigonoceps occipitalis	EN
4	Hooded Vulture	Necrosyrtes monachus	EN
5	Wattled Ibis	Bostrychia carunculata	LC/NE
6	Thick-billed Raven	Corvus crassirostris	LC/NE

Where, EN – Endangered; CEN – Critically Endangered; LC/NE – Least Concern but Near Endemic

3.1.3. Protected and Non Protected Biodiversity Sites

i. Protected Areas and Wetlands

There is no designated conservation area in the vicinity of Dilla RTC. There are however some wetlands that include rivers and surrounding swamp areas. There are two rivers; namely Legedarra North and Chichiu South of Dilla town which are flowing east and west down to Lake Abaya. Chichiu river is situated at immediate adjacent to the project site (Fig. 10).

The vegetation of the riverine areas characterized by *Ficus spp., Maesa lanceolata, Arundo donax, Vernonia amygdalina and Cyprus and Typha species. Prunus africana* which is part of the gallery forest is vulnerable according to IUCN red listing.



Fig. 10: Dilla RTC and Surrounding Rivers

4. Impact Assessment and Mitigation for Yirga-Alem IAIP and Dilla RTC

4.1. Assessment Methodology

One of the main objectives of ESIA is to predict, describe and assess impacts that may result from project activities and identify mitigation measures and management actions to avoid, reduce, remedy or compensate for significant adverse effects and, where practicable, to maximize potential positive impacts and opportunities. Therefore, environmental impacts from planned and non-planned activities associated with the IAIP and RTC during all phases of the project were assessed on the basis of detailed knowledge of these activities.

The nature of an impact which is defined as the type of change from baseline conditions could be either positive or negative. However, in the context of impacts on biodiversity, the likely positive effects are negligible and thus the assessment process which mainly bases on different scales of probability and severity as well as significance matrix gives emphasis to the negative impacts.

The impact assessment process attempted to identify and examine the potential impacts resulted from the proposed projects and prediction methods with various rating scales were used (See annex 3.for details). The impacts were assessed as either significant or not significant. Those that were assessed as significant were further rated as being of minor, moderate or major significance. For significant negative impacts mitigation measures were put in place to reduce the residual impacts to as low as reasonably practicable levels.

Besides, sensitivity of the biological components was mapped based on field observation since the significance of an impact of a given magnitude depends on the sensitivity of resources and receptors to that impact.

4.2. Yirga Alem IAIP - Impact Description and Mitigation Measures

Yirga-Alem IAIP area comprises of transformed woodland and open grassland. The woodland is largely dominated by Eucalyptus spp. surrounded by *Ficus sycomorus, Cordia Africana, Croton macrostachys, and Euphorbia candelabrum*. These trees and undergrowth vegetation cover support a wide variety of faunal species especially birds and are ecologically important. All phases of the project which comprise of site setup, fencing, site clearance, excavation, transportation, storing and preparation of construction materials, access road construction and erection of building structures and other industrial infrastructures as well as activities associated with operational and decommissioning phases are expected to have negative impacts on flora and fauna. These include: habitat destruction, deforestation, road kills, pollution and expansion of alien species and human-wildlife conflict due to poor waste management and increased contact with wild animals.

Moreover, the proposed project may create disturbance on the threatened and wetland bird

species and it can also result in alteration of the watershed of Gidabo River and its surroundings if proper mitigation measures are not put in place. Wastes during construction and operational phases may bring about behavioral (feeding) change of wild animals (especially primates) if not properly managed and disposed.

Disturbance and electrocution of avian species and deterioration of water quality could be the possible negative impacts expected during the operational phase of the project. Contamination of the ecosystem during replacement of machineries, removal of pipelines and associated infrastructures as well as abandonment of roads and rehabilitation of affected areas are the impacts that need to be addressed in the decommissioning stage.

The potential impacts in all phases of the envisaged IAIP and their mitigation measures are summarized in the table below (Table 6).

Table 6: Biodiversity Impact Assessment of Yirga-Alem IAIP

CONSTRUCTION PHASE

Impact					Ease	Pre-N	litigation	Measure	Mitigation Measure	Ро	st-Mitigati	on		
Numb er	Receptor	Description	Stage	Charac ter	of Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance		
Impact 1	Biodiversity (Fauna & Flora)	Deforestation and vegetation clearing	Constru ction	Negati ve	Moder ate	3	2	6	 Avoiding damage to and loss of large mature trees and minimize vegetation clearance as much as possible; Rehabilitating and re-vegetating the areas affected during construction process; 	2	1	2		
				Sigr	ificance	1	N3 - Moderate		Significance	N2 - Minor				
Impact 2	Biodiversity (Fauna & Flora)	Habitat destruction	Constru ction	e e	Moder ate	3	2	6	 Ensure that considerable awareness is created and local knowledge is used where possible to determine key habitats that require consideration; Minimize numbers of temporary camps and sites chosen for all camps will be in permitted areas only; Give special consideration to key habitats and their connectivity; Undertake regular monitoring of the main habitats; Rehabilitating and re-vegetating the areas affected during construction process; 	2	2	4		
			I	Sigr	ificance	N	N3 - Moderate Significance		Significance	N2 - Minor				
Impact 3	Biodiversity (Fauna)	Road kills	Constru ction	Negativ e	Moder ate	2	2	4	 Establishing speed bumpers and precaution sign posts on the sensitive wild animal crossing points; Launching awareness creation programs for the construction staff; 	2	1	2		
				Sigr	ificance	N2 - Minor		N2 - Minor		or	Significance		N2 - Minor	
Impact 4	Fauna	Pollution	Constru ction	Negativ e	High	2	3	6	 Developing effective management of waste and hazardous materials; All fine earth materials must be enclosed during transportation to the site to prevent spillage and dusting; Spilled earth and construction material on the main roads should be cleaned up 	2	2	4		

Impact					Ease	Pre-N	litigation	Measure	Mitigation Measure		Post-Mitigation		
Numb er	Receptor	Description	Stage	Charac ter	of Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance	
									 regularly; Trucks used during construction should be fitted with tailgates that close properly and with tarpaulins to cover the materials; The transportation of lubricants and fuel to the construction site should only be done in the appropriate vehicles and containers; All machinery must be keenly observed not to leak oils on the ground and maintenance must be operated/carried out in a designated area (protected service bays) and where oils are completely restrained from reaching the ground; 				
				Sign	ificance	N	3 - Moder	ate	Significance	N2 - Minor			
Impact 5	Biodiversity /Ecosyste m Maintenan ce	Disturbance of threatened & wetland bird species	Constru ction	Negativ e	Moder ate	3	3	9	 Give special consideration to key habitats of threatened and wetland birds, Local knowledge is used where possible to determine locally sensitive areas that require consideration; Avoiding disturbance of nesting sites of threatened avian species; Use of birds friendly power lines and associated infrastructures; Develop effective management of hazardous materials; 	2	2	4	
				Sign	ificance	N	N3 - Moderate		Significance		N2 - Mino	or	
Impact 6	Biodiversity /Ecosyste m Maintenan ce	Expansion of alien species	Constru ction	Negativ e	Moder ate	2	3	6	 Avoiding introduction of materials from areas where alien species occur and make sure that there are no new succession of exotic ones; Undertake local monitoring on habitat change/prevalence of invasive species; 	2	2	4	
				Sign	ificance	N	3 - Moder	ate	Significance		N2 - Mino	or	

Impact	_			Charac ter	Ease of Mitiga tion	Pre-N	litigation	Measure	Mitigation Measure	Pc	Post-Mitigation	
Numb er	Receptor	Description	Stage			Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
Impact 7	Biodiversity /Ecosyste m Maintenan ce	Human wildlife conflict/behavioral change due to poor waste management	Constru ction	Negativ e	Moder ate	3	3	9	 Launching awareness creation programs for the construction staff; Identification of approved disposal site and a system for supervision and monitoring; Avoiding feeding and any contact with wild animals. Undertake regular monitoring of prevalence of human-wildlife conflict/behavioral change; Consult concerned stakeholders and develop human- wildlife conflict resolution systems; 	2	2	4
				Sigr	ificance	N3 - Moderate		ate	Significance	N2 - Minor		
Impact 8	Biodiversity /Ecosyste m Maintenan ce	Alteration of the watershed of the Gidabo River and associated highly sensitive biodiversity areas.	Constru ction	e P	Moder ate	3	3	9	 Special consideration will be given to water resources and sensitive biodiversity areas; Avoiding creation of access to steep slopes that would scar the landscape or lead to soil erosion; Developing effective watershed management plan for Gidabo River and its surroundings; Avoiding creation of transport access to sensitive landscapes ; Use of biological soil and water conservation mechanisms. 	2	2	4
		•	•	Sigr	ificance	N	3 - Moder	ate	Significance		N2 - Mino	r

OPERATIONAL PHASE

Impact Numb er	Receptor	Description	Stage	Charac ter	Ease of Mitiga tion	Pre-Mitigation Measure			Mitigation Measure	Post-Mitigation		
						Proba	Severi	Signifi	Description	Proba	Severit	Signifi
						bility	ty	cance	Description	bility	У	cance
Impact	Biodiversity	Re-vegetation of	operatio	Positiv	None	4	2	8	 Appropriate selection of natural 	4	2	8
1		indigenous plant	nal	е	requir				vegetation ;			
		species in greenery			е				-			
		areas										
Significance				P3 - Moderate		rate		P3 - Moderate		ate		
-												

Impact	Receptor	Description	Stage	Charac	Ease of	Pre-N	litigation	Measure	Mitigation Measure	Post-Mitigation		
er		Description	olage	ter	Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
Impact 2	Biodiversity /Avian fauna	Disturbance and Electrocutions of avian species	operatio nal	Negativ e	Moder ate	1	4	4	 Undertake monitoring of the birds & their flyway on regular basis; Use of birds friendly power lines and associated infrastructures; 	1	2	2
Significanc				ificance	N3 - Moderate			Significance	N2 - Minor			
Impact 3	Biodiversity /Ecosyste m Maintenan ce	Water quality deterioration / pollution of surrounding water resources	operatio nal	Negativ e	Moder ate	3	2	6	 Design and implement proper solid & liquid waste management; Effective disposal of materials and garbage in designated waste disposal sites. 	2	2	4
				Sign	ificance	N3 - Moderate		ate	Significance		N2 - Mino	r
Impact 4	Biodiversity /Ecosyste m Maintenan ce	Attraction of wild animals by food wastes and due to increased contact with people	operatio nal	Negativ e	Moder ate	3	2	6	 Launching awareness creation programs for the whole staff; Avoiding feeding and any contact with wild animals. Develop human- wildlife conflict resolution systems; Adoption of conventional sewage treatment facilities and solid waste management; 	2	2	4
				Sign	ificance	N	3 - Moder	ate	Significance		N2 - Mino	r

DECOMISSIONING PHASE

Impact	Receptor	Description	Stage	Charac	Ease of	Pre-N	litigation	Measure	Mitigation Measure	Po	ost-Mitigati	on
er		Description	oluge	ter	Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
Impact 1	Biodiversity/ Ecosystem Maintenanc e	Contamination of the ecosystem during replacement of machineries, removal of pipelines and associated infrastructures;	Decom missioni ng	Negativ e	Moder ate	1	2	2	 Adoption of conventional sewage treatment facilities and solid waste management; 	1	1	1
				Sigr	nificance		N2 - Min	or		Ν	11 - Negligi	ble
Impact 2	Biodiversity/ Ecosystem Maintenanc	Abandonment of roads and rehabilitation of	Decom missioni ng	Positive	Moder ate	2	1	1	 Undertake environmentally friendly restoration mechanisms 	2	1	2

Impact	Receptor	Description	Stage	Charac	Ease arac of	Pre-N	litigation	Measure	Mitigation Measure	Post-Mitigation		
er		Decemption	otago	ter	Mitiga tion	ja Proba 1 bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
	е	affected areas										
				Sign	ificance		P2 - Min	or			P2 - Mino	r

CUMULATIVE IMPACTS

Impact	Receptor	Description	Stago	Charac	Ease of	Ease Pre-Mitig		Measure	Mitigation Measure	Pc	st-Mitigati	on
er		Description	Stage	ter	ter Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
Impact 1	Biodiversity/ Ecosystem Maintenanc e	Erosion and top soil removal during excavation	Constru ction	Negativ e	Moder ate	1	2	2	 Avoiding creation of access to steep slopes that would scar the landscape or lead to soil erosion Restore removed soils and recover exposed ones with grass and other appropriate species as soon as possible; Use of biological soil and water conservation mechanisms. 	1	1	1
				Sign	ificance		N2 - Min	or		N	l1 - Negligi	ble
Impact 2	Biodiversity/ Ecosystem Maintenanc e	Contamination of the ecosystem due to spill over and dusting of some construction materials and wastes	Constru ction	Negativ e	Moder ate	1	2	2	 Developing effective management of waste and hazardous materials; All fine earth materials must be enclosed during transportation to the site to prevent spillage and dusting; Spilled earth and construction material on the main roads should be cleaned up regularly; Trucks used during construction should be fitted with tailgates that close properly and with tarpaulins to cover the materials. 	1	1	1
				Sign	ificance		N2 - Min	or		N	l1 - Negligi	ble
Impact 3	Biodiversity/ Ecosystem Maintenanc e	Alteration of the watershed of the area	Constru ction/Op erational	Negativ e	Moder ate	2	3	6	 Developing effective watershed management plan for the area; Avoiding creation of access to steep slopes that would scar the landscape or lead to soil erosion; Support watershed conservation efforts in and around the project area. 	2	2	4
						1	N3 - Mode	rate			N2 - Mino	r

Moreover, based on the mapping, biodiversity sensitivity of the proposed Yirga-Alem IAIP is defined as very high, high, medium and medium low (Fig. 11).



Fig. 11: Biodiversity sensitivity map of Yirga-Alem IAIP

4.3. Dilla RTC - Impact Description and Mitigation Measures

Dilla RTC is characterized by Open grassland and Multilayer agro-forestry habitat. The native woody species occupying the upper layer of the agro-forestry is dominated by Ficus and Croton species. These trees and the middle layer vegetation cover provide habitats for considerable number of species of mammals and birds. All phases of the project which comprise of site setup, fencing, site clearance, excavation, transportation, storing and preparation of construction materials, access road construction and erection of building structures and other industrial

infrastructures as well as activities associated with operational and decommissioning phases are expected to have negative impacts on flora and fauna as well as ecosystem maintenance. The potential impacts of the RTC which biodiversity in general include: habitat destruction, deforestation, alien species invasion, pollution and alteration of watersheds and sensitive biodiversity areas. Some trees which constitute the upper layer of the agro-forestry will be negatively affected. Moreover, there will be loss of fertile soil during soil excavation and also contamination of some flora due to spillage of some construction chemicals.

Dilla RTC and its surroundings is a location for four species of critically endangered and endangered vultures as well as two species of near endemic birds. It is also situated at the immediate adjacent of Chichu River. Along the river some wetland birds were recorded. Trees such as *Prunus africana* which are part of the gallery forest are also among the vulnerable species located in the area. Therefore, the envisaged development will have negative impact on the the threatened species and their habitat. Besides, wastes during construction phase may result in behavioral (feeding) change of wild animals (especially primates) and human wildlife conflict if not properly managed and disposed. The primates especially Vervet monkeys can be the root cause for human wildlife conflict. Construction of the envisaged development can also cause expansion of alien species. Pollution and degradation of the highly sensitive wetlands and biodiversity areas is expected if appropriate mitigation measures are not put in place.

Contamination of the ecosystem during replacement of machineries, removal of pipelines and associated infrastructures as well as abandonment of roads and rehabilitation of affected areas are the impacts that need to be addressed in the decommissioning stage.

The potential impacts in all phases of the envisaged RTC and their mitigation measures are summarized in the table below (Table 7).

Table 7: Biodiversity Impact Assessment of Dilla RTC

CONSTRUCTION PHASE

					Ease	Pre-N	litigation	Measure	Mitigation Measure F	ost-Mitigati	on
Number	Receptor	Description	Stage	cter	of Mitiga tion	Proba bility	Severi ty	Signifi cance	Description Proba bility	Severit y	Signifi cance
Impact 1	Biodiversi ty (Fauna & Flora)	Deforestation and vegetation clearing	Constr uction	Negat ive	Moder ate	3	3	9	 Avoiding damage to and loss of large mature trees especially the <i>Ficus spp.</i> and minimize vegetation clearance as much as possible; Rehabilitating and re-vegetating the areas affected during construction process; Use of indigenous knowledge of the local community's agro-forestry development. 	2	2
				Sigr	ificance		N3 - Mode	rate	Significance	N2 - Mino	or
Impact 2	Biodiversi ty (Fauna & Flora)	Habitat destruction	Construction	Negati ve	Moder ate	3	3	9	 Ensure that considerable awareness is created and local knowledge is used where possible to determine key habitats that require consideration; Minimize numbers of temporary camps during construction phase; identification and monitoring of key habitats; Restore the key habitats affected during construction process. 	2	4
				Sigr	nificance	N	3 - Moder	ate	Significance	N2 - Mino	or
Impact 3	Fauna	Pollution	Constr uction	Negati ve	High	2	3	6	 Developing effective management of waste and hazardous materials; Pollutants materials associated with the construction process need to be properly handled and make sure that Chichu River and surrounding sensitive areas are not affected; The transportation of lubricants and fuel to the construction site should only be done in the appropriate vehicles and containers; All machinery must be keenly observed not to leak oils on the ground and maintenance must be operated/carried out in a designated area (protected service bays) and where oils are completely restrained from reaching the ground. 	2	4

Immed	December			Charra	Ease	Pre-N	litigation	Measure	Mitigation Measure	Post-Mitiga		on
Number	Receptor	Description	Stage	cter	of Mitiga tion	Proba bility	Severi ty	Signifi cance	Description Pr b	roba bility	Severit y	Signifi cance
				Sigr	nificance	N	3 - Moder	ate	Significance		N2 - Mino	r
Impact 4	Biodiversi ty/Ecosys tem Maintena nce	Disturbance of threatened & wetland bird species	Constr uction	Negati ve	Moder ate	3	3	9	 Give special consideration to key habitats of threatened and wetland birds, Undertake regular monitoring of locally sensitive areas that require consideration; Avoiding disturbance of nesting sites of threatened avian species; Use of birds friendly power lines and associated infrastructures; Develop effective management of hazardous materials. 	2	2	4
				Sigr	nificance	N	3 - Moder	ate	Significance		N2 - Mino	r
Impact 5	Biodiversi ty/Ecosys tem Maintena nce	Expansion of alien species	Constr uction	Negati ve Sigr	Moder ate	2 N	2 3 - Moder	4 ate	 Avoiding introduction of materials from areas where alien species occur and make sure that there are no new succession of exotic ones; Undertake local monitoring on habitat change/prevalence of invasive species; 	2	1 N2 - Mino	2 r
Impact 6	Biodiversi ty/Ecosys tem Maintena nce	Human wildlife conflict/behavioral change due to poor waste management	Constr uction	Vegati ve	Moder ate	3	3	9	 Launching awareness creation programs for the construction staff; Identification of approved disposal site and a system for supervision and monitoring; Avoiding feeding and any contact with wild animals. Undertake regular monitoring of prevalence of human-wildlife conflict/behavioral change ; Consult concerned stakeholders and develop human- wildlife conflict resolution systems. 	2	2	4
				Sigr	nificance	N	3 - Moder	ate	Significance		N2 - Mino	r
Impact 7	Biodiversi ty / Ecosyste m Maintena nce	Alteration of the watershed of the Chichu River and associated riverside forest	Constr uction	Negati ve	Moder ate	3	3	9	 Special consideration will be given to water resources and sensitive biodiversity areas; Avoiding creation of access to the riverine area that would scar the landscape or lead to soil erosion or devegetation; Developing effective watershed 	2	2	4

Impost	Decenter		Chara		Chara	Chara	Ease	Pre-Mitigation Measure			Mitigation Measure	Po	ost-Mitigati	on
Number	Receptor	Description	Stage	cter	Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance		
									 management plan for Chichu River and its surroundings; Avoiding any drainage towards the River. 					
Significance			ificance	N3 - Moderate		ate	Significance		N2 - Mino	r				

OPERATIONAL PHASE

Impact	Receptor			Chara	Ease Pre-Mitigation Measure Mitigation Measur		Mitigation Measure		Post-Mitiga	ation		
Number		Description	Stage	cter	Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
Impact 1	Biodiversi ty	Re-vegetation of indigenous plant species in greenery areas and use of local community agro-forestry practices	operati onal	Positi ve	None Requir ed	4	2	8	 Apply the indigenous knowledge of Gedeo community. Appropriate selection of natural vegetation. 	4	2	8
				Sigr	nificance	I	P3 - Mode	erate		F	P3 - Moder	ate
Impact 2	Biodiversi ty / Fauna	Disturbance of birds and primates (Vervet monkey and Guereza)	operati onal	Negati ve	Moder ate	1	4	4	 Undertake monitoring of the birds & their flyway on regular basis; Avoid disturbance of usual feeding sites of the primates; 	1	2	2
				Sigr	ificance		N2 - Min	or	Significance		N2 - Mino	or
Impact 3	Biodiversi ty / Ecosyste m Maintena nce	Chichu River and other sources water quality deterioration and pollution	operati onal	Negati ve	Moder ate	2	4	8	 Design and implement proper solid & liquid waste management; Avoid any drainage to Chichu River and other water sources; Effective disposal of materials and garbage in designated waste disposal sites. 	2	2	4
				Sigr	ificance	N	3 - Moder	ate	Significance		N2 - Minc	or
Impact 4	Biodiversi ty/Ecosys tem Maintena nce	Attraction of wild animals by wastes	operati onal	Negati ve	Moder ate	3	2	6	 Launching awareness creation programs; Avoiding feeding and any contact with wild animals. Develop human- wildlife conflict resolution systems; Adoption of conventional sewage treatment facilities and solid waste management. 	2	2	4

Impact	Receptor			Chara	Ease Chara of	Pre-N	litigation	Measure	Mitigation Measure	I	Post-Mitigatic	
Number		Description	Stage	cter	Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
				Sign	ificance	N	3 - Moder	ate	Significance		N2 - Mino	r

DECOMISSIONING PHASE

Impact	Pecentor			Chara	Ease	Pre-N	litigation	Measure	Mitigation Measure	Po	ost-Mitigati	on
Number	Receptor	Description	Stage	cter	Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
Impact 1	Biodiversit y/Ecosyste m Maintenan ce	Contamination of the ecosystem during replacement of machineries, removal of pipelines and associated infrastructures;	Deco mmiss ioning	Negati ve	Moder ate	1	2	2	 Adoption of conventional sewage treatment facilities and solid waste management; 	1	1	1
				Sigr	ificance		N2 - Min	or		N	I1 - Negligi	ble
Impact 2	Biodiversit y/Ecosyste m Maintenan ce	Abandonment of roads and rehabilitation of affected areas	Deco mmiss ioning	Negati ve Positiv e	Moder ate	2	1	1	 Undertake environmentally friendly restoration mechanisms 	2	1	2
				Sigr	ificance		P2 - Min	or			P2 - Mino	r

CUMULATIVE IMPACTS

				Ease Chara of		Pre-N	litigation	Measure	Mitigation Measure	Post-Mitigation		on
Impact Number	Receptor	Description	Stage	cter	of Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
Impact 1	Biodiversit y/Ecosyste m Maintenan ce	Erosion and top soil removal during excavation	Constr uction	Negati ve	Moder ate	1	2	2	 Avoiding creation of access to steep slopes that would scar the landscape or lead to soil erosion Restore removed soils and recover exposed ones with grass and other appropriate species as soon as possible; Use of biological soil and water conservation mechanisms. 	1	1	1
				Sign	nificance		N2 - Min	or		N	11 - Negligi	ble

	_				Ease	Pre-N	litigation	Measure	Mitigation Measure	Po	ost-Mitigati	on
Impact Number	Receptor	Description	Stage	Chara cter	of Mitiga tion	Proba bility	Severi ty	Signifi cance	Description	Proba bility	Severit y	Signifi cance
Impact 2	Biodiversit y/Ecosyste m Maintenan ce	Alteration of the watershed of the area	Constr uction	Negati ve Sign	Moder ate	2	3	6	 Developing effective watershed management plan for the area; Avoiding creation of access to steep slopes that would scar the landscape or lead to soil erosion; Support watershed conservation efforts in and around the project area. 	2	2 N2 - Mino	4
				oigi			to mode					•
Impact 3	Biodiversit y/Ecosyste m Maintenan ce	Increased urbanization leading to increased pressure on the ecosystem	Constr uction/ Operat ional	Negati ve	Moder ate	3	2	6	 Launching awareness creation programs; Integrate management plan of the RTC with Dilla town master plan; Undertake ecological monitoring on regular basis make sure that pressure is minimized; Launching awareness creation programs; 	2	2	4
		•	•	•	•	I	N3 - Mode	rate			N2 - Mino	r

Besides, based on the mapping, biodiversity sensitivity of the proposed Dilla RTC is defined as very high, high, medium and medium low (Fig. 12).



Fig. 12: Biodiversity sensitivity map of Dilla RTC

4.4. Residual Impacts and Conclusion

Generally, in both Yerga-Alem IAIP and Dilla RTC cases, effective application of the aforementioned mitigation measures by the project team is expected to reduce the potential negative impacts to a minor level. Involvement of all stakeholders during the planning of field activities and the effective avoidance of the sensitive areas will considerably reduce the residual impacts to the ecologically sensitive areas to a *Minor* significance.

Therefore, the findings of this assessment shows that the potential impacts associated with the proposed projects can be considerably minimized and avoided provided that the recommended mitigation measures are properly applied. Moreover, the activities associated with the projects need to be monitored at all phases in order to identify unpredicted impacts and take corrective measures.

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6. Annexes

Annex 1: Checklist of the Birds observed in and flying over the Yirga-AlemIAIP
Source: Field Observation (2017)

No.	Family Name	English Name	Scientific Name
1			
2	Scopidae	Hamerkop	Scopus umbretta
3	Threskiornithid	Sacred Ibis	Threskiornis aethiopicus
4	Anatidae	Egyptian Goose	Alopochen aegyptiacus
5	Accipitridae	Hooded Vulture*	Necrosyrtes monachus
6		White-backed Vulture**	Gyps africanus
7		Ruppell's Vulture**	Gyps rueppellii
8	Charadriidae	African Wattled Lapwing	Vanellus senegallus
9	Columbidae	Speckled Pigeon	Columba guinea
10		Laughing Dove	Streptopelia senegalensis
11		Red-eyed Dove	Streptopelia semitorquata
12		Blue-spotted Wood Dove	Turtur afer
13	Collidae	Speckled Mousebird	Colius striatus
14	Bucerotidae	Silvery-cheeked Hornbill	Bycanistes brevis
15	Turdidae	Groundscraper Thrush	Psophocichla listsirupa
16	Timaliidae	White-rumped Babbler	Turdoides leucopygius
17	Dicruridae	Fork-tailed Drongo	Dicrurus adsimilis
18	Corvidae	Fan-tailed Raven	Corvus rhipidurus
19	Passeridae	Swainson's Sparrow	Passer swainsonii
20	Ploceidae	Village Weaver	Ploceus cucullatus
21	Estrildidae	Red-billed Fire finch	Lagonosticta senegala

* Endangered Species; ** Critically Endangered Species

No.	Family Name	English Name	Scientific Name
1	Ardeidae	Cattle Egret	Bubulcus ibis
2		Black-headed Heron	Ardea melanocephala
3	Scopidae	Hamerkop	Scopus umbretta
4	Threskiornithid	Sacred Ibis	Threskiornis aethiopicus
5		Wattled Ibis (NE)	Bostrychia carunculata
6	Anatidae	Egyptian Goose	Alopochen aegyptiacus
7	Accipitridae	Hooded Vulture*	Necrosyrtes monachus
8		White-backed Vulture**	Gyps africanus
9		Ruppell's Vulture**	Gyps rueppellii
10		White-headed Vulture*	Trigonoceps occipitalis
11	Falconidae	Grey Kestrel	Falco ardosiaceus
12	Columbidae	Speckled Pigeon	Columba guinea
13		Bruce's Green Pigeon	Treron waalia
14		Laughing Dove	Streptopelia senegalensis
15		Ring-necked Dove	Streptopelia capicola
16		Red-eyed Dove	Streptopelia semitorquata
17		Blue-spotted Wood Dove	Turtur afer
18	Collidae	Speckled Mousebird	Colius striatus
19	Bucerotidae	Silvery-cheeked Hornbill	Bycanistes brevis
20	Picidae	Nubian Wood pecker	Campethera nubica
21	Muscicapidae	Abyssinian Slaty Flycatcher	Melaenornis chocolatinus
22		African Paradise Flycatcher	Terpsiphone viridis
23	Nectariniidae	Variable Sunbird	Cinnyris venustus
24	Dicruridae	Fork-tailed Drongo	Dicrurus adsimilis
25	Corvidae	Fan-tailed Raven	Corvus rhipidurus
26		Thick-billed Raven (NE)	Corvus crassirostris
27	Passeridae	Swainson's Sparrow	Passer swainsonii
28	Ploceidae	Village Weaver	Ploceus cucullatus
29	Estrildidae	Red-billed Fire finch	Lagonosticta senegala
30		Red-cheeked Cordon-bleu	Uraeginthus bengalus

Annex 2: Checklist of the Birds observed in and flying over Dilla RTC Source: Field Observation (2017)

^{(NE) –} Near Endemic (found in Ethiopia & Eritrea only) * Endangered Species; ** Critically Endangered Species

Annex 3: Impact Scoring/Rating Definitions

Negative	Positive	
Negligible	Negligible	1
Minor	Minor	2-4
Moderate	Moderate	6-9
Major	Major	12-1

Rating Scale	Description
1	Unlikely - very improbable, never heard of in the industry, or an event with a short duration (probably will not happen).
2	Low probability - incident has occurred in the industry and so therefore could occur, or an event lasting up to a day (some possibility, but low likelihood).
3	Medium Probability - incident has (or is) expected to occur during the project or is very likely to, or an event which may occur up to 1 month (distinct possibility).
4	High probability - incident is expected to happen frequently a year or is almost certain to happen, or an event which is expected to occur multiple times (most likely).

ENVIRONMENTAL RECEPTORS – PHYSICAL AND BIOLOGICAL

CATEGORY	NEGATIVE	POSITIVE
	Major, long term national, international or transboundary effects.	Baseline will be significantly improved by the project.
	Deterioration/improvements of the existing habitat or ecosystem baseline conditions is significant.	Results in changes / increase in the abundance and biodiversity of populations.
4 High	Rehabilitation is required or the baseline will not recover.	Exceed national and international regulatory standards in protection and creation of natural habitats.
	Results in changes / reduction in the abundance and biodiversity of populations which may or may not	

CATEGORY	NEGATIVE	POSITIVE
	recover. Such impacts are a major non-compliance with national and international regulatory standards and may result in immediate intervention by governmental bodies and stakeholders.	
3 Medium	Moderate, medium term deterioration / impact on the ecosystem on a local / national level, leading to observable and measurable changes (negative). Moderate deterioration/improvements and changes / reduction in the abundance and biodiversity of the area with moderate recovery periods to baseline conditions. Non-conformance with national and international regulatory standards which may result in the intervention by governmental bodies and stakeholders.	Moderate, medium term rehabilitation of ecosystems or national significance, leading to observable and measurable changes. Moderate deterioration/improvements and changes / increase in the abundance and biodiversity of the area with moderate recovery periods to baseline conditions. Conformance with national and international regulatory standards.
2 Low	An effect will be experienced but they will be minor, short term and local, leading to observable and measurable changes recoverable within short durations. Potential non-conformance with regulatory standards. Unlikely to result in concerns being raised by governmental bodies or stakeholders. Minor deterioration of ambient environmental conditions and recovery requires little or no intervention.	An effect will be experienced but they will be minor, short term and local, leading to observable and measurable changes recoverable within short durations. Partial conformance with regulatory standards. Meets governmental and stakeholder requirements. Minor improvements to ambient environmental conditions.
1 Very Low	Deemed 'imperceptible' or indistinguishable from natural background conditions. No public interest.	Deemed 'imperceptible' or indistinguishable from natural background conditions. No public interest.