

GOVERNMENT OF TELANGANA
ENVIRONMENT, FORESTS, SCIENCE & TECHNOLOGY (FOR.I) DEPARTMENT

Letter. No.232/For.I(1)/2021

Dated:14-03-2023

From
The Additional Secretary to Government,
EFS&T Department, Telangana Secretariat,
Hyderabad.

To
The Inspector General of Forests,
Government of India, Ministry of Environment,
Forests & Climate Change, Indira Paryavaran Bhavan,
Jorbagh Road, New Delhi -110 003. (w.e.)

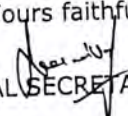
Sir,

Sub: FCA, 1980 - Diversion of **649.3014 Ha** forest land in Ramavaram RF of Ramavaram Range of Kothagudem forest division for grant of mining lease for proposed venkateshkhani OCP from underground rights to surface rights in Kothagudem Area in Bhadradi Kothagudem District in favour of M/s. SCCL. - Additional Information Submitted - Regarding.

- Ref: 1.From the PCCF(HoFF),T.S, Hyd., Ref.No.10066/2019/FCA-4,
Dated:16.01.2021.
2.Govt. Lr.No.232/For.I(1)/2021, Dated:18.02.2021.
3.From the PCCF(HoFF), T.S., Hyd., Ref.No.10066/2019/
FCA-4, Dated:29.06.2021.
4.Govt.Lr.No.232/For.I(1)/2021, Dated:16.07.2021.
5.From the PCCF(HoFF), T.S., Hyd., Ref.No.10066/2019/
FCA-4, Dated:07.12.2021.
6.Govt.Lr.No.232/For.I(1)/2021, Dated:18.12.2021.
7.From the PCCF(HoFF), T.S., Hyd., Ref.No.10066/2019/
FCA-4, Dated:12.01.2022.
8.Govt.Lr.No.232/For.I(1)/2021, Dated:28.01.2022.
9.From the PCCF (HoFF), T.S., Hyd., Ref.No.FC4 /FC29/6/2022,
Dated:16.05.2022.
10.Govt.Lr.No.232/For.I(1)/2021, dt:24-05-2022.
11.From the Assistant Inspector General of Forests,
GoI, MoEF&CC(Forest Conservation Division), New Delhi,
F.No.8-05/2021-FC, dt.20.06.2022.
12.From the PCCF(HoFF), T.S, Hyd., Ref.No.PCCF-FC4/FC29/
6/2022-FCA Section, Dt:05.07.2022.
13.Govt.Lr.No.232/For.I(1)/2021, dt:27-07-2021.
14.From the Assistant Inspector General of Forests, GoI,
MoEF&CC(Forest Conservation Division), New Delhi,
F.No.8-05/2021-FC, Dt:26.10.2022.
15.Govt.Lr.No.232/For.I(1)/2021, dt:04-11-2022.
16.From the PCCF(HoFF), T.S., Hyd., Ref.No.FC4/FC29/6/2022,
Dt.07.03.2023.

I am to forward the additional information in respect of the proposal for diversion of **649.3014 Ha** forest land in Ramavaram RF of Ramavaram Range of Kothagudem forest division for grant of mining lease for proposed venkateshkhani OCP from underground rights to surface rights in Kothagudem Area in Bhadradi Kothagudem District in favour of M/s.SCCL, as reported by the Principal Chief Conservator of Forests (HoFF), Telangana State, Hyderabad in the letter 16th cited and requested for consideration the proposal is very crucial for coal supply to the nearby thermal power plants.

Yours faithfully,


for ADDITIONAL SECRETARY TO GOVERNMENT.

Copy to:

The Principal Chief Conservator of Forests (HoFF),
Telangana State, Hyderabad.

SC.

**GOVERNMENT OF TELANGANA
FOREST DEPARTMENT**

From
Sri R.M.Dorbiyal, IFS,
Principal Chief Conservator of Forests (Head of
Forest Force)(FAC),
Telangana State, "Aranya Bhavan",
Saifabad, **Hyderabad.**

To
**The Spl. Chief Secretary to
Government,**
Forests Department,
Telangana State,
Hyderabad.

Ref.No. FC4/FC29/6/2022 , Dated:07/03/2023.

Madam,

Sub:TSFD - F(C) Act, 1980 -Diversion of 649.3014 ha forest land in Ramavaram RF of Ramavaram Range of Kothagudem forest division for grant of mining lease for proposed VenkateshKhani OCP from Underground rights to Surface rights in Kothagudem Area in Bhadradi Kothagudem District in favour of M/s.SCCL - **Additional Information Sought by Gol, MoEF& CC, New Delhi- Information Furnished -** Regarding.

- Ref:**
1. CCF/CF, Kothagudem Rc.No.117/2020/M3,Dt:01.12.2020.
 2. PCCF Rc.No. 10066/2019/FCA-4,Dt:16.01.2021.
 3. Gol, MoEF & CC, New Delhi F.No. 8-05/2021-FC Dt. 08.03.2021.
 4. PCCF Rc.No. 10066/2019/FCA-4,Dt:15.03.2021.
 5. General Manager, Kothagudem Area, SCCL, Bhadradi Kothagudem district Ref.No.KGM/EST/F/33/265,Dt:10.06.2020.
 6. FDO, Kothagudem Rc.No.631/2019/A5 Dt: 08.06.2021 addressed to DFO, BhadradiKothagudem
 7. FDO, WLM kinnerasani Rc.No.213/2020/K3 Dt. 17.04.2021 addressed to DFO, Bhadradi Kothagudem.
 8. PCCF Rc.No.10066/2019/FCA-4,Dt:29.06.2021.
 9. General Manager, Environment, SCCL, Bhadradi Kothagudem district Ref.No.CRP/ENV/A/408A/617 dt:11.10.2021.
 - 10.PCCF Rc.No.10066/2019/FCA-4 Dt:17.11.2021.
 - 11.Director(Planning&Projects), SCCL, Kothagudem District Ref No.CRP/EST/C/005/1201 dt:21.12.2021.
 - 12.PCCF Rc.No.10088/2021/FCA-4 Dt:10.01.2022.
 - 13.State govt Lr.No.232/For.I(1)/2021 Dt. 28.01.2022.
 - 14.Director(Operations), SCCL, Kothagudem District Ref No.CRP/EST/C/005/257 dt:04.02.2022.
 - 15.PCCF Rc.No.10088/2021/FCA-4 Dt:21.02.2022.
 - 16.Gol, MoEF & CC, New Delhi F.No. 8-05/2021-FC Dt. 25.02.2022.
 - 17.CF, Karimnagar Rc.No.167/2022/M2, Dated:-06-05-2022.
 - 18.PCCF Rc.No.FC4/FC29/6/2022 , Dated: 16-05-2022.
 - 19.State govt Lr.No.232/For.I(1)/2021 Dt. 24.05.2022.
 - 20.CF, Kothagudem Rc.No.40/2020/M3 dated 18.06.2022.
 - 21.Gol, MoEF & CC, New Delhi F.No. 8-05/2021-FC Dt. 20.06.2022.
 - 22.Director(Planning&Projects), SCCL, Kothagudem District Ref No.CRP/EST/F/117/724 dt:21.06.2022.
 - 23.CF, Karimnagar Rc.No.167/2022/M2 dated 28.06.2022.
 - 24.PCCF Rc.No.FC4/FC29/6/2022 , Dated:05.07.2022
 - 25.Gol, MoEF & CC, New Delhi F.No.8-05/2021-FC Dt.26.10.2022.
 - 26.PCCF Rc.No.FC4/FC29/6/2022 , Dated:12.11.2022.
 - 27.DFO, Bhadradi Rc.No.241/2020/D1 Dt. 28.02.2023 addressed to CF,

Bhadradi
28.Director(Planning&Projects), SCCL, Kothagudem District
Ref No.CRP/DPP/VK/OC/20/51 dt:04.03.2023.

Vide ref 25th cited, the GoI, MoEF & CC, New Delhi has sought additional information on the subject proposal for further consideration of the proposal.

Accordingly, vide references 27th and 28th cited, the District Forest Officer, Bhadradi Kothagudem and the Director(Planning&Projects), SCCL, Kothagudem District has furnished information as desired by the GoI, MoEF & CC, New Delhi which are furnished as follows, with remarks:

Point No.1:-A study to be carried out by IIFM Bhopal on the Cost-Benefit analysis on conversion of underground mines to open cast mines and the cost of the study will be borne by User Agency. The Cost Benefit Analysis shall account for the ecological/ecosystem services provisions from the proposed mining area/landscape.

Reply:- M/s.SCCL has informed that, the work of getting the Cost Benefit analysis was entrusted to the IIFM-Bhopal. Accordingly, the Director, IIFM-Bhopal, has sent the report and the report has been prepared after field visits and taking all the essential components like ecological/ecosystem services into accounts. The revised Cost Benefit ratio has been arrived as 1:12.53 against the previous of 1:20.10. In the report emphasis has been laid on water conservation, sedimentation regulation etc. The SCCL is willing to work with this cost: benefit ratio and it is favorable to them. The report is enclosed.

Point No.2:-The details/ KML files of the DFL identified for carrying out one half times CA w.r.t the safety zone may be provided.

Reply:- The District Forest Officer, Bhadradi Kothagudem has informed that the one and half times the safety zone area is identified to an extent of 11.00 Ha in compartment No. 29 of Penagadapa RF, Ramavaram Range of Kothagudem Division. The Safety zone area map and KML file is enclosed.

M/s. SCCL will deposit the money with the Forest department as and when asked for raising afforestation in this area.

Point No.3:-The State Government may comment on the dumping of the material in Goutham Khani Open Cast Mining and its impact on the approved Mining closure plan/ R&R plan based activities.

Reply:-

1. M/s.SCCL has informed that the GouthamKhani OC Mine was started during the year, 1993-94 by converting 4 underground mines viz., 8 Incline, 9 Incline, 10 Incline and 11 Incline mines into OC. From this mine, 71.55 Mt of Coal has been extracted by generating 335.49 Mm³ of OB. Out of 902 Ha of GK OC Mine area, the forest land is 540.27 Ha and non-forest land is 361.73 Ha. The permission under F (C) Act for 540.27 Ha of forest land was obtained in 3 parcels viz., (i) 261.31 Ha of FL granted vide F.No.8-117/2002-FC, dt.01.02.2010, (ii) 124 Ha of FL granted vide F.No.8-17/98-FC, dated 08.02.1999 and (iii) 154.96 Ha granted vide F.No.8-62/2005-FC, dated 09.07.2008.
2. As per the approved Mining Plan (MP) of GK OC Mine, overburden dump was proposed in an area of **503.60 Ha up to a height of +80 Meters**. The void is supposed to be with standing water in an area of 221.64 Ha up to a depth of 240 Meters. The safety barrier all along the boundary is supposed to be in an area of 75.98 Ha and infrastructure area is in an area of 56.28 Ha.
3. At the time of submission of Mining Plan of GK OC Mine, there was no proposal of conversion of VK-7 and PVK-5 Incline UG coal mines into Open Cast. Subsequently, as the coal was exhausted in GK OC, without further scope of extraction of coal by UG method in VK No.7 Incline, these 2 mines were closed in 2022 and 2021 respectively. PVK No.5 Incline is an adjoining operating UG mine and will be day lighted after 11 years (from 2019-20) of underground mining. Except, 9.93 MT of balance reserves to be extracted underground mining during the next 11 years (from 2019-20), no further reserves could be extracted from these 2 mines by UG method due to adverse geo-mining conditions and safety issues prevailing in the mines. In case, these 2 mines are not converted to opencast, about 180.18 MT cannot be extracted and lost forever. Keeping in view of this, VK Coal Mine (Amalgamation of VenkateshKhani No.7 Incline, PadmavathiKhani No.5 Incline &GouthamKhani OC Mine) was formulated.
4. Accordingly, SCCL had obtained approval of Mining Plan (Including Mine Closure Plan) from MoC, Gol, vide 38011/12/2017-PCA, Dt.27.01.2020 for VK Coal Mine which involves 787.14 Ha of GK OC area. As per this proposal, VK No.7 UG will be converted into OC immediately and PVK No. 5 Incline will be converted into OC after 11 years (from 2019-20) of UG mining. In this context, it is to mention that 100 Ha of rehabilitated OB dumping area (FL) (out of 361.34 Ha of reclaimed external dump area of GK OC Mine), was surrendered to the Forest Department and the revised forest land diversion for 161.34 Ha of forest land was obtained vide F.No.8-117/2002-FC, dated 01.02.2010. Further, it is proposed to utilize 403.60 Ha of dumping area, 221.64 Ha void area, 75.98 Ha of safety zone all along the boundary & 56.28 Ha of infrastructure area of GK OC in the instant proposal as part of sequential mining.
5. It is further submitted that by utilising 403.60 Ha of GK OC OB dumping area, 221.64 Ha of GK OC voids & 75.98 Ha of safety zone all along the boundary and 56.28 Ha of infrastructure area, the following benefits will be accrued:
 - a. No new area is required for breaking for OB dumping, thus reducing the soil loss and soil flow into the adjoining area, if any.
 - b. In the instant proposal, rehabilitation of OB dump area will be in 1307.356 Ha (403.60 Ha of GK OC dumping area + 903.756 Ha of new OB dumping area) as

against rehabilitation in OB dumping area of 503.60 Ha in GK OC Mine. Thus, there is an increase of 803.756 Ha of OB dumping area. Hence, SCCL will do rehabilitation in more areas including regrassing which will be available for grazing purpose, carbon sequestration and other social benefits etc. The increased area after rehabilitation will also be helpful for wildlife in the adjoining area.

- c. The void area will be in 386.334Ha with standing water upto 300 meters depth as against 221.64 Ha area of GKOC mine upto 240 meters. This will help in recharging the ground water in more area in the project as well as adjoining areas. This will be also helpful to wildlife and general improvement in landscape for wildlife.
- d. The existing safety zone all along GKOC in 75.98Ha will be maintained and increased up to 160.80 Ha area in VKOC, thus reducing the impact, if any on the nearby wild life.
- e. The existing manpower of GKOC including outsourcing manpower employed from the adjoining villages will be continued in the VKOC and hence, the employment will be continued.
- f. By starting this mine, 180.18Mt of coal from VK OC will be produced during its life (40 years from 2019-20). Hence, the sustenance of coal supplies will be continued to the adjoining thermal power stations (Kothagudem Thermal Power Station (KTPS) of TS GENCO (1800 MW), Nava Bharat Ventures (264 MW), etc) situated at a distance of around 20 km.
- g. Thus, by converting VK No.7 Incline & PVK No.5 Incline UG mines into OC by utilising GKOC Mine area, it will be beneficial to the SCCL, the State Government.

Table 1. Summary of impacts of dumping of the material in Goutham Khani Opencast Mining

Sl. No	Parameter	GK OC	VK OC	Benefits of VK OC
1	Rehabilitation of OB dumping area (Ha)	503.60	1307.356	<ul style="list-style-type: none"> 1. Rehabilitation in more areas including regrassing which will be available for grazing purpose, carbon sequestration and other social benefits etc. 2. Helpful for wildlife in the adjoining area.
2	Void Area (Ha) for recharging the ground water	221.64	386.334	<ul style="list-style-type: none"> 1. Help in recharging the ground water in more area in the project as well as adjoining areas. 2. Helpful to wildlife and general improvement in landscape for wildlife.
3	Safety Zone all along the oc mine boundary (Ha) for reducing the impact on nearby wild life	75.98	160.80	<ul style="list-style-type: none"> 1. Increased area under safety zone will help in reducing the impact, if any on the nearby wild life.

Point No.4:-Considering the area to be diverted is very large a biodiversity impact assessment study may also be carried out by reputed institution. The cost for the study will be borne by the User Agency and the study report shall be submitted to this Ministry as early as possible.

Reply:- M/s.SCCL has submitted the biodiversity report carried out by the EPTRI (Environment Protection Research & Training Institute, Hyderabad) (Copy enclosed). In the report it has been recommended to engage one wildlife expert at least for 10 years to monitor the impact of mining in adjoining forest area in the buffer, besides taking suitable Soil Moisture Conservation works in the adjoining areas and the same has also been reflected vide para 5 (Wildlife) in the Site Inspection report of the IRO, Hyderabad. A Wildlife Conservation/Mitigation plan was prepared was approved by the Chief Wildlife Warden, TS, vide reference 5694/2021/WL-I Dt.12.10.2021 for Rs.4.78 Crores.

Further , it is submitted that the GK OC Mine has been closed and nearest KTPS thermal power plant is having linkage with the proposed VK OC mines.

In view of the above, the State Government are requested to forward the information to Gol, MoEF& CC, New Delhi for consideration of this proposal for placing this proposal before FAC for grant of Stage-I approval as the proposal is very crucial for coal supply to the nearby thermal power plants.

Encl: As above.

Yours faithfully,

Signed by Rakesh Mohan

Dobriyal

Date: 07-03-2023 12:04:39

Reason: Approved

Prl. Chief Conservator of Forests
Head of Forest Force(HoFF)

Advance Copy submitted to the Director General of Forests & Special Secretary to the Govt, MoEF& CC, Gol, Indira Paryawarana Bhawan, Jorbagh Road, New Delhi - 110003 for information and necessary action.

Copy to

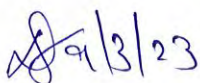
The Conservator of Forests, Bhadradi Circle and the District Forest Officer, Kothagudem.

Sri Surendra pandey, IFS (Retd.), Advisor (Forestry), The SCCL, Singareni Bhavan, Red Hills, PB.No.18, Khairatabad(Post), Hyderabad - 500004 for information .

The General Manager, M/s Singareni Collieries Corporation Limited, Kothagudem Area, Bhadradi Kothagudem District, PO: Venkatesh Khani - 507103

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for Principal Chief Conservator of Forests


9/3/23

G.VENKATESWARA REDDY

Director (Planning & Projects)



The Singareni Collieries Co. Ltd.

(A Government Company)

KOTHAGUDEM - 507 101,

Bhadradi Kothagudem Dist., T.S., India.

CIN : U10102TG1920SGC000571

Ref.No.CRP/DPP/VK OC/20151

Date: 04.03.2023

To
The Principal Chief Conservator of Forests
& Head of Forest Force,
Govt. of Telangana,
Aranya Bhavan, Hyderabad.

Sir,

Sub:- F (C) - Diversion of 649.3014 Ha of RF for Venktesh Khani OCP in Kothagudem Forest Division, submission of additional information as sought in the EDS raised by MOEF&CC, GOI, request to furnish this information to the MOEF &CC, GOI, and uploading it in Parivesh portal - Reg.

Ref:- 1. MoEF&CC, GoILr.No. 8-05/2021-FC, dated 26.10.2022.
2. GM KGM Ref.No-KGM/EST/F/33/594 Dt.15.12.2022
3-Director IIFM Ref.No-IIFM/SPS/Aca 01/2023 /28 Dt.20.02.2023

Kind attention is invited to the references 1st cited wherein EDS has been raised and certain additional information was sought by the MOEF &CC, GOI. All the details are furnished herewith for favor of information and submission to the MOEF &CC, GOI through the State Government.

1. A study to be carried out by IIFM Bhopal on the Cost-Benefit analysis on conversion of underground Mines to open cast mines and the cost of the study will be borne by User Agency. The Cost-Benefit Analysis shall account for the ecological/ecosystem services provisions from the proposed mining area/landscape.

As advised by the MOEF &CC, GOI, the work of getting the C : B analysis was entrusted to the IIFM-Bhopal. Accordingly, vide reference 3rd cited, the Director, IIFM-Bhopal, has sent the report. This report has been prepared after field visits and taking all the essential components like ecological/ecosystem services into accounts. The revised C:B ratio has been arrived as 1:12.53 against the previous of 1:20.10. In the report emphasis has been laid on water conservation,

sedimentation regulation etc. The SCCL is willing to work with this cost : benefit ratio and it is favorable to them. The report is enclosed as **Annexure-I**

2. The details/KML files of the DFL identified for carrying out one half times CA w.r.t the safety zone may be provided.

The KML file of the DFL identified for carrying out one and half times CA w.r.t the safety zone is enclosed as **Annexure-II**. This area comes to 11 Ha.

The SCCL will deposit the money with the Forest department as and when asked for raising afforestation in this area. An undertaking to this effect is also enclosed.

3. The State Govt. may comment on the dumping of the material in Goutham Khani Open Cast Mining and its impact on the approved Mining closure plan / R&R plan based activities.

1. It is brought to the kind notice that Goutham Khani OC Mine was started during the year, 1993-94 by converting 4 underground mines viz., 8 Incline, 9 Incline, 10 Incline and 11 Incline mines into OC. From this mine, 71.55 Mt of Coal has been extracted by generating 335.49 Mm³ of OB. Out of 902 Ha of GK OC Mine area, the forest land is 540.27 Ha and non-forest land is 361.73 Ha. The permission under F (C) Act for 540.27 Ha of forest land was obtained in 3 parcels viz., (i) 261.31 Ha of FL granted vide F.No.8-117/2002-FC, dt.01.02.2010, (ii) 124 Ha of FL granted vide F.No.8-17/98-FC, dated 08.02.1999 and (iii) 154.96 Ha granted vide F.No.8-62/2005-FC, dated 09.07.2008.

2. As per the approved Mining Plan (MP) of GK OC Mine, overburden dump was proposed in an area of **503.60 Ha up to a height of +80 Meters**. The void is supposed to be with standing water in an area of 221.64 Ha up to a depth of 240 Meters. The safety barrier all along the boundary is supposed to be in an area of 75.98 Ha and infrastructure area is in an area of 56.28 Ha.

3. At the time of submission of Mining Plan of GK OC Mine, there was no proposal of conversion of VK-7 and PVK-5 Incline UG coal mines into Open Cast. Subsequently, as the coal was exhausted in GK OC, without further scope of extraction of coal by UG method in VK No.7 Incline, these 2 mines were closed in 2022 and 2021 respectively. PVK No.5 Incline is an adjoining operating UG mine and will be day lighted after 11 years (from 2019-20) of underground mining. Except, 9.93 MT of balance reserves to be extracted underground mining during the next 11 years (from 2019-20), no further reserves could be extracted from these 2 mines by UG method due to adverse geo-mining conditions and safety issues prevailing in the mines. In case, these 2 mines are not converted to opencast, about 180.18 MT cannot be extracted and lost forever. Keeping in view of this, VK Coal Mine (Amalgamation of Venkatesh Khani No.7 Incline, Padmavathi Khani No.5 Incline & Goutham Khani OC Mine) was formulated.

4. Accordingly, SCCL had obtained approval of Mining Plan (Including Mine Closure Plan) from MoC, GoI, vide 38011/12/2017-PCA, Dt.27.01.2020 for VK Coal Mine which involves 787.14 Ha of GK OC area. As per this proposal, VK No.7 UG will be converted into OC immediately and PVK No. 5 Incline will be converted into OC after 11 years (from 2019-20) of UG mining. In this context, it is to mention that 100 Ha of rehabilitated OB dumping area (FL) (out of 361.34 Ha of reclaimed external dump area of GK OC Mine), was surrendered to the Forest Department and the revised forest land diversion for 161.34 Ha of forest land was obtained vide F.No.8-117/2002-FC, dated 01.02.2010. Further, it is proposed to utilize 403.60 Ha of dumping area, 221.64 Ha void area, 75.98 Ha of safety zone all along the boundary & 56.28 Ha of infrastructure area of GK OC in the instant proposal as part of sequential mining.
5. It is further submitted that by utilizing 403.60 Ha of GK OC OB dumping area, 221.64 Ha of GK OC voids & 75.98 Ha of safety zone all along the boundary and 56.28 Ha of infrastructure area, the following benefits will be accrued:
 - a) No new area is required for breaking for OB dumping, thus reducing the soil loss and soil flow into the adjoining area, if any.
 - b) In the instant proposal, rehabilitation of OB dump area will be in 1307.356 Ha (403.60 Ha of GK OC dumping area + 903.756 Ha of new OB dumping area) as against rehabilitation in OB dumping area of 503.60 Ha in GK OC Mine. Thus, there is an increase of 803.756 Ha of OB dumping area. Hence, SCCL will do rehabilitation in more areas including regrassing which will be available for grazing purpose, carbon sequestration and other social benefits etc. The increased area after rehabilitation will also be helpful for wildlife in the adjoining area.
 - c) The void area will be in 386.334Ha with standing water upto 300 meters depth as against 221.64 Ha area of GKOC mine upto 240 meters. This will help in recharging the ground water in more area in the project as well as adjoining areas. This will be also helpful to wildlife and general improvement in landscape for wildlife.
 - d) The existing safety zone all along GKOC in 75.98Ha will be maintained and increased up to 160.80 Ha area in VKOC, thus reducing the impact, if any on the nearby wild life.
 - e) The existing manpower of GKOC including outsourcing manpower employed from the adjoining villages will be continued in the VKOC and hence, the employment will be continued.
 - f) By starting this mine, 180.18Mt of coal from VK OC will be produced during its life (40 years from 2019-20). Hence, the sustenance of coal supplies will be continued to the adjoining thermal power stations (Kothagudem Thermal

Power Station (KTPS) of TS GENCO (1800 MW), Nava Bharat Ventures (264 MW), etc) situated at a distance of around 20 km.

- g) Thus, by converting VK No.7 Incline & PVK No.5 Incline UG mines into OC by utilizing GKOC Mine area, it will be beneficial to the SCCL, the State Government.

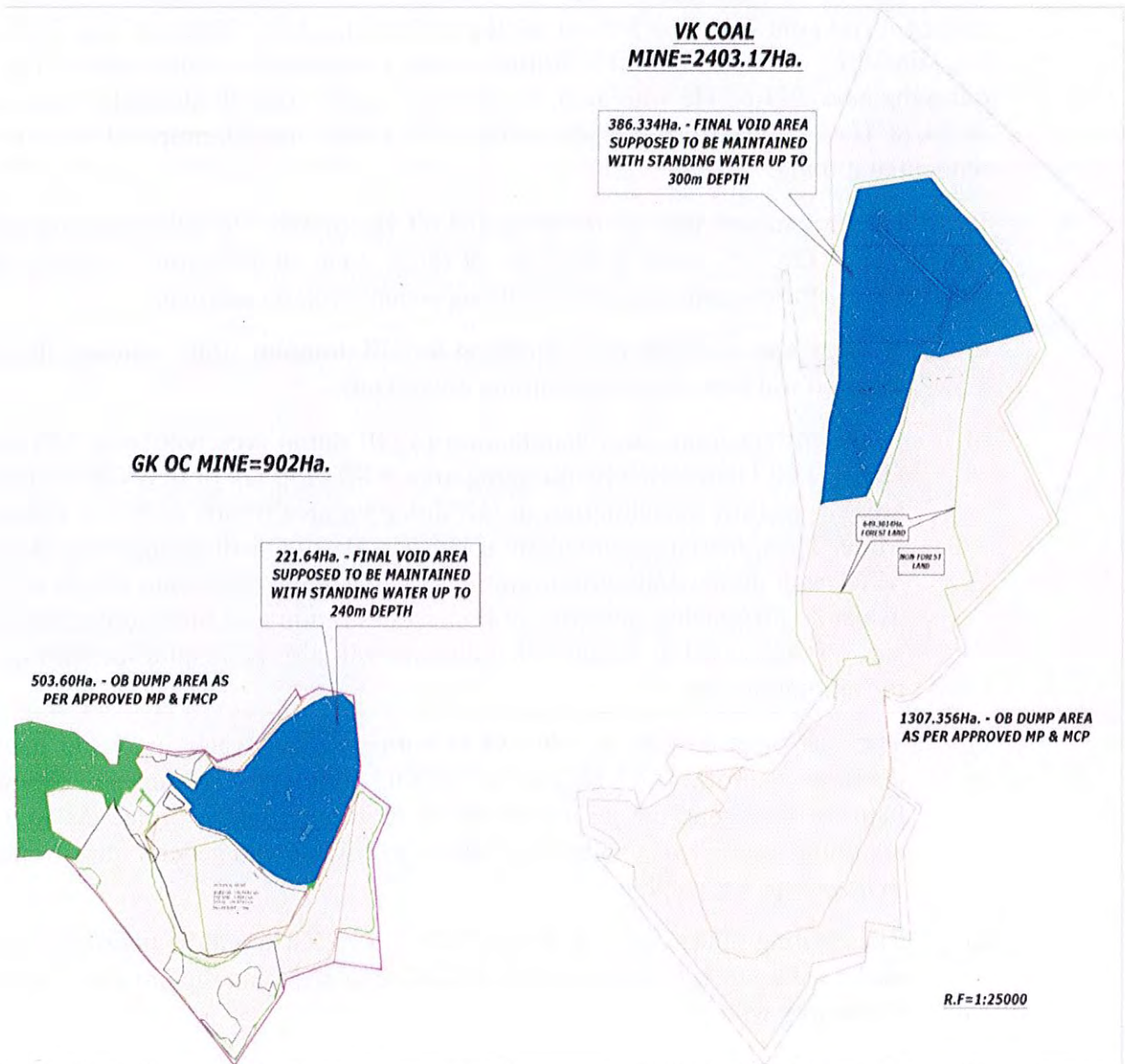


Table 1. Summary of impacts of dumping of the material in Goutham Khani Opencast Mining

Sl. No	Parameter	GK OC	VK OC	Benefits of VK OC
1	Rehabilitation of OB dumping area (Ha)	503.60	1307.356	1. Rehabilitation in more areas including regrassing which will be available for grazing purpose, carbon sequestration and other social benefits etc. 2. Helpful for wildlife in the adjoining area.
2	Void Area (Ha) for recharging the ground water	221.64	386.334	1. Help in recharging the ground water in more area in the project as well as adjoining areas. 2. Helpful to wildlife and general improvement in landscape for wildlife.
3	Safety Zone all along the oc mine boundary (Ha) for reducing the impact on nearby wild life	75.98	160.80	1. Increased area under safety zone will help in reducing the impact, if any on the nearby wild life.

- iv- Considering the area to be diverted is very large a biodiversity impact assessment study may also be carried out by reputed institution. The cost for the study will be borne by the User Agency and the study report shall be submitted to this Ministry as early as possible.

The Singareni Collieries (SCCL) vide reference 2nd cited, has submitted biodiversity report carried out by the EPTRI (Environment Protection Research & Training Institute, Hyderabad) to the O/o Principal Chief Conservator of Forest & HOFF, Hyderabad. (Copy enclosed as Annexure-III). In the report it has been recommended to engage one wildlife expert at least for 10 years to monitor the impact of mining in adjoining forest area in the buffer, besides taking suitable Soil Moisture Conservation works in the adjoining areas. The same has also been reflected vide para 5 (Wildlife) in the Site Inspection report of the IRO, Hyderabad. A Wildlife Conservation/Mitigation plan was prepared was

G. VENKATESWARA REDDY
 Director (Planning & Projects)
 The Singareni Collieries Co. Ltd.
 KOTHAGUDEM

approved by the Chief Wildlife Warden, TS, vide reference 5694/2021/WL-I Dt.12.10.2021 for Rs.4.78 Crores.

It is submitted that as GKOC mine has been closed and nearest KTPS Thermal power plant is having linkage with this proposed VKOC Mines, early starting of the mining in this area is crucial.

Hence, it is humbly requested to kindly furnish this EDS replies to the MOEF &CC, GOI, through the State Government with a request to consider this proposal for placing this proposal before FAC during this month ie. March'2023 for grant of Stage-I as this proposal is very crucial for coal supply to the nearbythermal power plants.

Yours faithfully


Director (Planning & Projects)

Encl: as above

Copy submitted to :


The Inspector General of Forests (FC), Ministry of Environment and Forests & Climate Change, Government of India. Indira Paryavaran Bhavan, Jorbagh Road, Aliganj, New Delhi- 110 003 for favor of information with a request to consider our request.

The Regional Officer, Integrated Regional Office, MOEF & CC, GOI, 3rd Floor, Aranya Bhavan, Hyderabad, for favor of information.

The Chief Conservator of Forests, Bhadradi Circle, Warangal, for favor of information with a request to submit this report to the Nodal Officer & the Principal Chief Conservator of Forests, TS.

The District Forest officer, Bhadradi Kothagudem for favor of information with a request to submit this report to the Nodal Officer & the Principal Chief Conservator of Forests, TS.

Yours faithfully


Director (Planning&Projects)

G. VENKATESWARA REDDY
Director (Planning & Projects)
The Singareni Collieries Co. Ltd.
KOTHAGUDEM

**Cost Benefit Analysis studies for Conversion
of Underground Mine to Open Cast Mine of
Venkatesh Khani Coal Mines of SCCL**

Submitted by:



**Indian Institute of Forest Management
Bhopal**

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1 Introduction

Singareni Collieries Company Limited (also known as SCCL) is jointly owned by the Government of Telangana (51%) and the Government of India (49%). It comes under the Department of Energy of Telangana Government. The Union Government's administration of the company is held by the Ministry of Coal.

The Singareni Collieries Company Ltd. (SCCL) currently operates 24 underground mines and 18 open cast mines. These 42 mines are spread over six districts of Telangana which are Komaram, Bheem Asifabad, Mancherial, Peddapalli, Jayashankar Bhupalpalli, Bhadradi Kothagudem and Khammam. In the Godavari valley coalfield – There is a gap of 19.5 MT between demand and supply. To bridge this gap, SCCL is undertaking expansion of existing opencast mines, conversion of underground mines to opencast and opening new mines in the lease hold area. SCCL is also to open a new coal mine (Naini Coal Block) in Odisha State.

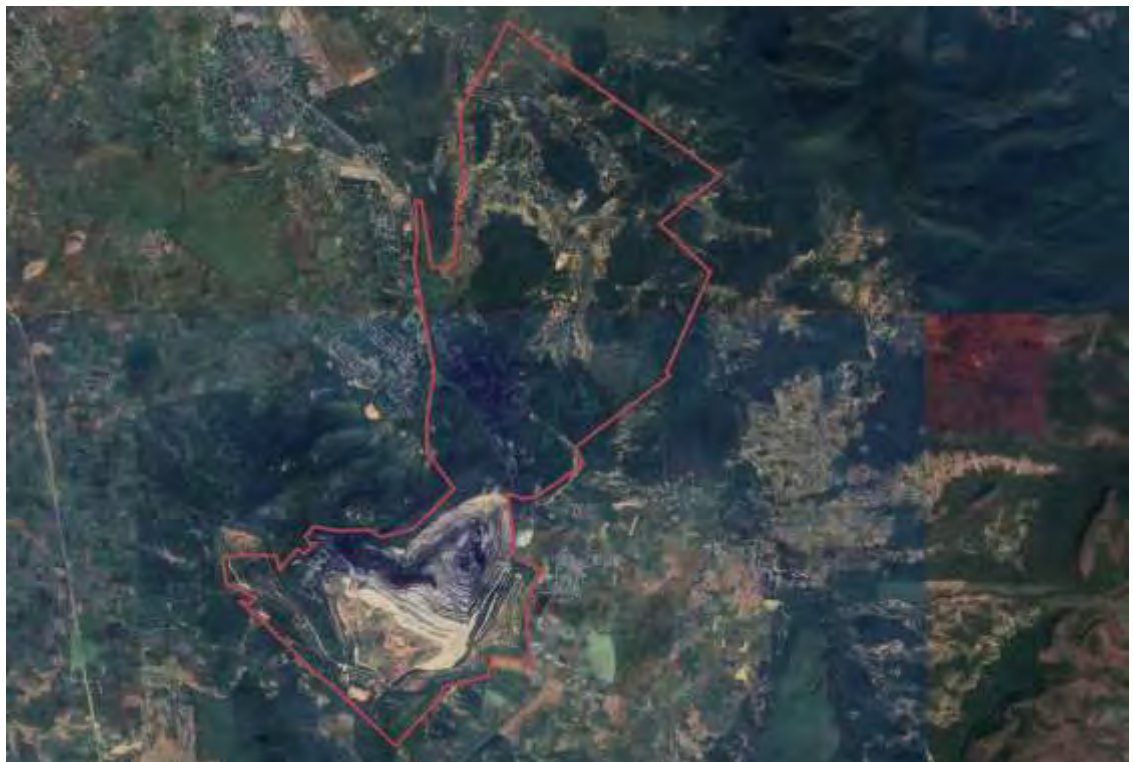


Figure i: Study Area

The study area of 650 Ha is located at Ramavaram RF, Kothagudem Forest Division in Bhadradi Kothagudem district of Telangana. Its geographical coordinates are Latitude 170 27'18" N to 170 28'04" N and Longitude 800 37'30" E to 800 39'45" E. The maximum temperature varies between 22.5 to 40.6°C with wind speed of 5.6m/s for south to south-west direction. The relative humidity ranges between 42.6 percent and 99.9 percent. The annual rainfall is 1150.7mm. There is presence of red soil.

The present assignment deals with calculating a revised benefit cost ratio taking into account the costs related to Ecosystem Services. These costs have not been accounted for in the original NPV calculations. The result is a revised Benefit-Cost ratio after considering the costs of ecosystem services that have not been taken into account in the original ratio.

2 Ecosystem Services

Ecosystem Services

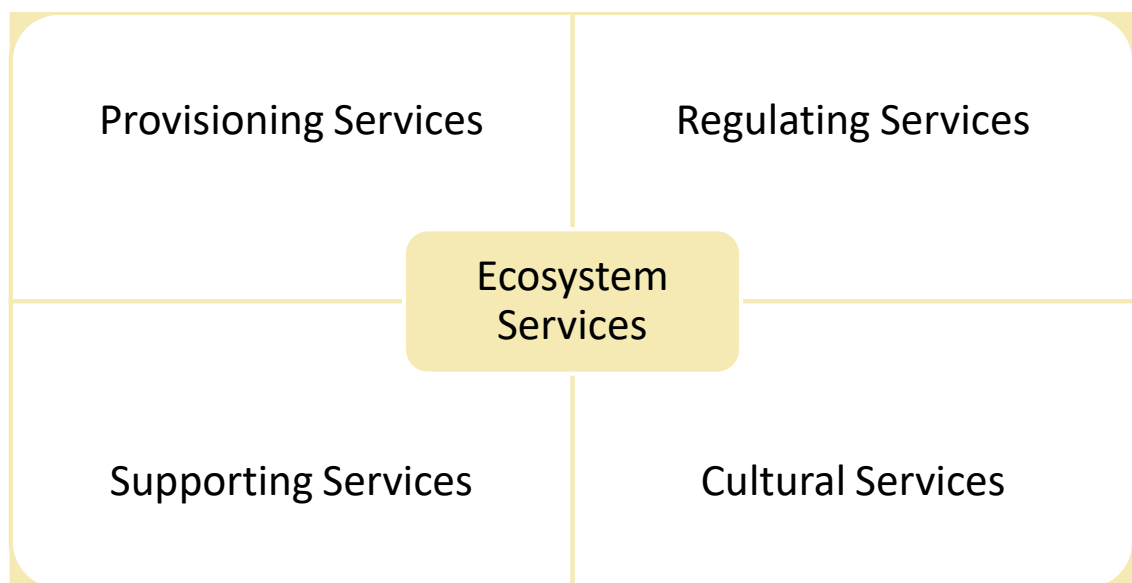
Benefits (in terms of goods or services) provided by nature that are of fundamental importance to human well-being, health, livelihoods, and survival and include provisioning services, regulating services, cultural services, and supporting services

The first study on the concept of the ecosystem was done by Daily et al. (1997). According to the study, ecosystem services are “a wide range of conditions and processes through which natural ecosystems, and the species that are a part of them, help sustain and fulfil human life. They maintain biodiversity and the production of ecosystem goods, such as food, forage timber, biomass, fuel, natural fibre, and many pharmaceuticals, industrial products, and their precursors”.

Some common examples of ecosystem services are carbon sequestration and storage, air and water purification, flood mitigation, soil fertility, generation, renewal and preservation of soils, wastes decomposition, pollination, seeds dispersal, nutrients cycling, protection from the sun’s harmful ultraviolet rays, partial stabilization of climate, moderation of weather events, aesthetic beauty, etc.

The flow of ecosystem goods and services in a region is determined primarily by its spatial dimensions. It also depends on the extent, the type, layout, and the associated ecosystem which are supplying the resources. For instance, the value of water quality service offered by a waterbody can critically be affected by the amount of nutrients cycled, sediments retention, waste detoxification etc. It may also be dependent on the location and soil type.

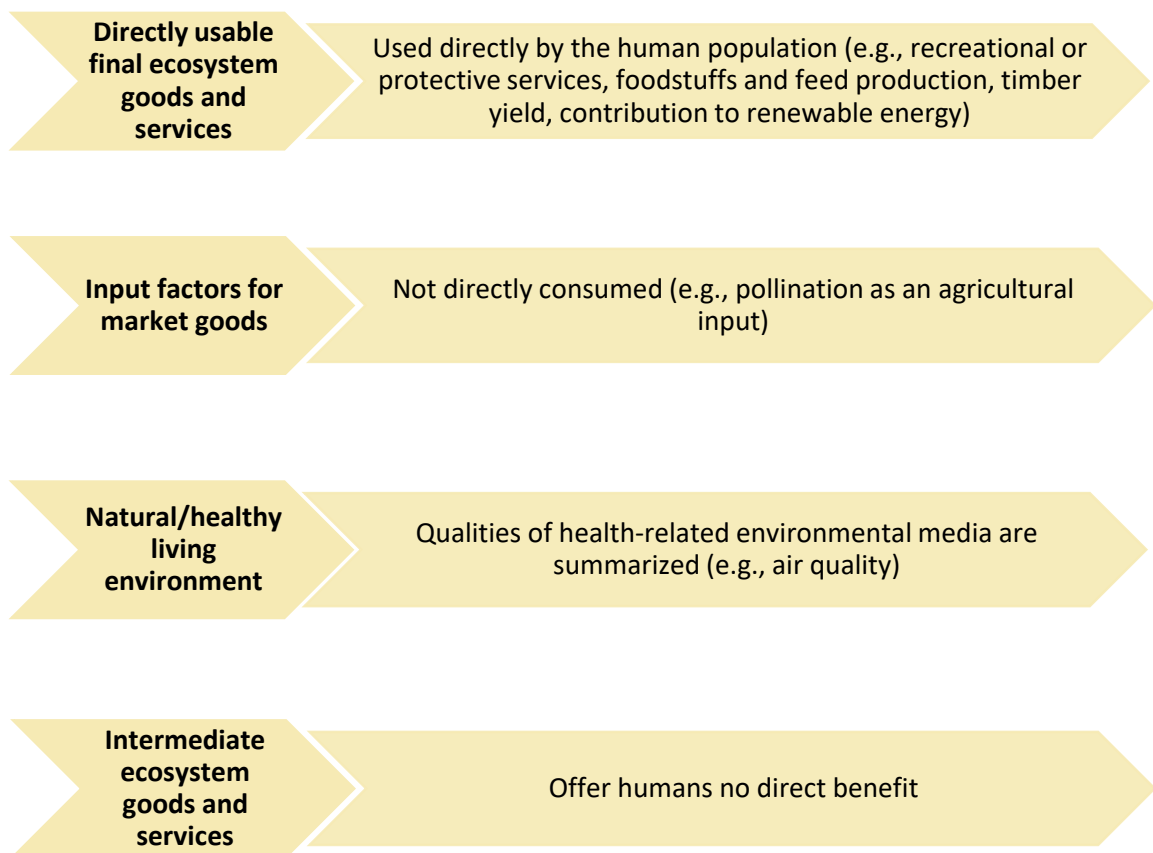
The Millennium Ecosystem Assessment (MEA) report of 2005, defines ecosystem services as the benefits people obtain from ecosystems. It categorizes ecosystem services under the following four categories.



There are few other studies where ecosystem services classification is based on the functional groups (de Groot et al., 2002, MA, 2005) such as habitat, production, regulation, carrier, and information services. The other classification (Norberg, 1999) is through organizational groupings. It includes services associated with certain species, that regulate some exogenous input, or that are related to the organization of biotic entities.

Another classification is through descriptive groupings, such as renewable non-renewable, resource goods, physical structure services, biotic services, biogeochemical services, information services, and social and cultural services (Moberg and Folke, 1999).

However, Boyd and Banzhaf, 2007 and MA, 2005 consider ecosystem services as only those goods and services that are directly enjoyed, consumed or used by humans as Final Ecosystem Goods and Services (FEGS). It identifies the following four types of ecosystem goods and services.



According to Staub et al. (2011) ecosystem services “concentrates on those aspects of ecosystems that have a recognizable connection to (human) welfare, and is used or valued in some form or other by the human population”.

3 Sediment Delivery Ratio (SDR)

3.1 Introduction

Sediment generation and transport is a natural ecosystem process. At landscape scales, erosion generates sediments and is mainly transported by water. The sediment is transported to and deposited in floodplains and the sea. It enriches the floodplains and coastal areas, and has led to the formation of deltaic regions. Natural vegetation cover is a vital element in this process, it slows down the process of erosion and traps substantial part of the sediment within the catchment. Without adequate natural vegetation, soil erosion and transport processes are much accelerated. These lead to poor soil quality, excessive siltation in river and streams, leading to increased flooding and shortening of lifespan of reservoirs due to siltation. An imbalance in sediment erosion and transport has far reaching consequences from local to regional scales. Thus, forests provide an important Ecosystem service by regulation of sediment dynamics.

3.2 Data acquisition

3.2.1 Land Use Land Cover (LULC)

The LULC raster was sourced from the European Space Agency (ESA) initiated - WorldCover project. The land cover product is at 10 m resolution for the year 2020 and is based on both Sentinel-1 and Sentinel-2 data, containing 11 land cover classes out of which 7 land cover classes were witnessed in our study area.

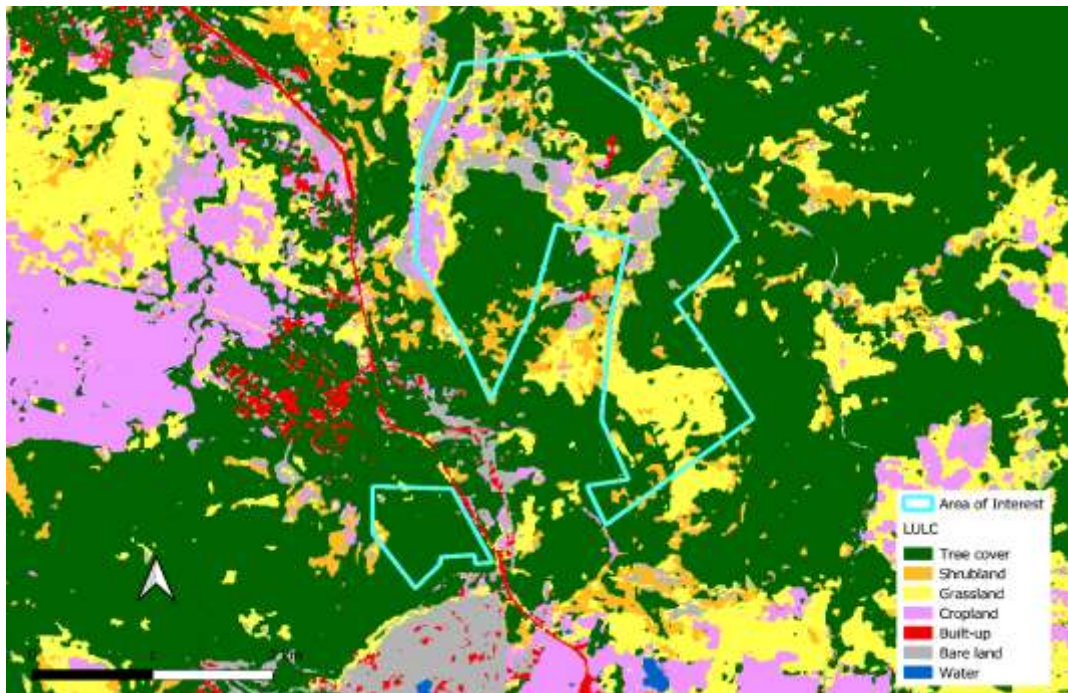


Figure ii: LULC of the study area

3.2.2 Watersheds

InVEST tool DelineateIT is used to delineate watersheds. Watershed creation tools provided with GIS software, as well as some hydrology models, recommends to use the DEM that is being used in the InVEST modeling, such that the watershed boundary corresponds correctly to the topography.

3.2.3 Digital Elevation Model

A digital elevation model (DEM) is a raster map of elevation, where each pixel's value is its elevation above sea level (usually in meters). The Bhuvan website hosted by the National remote sensing center was used for the same. The satellite referred is Cartosat-1: CartoDEM Version-3 R.

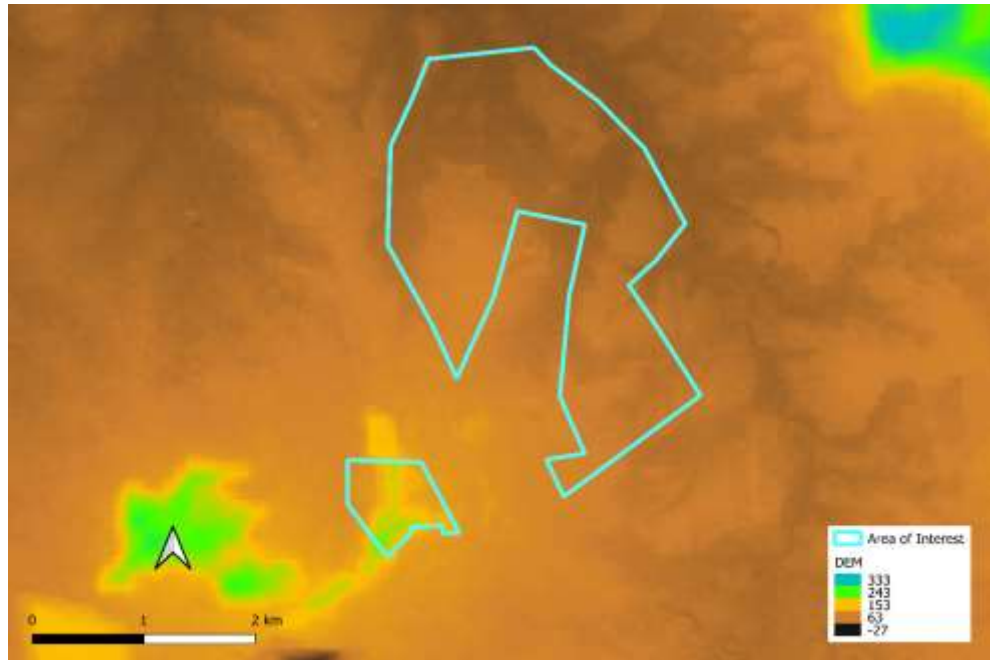


Figure iii: DEM of the study area

3.2.4 Erosivity

Rainfall Erosivity Index (R) is obtained from the country specific equations derived based on extensive literature search. The raster file of rainfall erosivity is obtained by using the formula: $R = 81.5 + 0.38P$, where R is the rainfall erosivity and P is the mean annual precipitation (Babu, B. L., & Kumar, 2004; Jain & Das, 2010; Benavidez, Rubianca, Jackson, & Max, 2018).

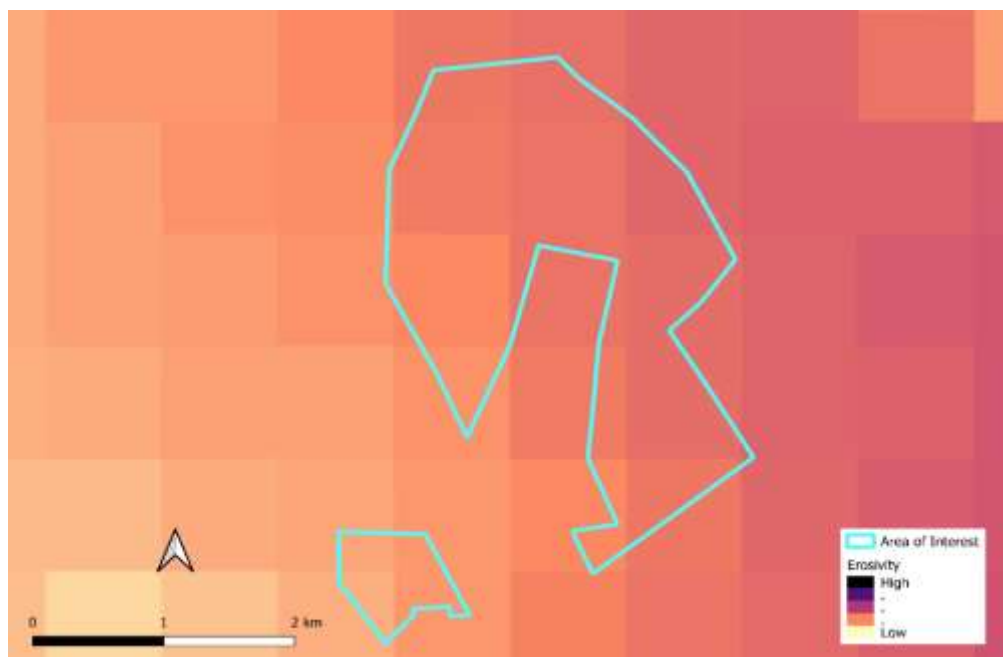
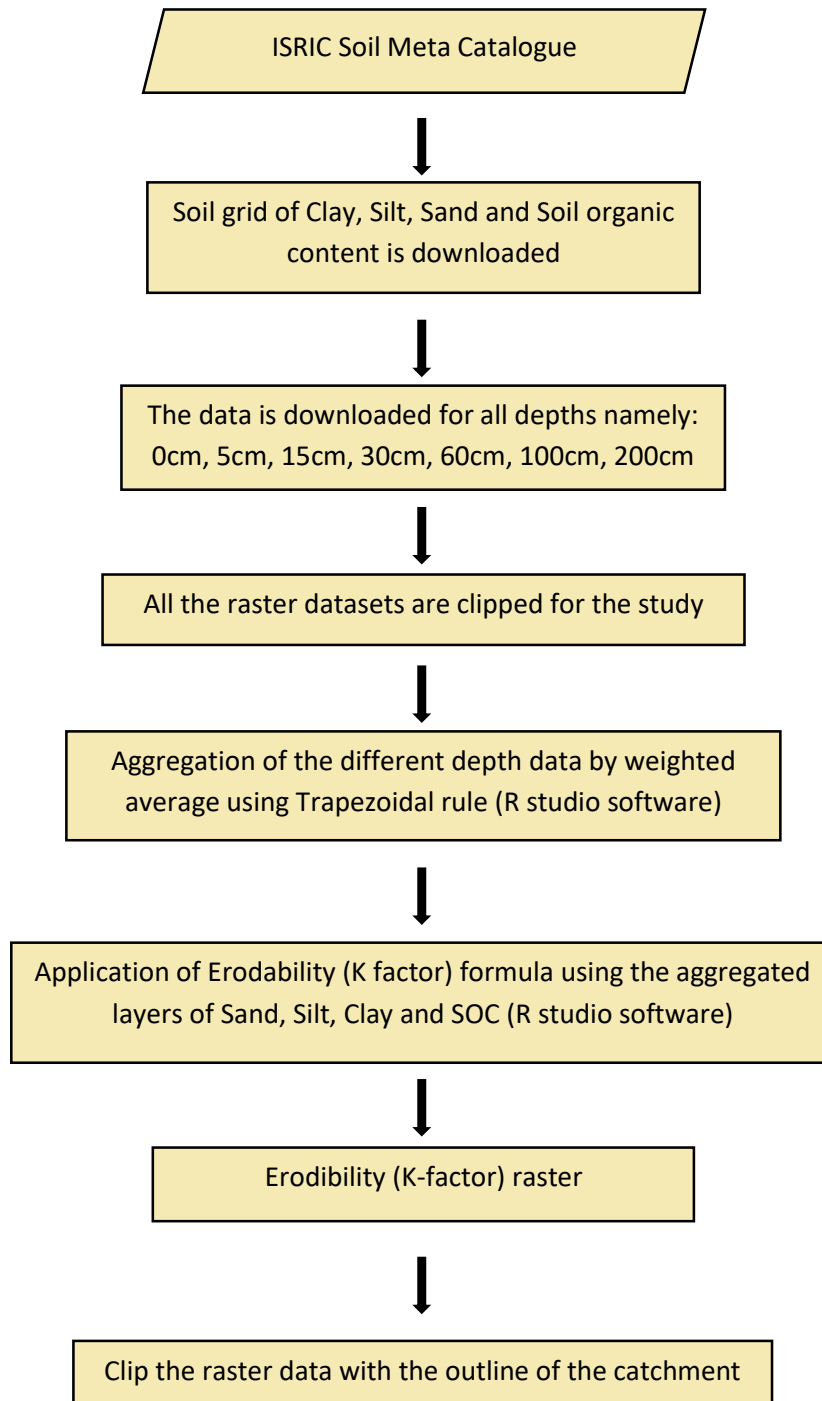


Figure iv: Erosivity map of the study area

3.2.5 Soil Erodibility (K Factor)

Soil erodibility factor gives the susceptibility of soil particles to detach and transport by rain fall or runoff. The raster data gives the erodibility factor for each pixel value. The ISRIC Soil metadata has been used to obtain layers of percentage sand, percentage clay, percentage silt and percentage soil organic carbon at various depths of soil. These raster layers are further processed as shown in the following flowchart by keeping (Tomislav, et al., 2017) and (Yang, et al., 2018) as reference.

Steps followed:



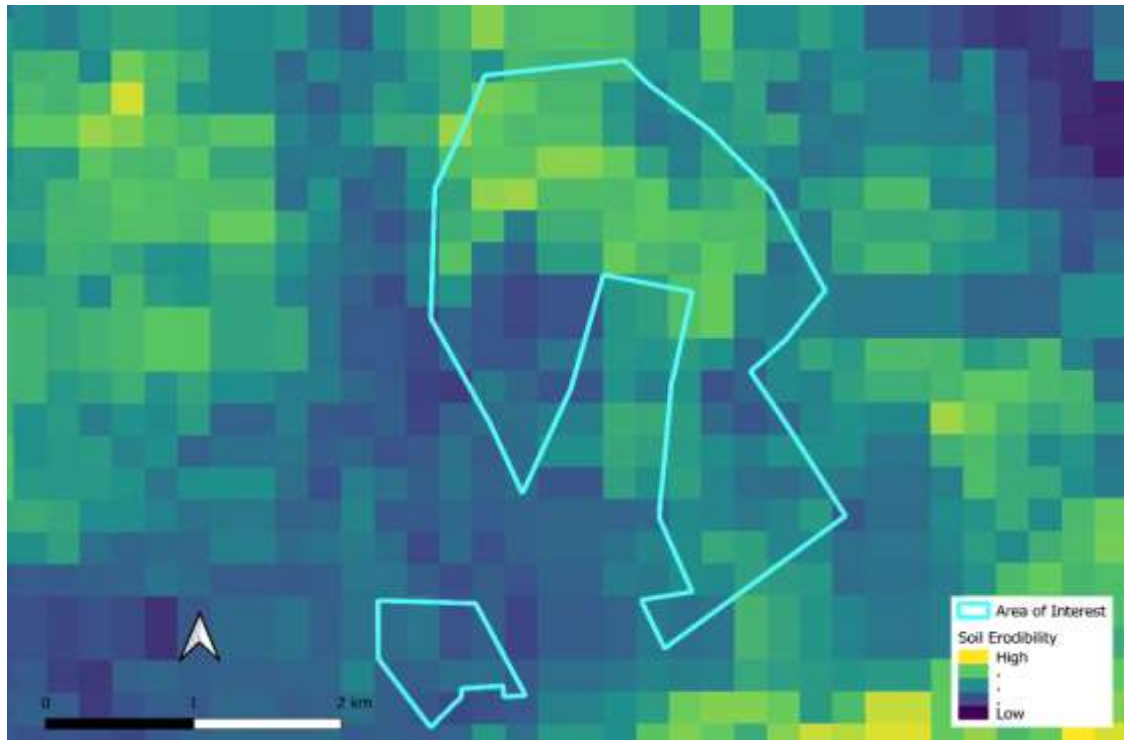


Figure v: Erodibility map of the study area

3.2.6 Biophysical Table

Table 1: Biophysical table used for SDR modelling

Description	lucode	usle_c	usle_p
Cropland	40	0.9	1
Water	80	0	1
Bare land	60	0.9	1
Shrubland	20	0.01	1
Grassland	30	0.01	1
Built-up	50	1	1
Tree cover	10	0.001	1

usle_c: It is the cover management factor. It accounts for the specified crop management relative to tilled continuous fallow.

usle_p: It is the support practice factor. It accounts for the effects of contour ploughing, strip-cropping or terracing relative to straight-row farming up and down the slope.

Both of these values are obtained by referring to the UN-FAO documentation provided in the appendix of the InVEST – SDR documentation (FAO, 2006).

3.2.7 Other Model Parameters

3.2.7.1 Threshold Flow Accumulation

A threshold flow accumulation of value of 5000 is taken by referring to the InVEST, Sediment Delivery Ratio (SDR) specific documentation.

3.2.7.2 Borselli K Parameter

A default value of 2 was used by referring to the InVEST, Sediment Delivery Ratio (SDR) specific documentation.

3.2.7.3 Borselli IC0 Parameter

A default value of 0.5 was used by referring to the InVEST, Sediment Delivery Ratio (SDR) specific documentation.

3.2.7.4 Maximum SDR Value

A default value of 0.8 was used by referring to the InVEST, Sediment Delivery Ratio (SDR) specific documentation.

3.2.7.5 Maximum L Value

A default value of 122 was used by referring to the InVEST, Sediment Delivery Ratio (SDR) specific documentation.

3.3 Method

The Land use pattern of the current scenario of the study area was used to run the SDR model in InVEST. Another land use raster was created with the change in the land use type of the study area from forest. Shrub-land and grassland to bare land as the area would be converted into an open cast. This was new land use raster was used as an input file in the SDR model with other parameters remaining same. The difference in the results of both the models was obtained to know the sediment deposition in the streams or lower elevation area due to the loss of vegetation in the study area.

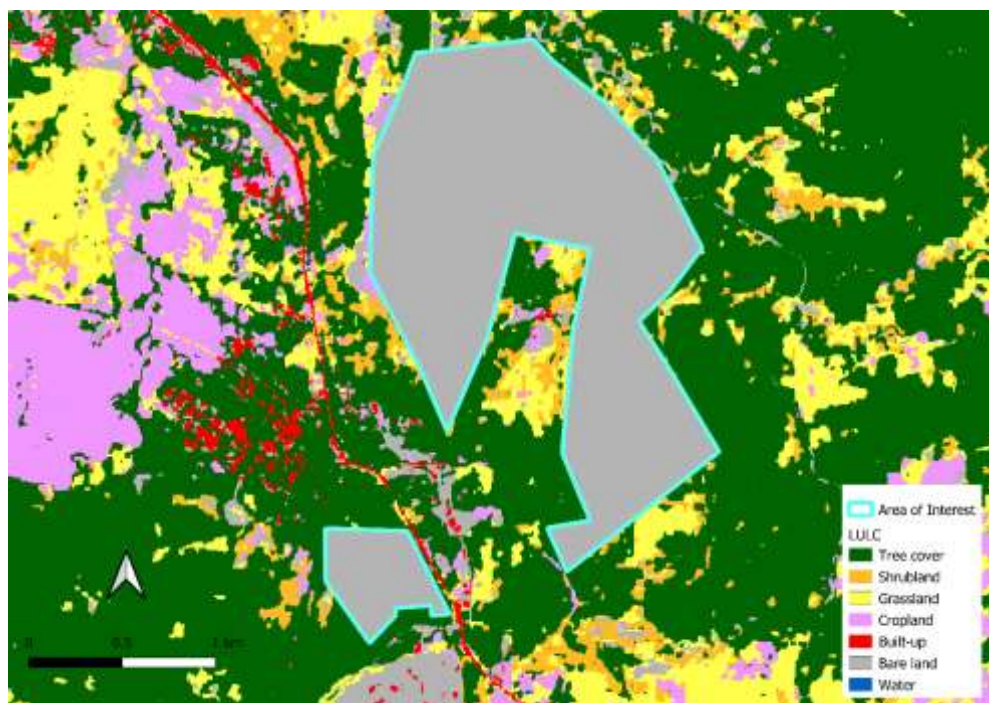


Figure vi: Modified LULC of the study area

3.4 Results

Table 2: Results of SDR

Description	Result
Total Sediment deposited per year	9203 tonnes
Soil erosion per hectare	13.94 tonnes

4 Ecosystem Services from Forests

In this study, the Millennium Ecosystem Assessment (MEA) framework has been used to assess the economic valuation of the various ecosystem services. These ecosystem services are valued using direct methods or the benefits-transfer method. The following section provides information regarding the ecosystem services, the methodology used for physical quantification and economic valuation, and the results. Overall, 16 services are being evaluated. Out of these, two services i.e., water provisioning, and Sediment retention are evaluated for the study area, using InVEST modeling software. For the remaining ecosystem services, suitable methods are used for evaluation.

4.1 Provisioning Services

Provisioning services are manifested in the goods people obtain from ecosystems such as food and fiber, fuel in the form of wood or non-woody biomass, and water from rivers, lakes, and aquifers. The above-mentioned list of provisioning services has been already taken into account in the calculation of the NPV in the original benefit-cost ratio.

4.2 Regulating Services

Regulating services provided by ecosystems are diverse and include the impacts of pollination and pest and disease regulation on the provision of ecosystem goods such as food, fuel, and fiber. Currently, the economic values of nine services from this category (gene-pool, gas regulation, pollination, biological control, water purification, water provisioning, sediment retention, carbon storage and, carbon sequestration) have been evaluated. Information is provided in the tables listed below. The values are estimates and further information would yield an appropriate estimate for accounting purposes.

4.2.1 *Genepool protection*

The economic value of biodiversity in this study is envisioned in terms of the value of information and insurance.

- a. **Biological Information Value:** Biodiversity, as we know, is a result of the continuous evolutionary process that has taken place over thousands of years. Thus, a stock of information is represented by various life forms. All the evolutionary process has taken place in various environmental contexts, thus enabling organisms to become more resilient to natural changes. Unique and endemic species throughout the various ecosystems have evolved various forms of defense mechanisms such as chemical compounds for survival. These compounds have an immense potential to cure human illnesses. For example, leukemia is today treated with compounds derived from the rosy periwinkle of Madagascar, and the bark of the Pacific yew tree is the source of treatment for ovarian cancer. Such chemicals are of potential value to the pharmaceutical industry. Additionally, wild cultivars and wild crop varieties are vital genetic repositories that play an essential role to ensure food security.
- b. **Insurance Value:** Another way of product's approach to the value of biodiversity is the economic value of products derived from the value of the information contained in it.

Therefore, biodiversity is a precondition for all the other values derived from the forests. On this basis, the economic value of biodiversity as insurance is the insurance premium the consumers have to pay for the preservation of these services. The diversity contains millions of years of information and this brings resilience to the environmental change where it protects other functions of forests. Therefore, the economic value of a patch of forest must be equal to its informational value plus its insurance value.

Due to the lack of site-specific data for estimating the value of gene-pool protection, the benefit transfer method has been used. The economic value derived from a meta-analysis study by Costanza et al. (2014) was used for calculation purposes. All analyses have made the assumption that the conversion rate from US Dollars to Indian Rupees is Rs.81.78. Table 3 provides the summary of the methodology used for estimating the flow value of gene pool protection services.

Table 3: Summary of methodology used for flow value for gene pool protection

Ecosystem Service Method	Gene pool Protection	
	Benefits transfer	
	Data used	Data sources
Benefits transfer value	Rs. 111079.35/ha/year	Costanza et al. (2014)
Total physical area	Total forest area – 650 ha	
Economic value	Rs. 7.22 crore / year	

4.2.2 Biological control

Forests and other natural ecosystems are known to control the populations of disease-inflicting organisms (Viruses, bacteria, parasites, etc.), their hosts, and intermediate vectors (rodents, insects, etc.). Deforestation reduces the diversity of the interactions between organisms and this results in the unbalanced population distribution of species, thereby, increasing the possibility of the spread of disease-infected organisms. Due to inadequate site-specific studies and data for estimating the economic value of biological control, the method of benefits transfer has been used.

Based on unit area values of biological control (@ Rs. 715/ha/year) for different types of ecosystems from a recent meta-analysis study (Costanza et al., 2014), the economic value of the ecosystem service has been derived at the division level. Table 4 provides the summary of the methodology used for estimating the flow value of biological control services.

Table 4: Summary of the methodology used for economic value of biological control

Ecosystem Service Method	Biological Control	
	Benefits transfer	
	Data used	Data sources
Benefits transfer value	Rs. 715/ha/year	Costanza et al. (2014)
Total physical area	Total forest area – 650 (ha)	
Economic value	Rs. 0.05 crore / year	

4.2.3 Pollination

Pollination is fundamental for agricultural production, and plant reproduction. It also maintains terrestrial biodiversity. Most of the world's major crops are consumed by humans and the majority of the wild flowering plants depend on animal pollination. Forests with their diversity of species depend on pollination and also provide a valuable service function for the surrounding areas. Due to a lack of data for pollination values in the state, the benefit transfer method has been used to estimate the economic value.

Based on unit area values of pollination for different types of ecosystems from a recent meta-analysis study (Costanza et al., 2014), the economic value of the ecosystem service has been derived (@ Rs. 1950/ha/year) as shown in table 5.

Table 5: Summary of the methodology used for flow value of pollination

Ecosystem Service Method	Pollination	
	Benefits transfer	
	Data used	Data sources
Benefits transfer value	Rs.1950/ha/year for tropical forests	Costanza et al. (2014)
Total physical area	Total forest cover – 650(ha)	
Economic value	Rs. 0.13 crore / year	

4.2.4 Gas regulation

Forests are also known to regulate the local climate and improve air quality. Trees provide shade but they have a significant influence on rainfall and water availability. Forests also remove toxic air pollutants from the atmosphere. Site-specific studies related to the economic value of air quality improvement by forests are not available; hence, the benefit transfer method has been used.

Based on the unit area values of gas regulation for different types of ecosystems from a recent meta-analysis study (Costanza et al., 2014), the economic value of the ecosystem service has been derived (@ Rs. 780/ha/year). Table 6 provides the summary of the methodology used for estimating the flow value of gas regulation services.

Table 6: Summary of the methodology used for economic value of gas regulation services in the study area

Ecosystem Service Method	Gas Regulation	
	Benefits transfer	
	Data used	Data sources
Benefits transfer value	Rs.780/ha/year for tropical forests	Costanza et al. (2014)
Total physical area	Total forest cover 650 (ha)	
Economic value	Rs. 0.05 crore / year	

4.2.5 Carbon storage (Stock value)

1. As per the ASFR-2021 Report,

- The carbon stock value of the entire Indian forests is 7204 Million tonnes and the total area of forests present in the country is 7,13,789 sq.km. Hence carbon stock per hectare can be calculated by dividing the total carbon stock by total area ($7204 \times 1000000 / 713789 \times 100$). This gives a carbon stock of 101 tonnes per hectare.
- The value of carbon Stock per hectare will be = $101 * 86 * 81.78 = \text{Rs. } 7,10,341 / \text{Ha}$
- The value of Carbon Stock for 650 Ha will be = $7,10,341 * 650 = 46.17 \text{ Crores.}$

2. As per the Indian State Of Forest Report -2017

- As per the report (table 8.6) the carbon stock for the Tropical Dry deciduous Forests per hectare is 95.54 tonnes. Accordingly, the Carbon stock for 650 Ha. will be = $650 * 95.54 = 62,101 \text{ tonnes.}$
- The value of carbon Stock for 650 Ha in rupees will be = $62,101 * 86 * 81.78 = 43.67 \text{ crores.}$

The carbon stock value of **43.67 crores** is chosen as this value of carbon stock resembles more with the forests present in the study area.

4.2.6 Water provisioning

Forests play an essential role in extending water supply to the landscape. Forests have a significantly dominant effect on the hydrological processes at the watershed level. The forest canopy cover intercepts precipitation and reduce their intensity of impact on the forest floor. Part of the water evaporates back into the atmosphere, part contributes to surface run-off and part of the precipitation is absorbed by the roots and later enters the atmosphere through transpiration. Once the soil moisture reaches its field or saturation capacity, the remaining water recharges the groundwater table. Table 7 provides the summary of the methodology used for estimating the flow value of water provisioning services.

Table 7: Economic value and methods used for the estimation of water provisioning services

Ecosystem Service Method	Water provisioning	
	Benefits transfer	
	Data used	Data sources
Physical estimation	Average water recharge value of forest – $73 \text{ m}^3/\text{ha}/\text{year}$	GIST Monograph 7 (2006)
Per Unit Value	Rs. $18.43 / \text{m}^3$ is considered as the economic value of differential water recharge happening because of forests	World Bank (2013)
Total physical volume	$47450 \text{ m}^3/\text{year}$	
Economic value	Rs.0.09 crores / year	

4.2.7 Sediment regulation

Forests with varying levels of canopy cover and soil properties play a vital role in holding the soil physical structure and thus ensuring its stabilization. In this study, the economic value has been estimated using the avoided offsite costs from sedimentation. Information from

secondary literature has been used to estimate the contribution of forests in preventing soil erosion compared to managed ecosystems. Sediment retention values provided by running the Sediment Delivery ratio models of InVEST was used for the physical quantification; the study recorded that 13.94 tons of sediment retention capacity is provided by each hectare of forests in the study area each year. Table 8 provides the summary of the methodology used for estimating the flow value of sediment regulation.

Table 8: Economic value and methodology for sediment regulation

Ecosystem Service Method	Sediment Regulation	
	InVEST modelling	
	Data used	Data sources
	Total sediment lost in the watershed – 9203 tonnes	InVEST Result
Cost of Substitute	Dredging cost @ Rs 285 per 1.2 c.m.	Dredging Corporation of India
Economic value	Rs. 0.25 crores/year	

4.2.8 Water purification

Forests not only regulate the flow of water but also help in maintaining its quality. In evaluating the water purification service of the forests, the number of beneficiaries dependent around the study area has been assumed. Further, the per capita per day domestic water requirement is calculated to derive total domestic water requirement. This quantity is then multiplied with the average cost of treating water to obtain the cost of water purification.

Table 9: Economic value and methods used for the estimation of water purification services

Ecosystem Service Method	Water purification	
	Benefits transfer	
	Data used	Data sources
Physical estimation	Average number of population surrounding the forest area - 2000	
Per capita per day consumption	200 liters per capita per day	Assumption
Nominal cost of water treatment	Rs.10 per m ³	Nominal price
Economic value	Rs.0.15 crores / year	

4.2.9 Climate regulation

Climate regulation refers to the maintenance of a favorable climate, both at local and global scales, which has important implications for health, crop productivity, and other human activities. Forest ecosystems help in climate regulation by trapping moisture and cooling the earth's surface, thus regulating rainfall and temperature.

Due to the lack of site-specific studies for estimating the economic value of climate regulation, the method of benefits transfer has been used. Based on the unit area value of climate regulation for different types of ecosystems from a meta-analysis study (Costanza et al., 2014), the economic value of this ecosystem service has been derived (@134904Rs. /ha/year). Table

10 provides the summary of the methodology used for estimating the flow value of climate regulation services.

Table 10: Summary and methodology used for the flow value of climate regulation services

Ecosystem Service Method	Climate regulation	
	Benefits transfer	
	Data used	Data sources
Benefits transfer value	Rs. 134904 /ha/year for tropical forests	Costanza et al. (2014)
Total physical area	Total forest area - 650 Ha	
Economic value	Rs. 8.77 crore / year	

4.2.10 Waste assimilation

Due to the lack of site-specific studies for estimating the economic value of climate regulation, the method of benefits transfer has been used. Using the estimate of economic value of waste assimilation for tropical forest (Rs. 7920 /ha/year) from a global meta-analysis study Costanza et al., 2014), the economic value of this ecosystem service has been derived (4389.97 crores/year). Table 11 provides the summary of the methodology used for estimating the flow value of waste assimilation services.

Table 11: Summary and methodology used for the flow value of waste assimilation services

Ecosystem Service Method	Waste assimilation	
	Benefits transfer	
	Data used	Data sources
Benefits transfer value	Rs. 7920 /ha/year for tropical forests	Costanza et al. (2014)
Total physical area	Total forest area - 650 (ha)	
Economic value	Rs. 0.51 crore/ year	

4.3 Supporting Services

Supporting services provide the basic infrastructure of life such as providing mechanisms to harness the sun's energy, forming and maintaining the fertility of the soils, and cycling of water and nutrients in the ecosystems. Supporting services lay the basic foundation for the production of all other ecosystem services and are strongly interrelated to the physical, chemical and biological interactions.

5.3.1 Habitat for species

The forests provide habitats for some of the major species in India such as the tiger, and sloth bear, caracal, etc. In fact, forests are also genetic repositories for living organisms and, hence contribute to species preservation in case of species loss outside forest areas.

Due to the lack of site-specific studies for estimating the economic value of habitat provisioning, the method of benefits transfer has been used. Based on the unit area value of habitat/refugia for different types of ecosystems from a meta-analysis study, the economic value of this ecosystem service has been derived (@ Rs. 2535/ha/year). Table 12 provides the summary of the methodology used for estimating the flow value of habitat for species.

Table 12: Summary for flow value of habitat for species

Ecosystem Service Method	Habitat for species	
	Benefits transfer	
	Data used	Data sources
Benefits transfer value	Rs. 2535/ha/year for tropical forests	Costanza et al. (2014)
Total physical area	Total forest area - 650 (ha)	
Economic value	Rs. 0.16 crores / year	

5.3.2 Nutrient cycling

Forests with complex ecological structure avoid erosion of soil through runoff in streams. An indirect benefit of avoided soil erosion is the retention of nutrients and regulated discharge during rainfall. According to the literature survey, nutrient cycling is estimated using the replacement cost of fertilizers and thus, a similar approach is used here in the valuation.

Physical quantification of nutrient cycling has been estimated using estimates of **soil erosion avoided** and the **concentration of NPK** (nitrogen, phosphorus, potassium) is derived from the GIST study conducted in 2006. According to the study, each kg of avoided erosion contains 2.32 g of nitrogen, 0.044 g of phosphorus, and 8.25 g of potassium. This physical estimate is then used along with the price of NPK fertilizers in India to obtain the economic value of nutrient cycling from forest areas as shown. Table 13 provides the summary of the methodology used for estimating the flow value of nutrient cycling/retention.

Table 13: Summary and methodology used for the flow value of nutrient cycling services

Ecosystem Service Method	Nutrient cycling (InVEST)	
	Substitution cost and Benefits transfer method	
	Data used	Data sources
	Total sediment lost in the watershed – 9203 tonnes	InVEST Result
	Each kg of avoided erosion contains 2.32 g of nitrogen, 0.044 g of phosphorus and 8.25 g of potassium	GIST Monograph 7 (2006)
Cost of substitute	Price of NPK – Rs.178	Indian Fertilizer Scenario 2017
Economic value	Rs. 0.16 crores /year	

5 Summary of Ecosystem Services Valuation

The economic valuation process has revealed that the forests of the study area provide ecosystem services worth about Rs. 175 crores as stock, and an annual flow of about Rs. 10.5 crores. Table: 17 and Table: 18 shows the summary of flow values of 11 ecosystem services that are mapped. **The valuation of genepool services of Rs 7.33 crores per year has not been taken into account in the calculation of the ecosystem services in Table 14, because the surrounding forest contains the same species as the study area, and the future benefits of this genepool are available for human well-being even if the study area is converted to open cast mining.**

Table 14: Summary of ecosystem flow values per annum

Ecosystem Services	Economic Value (crores)
Water Provisioning	0.09
Water Purification	0.15
Sediment Regulation	0.25
Nutrient Cycling	0.16
Biological Control	0.05
Pollination	0.13
Habitat for Species	0.16
Gas Regulation	0.05
Climate Regulation	8.77
Waste Assimilation	0.51
Total (Flows)	10.32

Table 15: Summary of ecosystem stock values

Ecosystem Services	Economic Value (crores)
Carbon Stock	43.80

6 Conclusion

The economic value of loss of eco-system services due to diversion of forests shall be the net present value (NPV) of the forest land being diverted as prescribed by the Ministry of Environment, Forests and Climate Change (MoEF&CC). In this study, in addition to the ecosystem services accounted in the calculation of NPV, certain additional services such as water provisioning, water purification, sediment regulation, nutrient cycling, biological control, pollination, habitat for species, gas regulation, climate regulation and waste assimilation services are also assessed and their respective flow values have been included in the calculation of a **revised NPV**. This is done by assuming a flow period of 25 years with a discount rate of 10% per year. A stock value of carbon from the existing forests has also been assessed and added to the cost of the project. Finally the **revised cost and benefit ratio** has been calculated which comes up to **1: 12.53**. The details of the cost benefit analysis is given in the table number 16, 17 and 18 of the annexures.

7 Appendix

7.1 Net Present Value (NPV) calculation of additional ecosystem services

In calculating the net present value (NPV), the stock value has been considered for only the 0th year. The flow values of ecosystem services are considered for the next twenty five years. Hence, a sum of 10.32 crore has been considered starting from 'year 1' with a discount rate of 10 % for a period of 25 years.

Table 16: Net Present Value calculation of flow values (in Rs crores)

Year	Cost	Present Value of Cost
0	43.8	43.80
1	10.32	9.38
2	10.32	8.53
3	10.32	7.75
4	10.32	7.05
5	10.32	6.41
6	10.32	5.83
7	10.32	5.30
8	10.32	4.81
9	10.32	4.38
10	10.32	3.98
11	10.32	3.62
12	10.32	3.29
13	10.32	2.99
14	10.32	2.72
15	10.32	2.47
16	10.32	2.25
17	10.32	2.04
18	10.32	1.86
19	10.32	1.69
20	10.32	1.53
21	10.32	1.39
22	10.32	1.27
23	10.32	1.15
24	10.32	1.05
25	10.32	0.95
	Total	137.35
		13734.51 (Rs. lakhs)

7.2 Estimation of Benefit – Cost ratio (with ecosystem services accounted as additional costs)

Table 17: Estimation of costs (in Rs. Lakhs)

I.	ESTIMATION OF COSTS				
S. No.	Parameters	Unit	Rate Per Unit/Basis	Quantity	Value
1	Ecosystem Services	Lakh/Ha	8.03	649.30	5213.89
2	Loss of Animal husbandry productivity		10% of NPV		521.39
3	Cost of Human Resettlement	Lakh/PDF	20	100	2000
4	Loss of Public Facilities	Cr./Km	4	5	2000
5	Possession Value of Forest Land Diverted		30% of NPV		1564.17
6	Cost of Suffering to Oustees		1.5 times of 2 years wage cost		362.7
7	Habitat Fragmentation Cost		50% of NPV		2606.95
8	Compensatory of Forestation	Lakh/Ha	6.5	1298.60	8440.92
	Total Cost (A)				22710.01
	Additional Costs				13734.51
	Revised Total Cost (C)				36444.51

Table 18: Estimation of benefits (in Rs Lakhs)

II.	ESTIMATION OF BENEFITS		
1	Increase in Productivity	As per detailed project report	6729.28
2	Benefit to Economy		334540.51
3	No of population benefited		
4	Economic benefits due to direct and indirect employment		114796.02
5	Economic benefits due to compensatory afforestation		422.05
	Total Benefits (B)		456487.86
	Benefit Cost Ratio (B/A)		20.10
	Revised Benefit Cost Ratio (B/C)(additional cost)		12.53

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**Report on the Biodiversity of area of Proposed
Venkatesh Khani Coal Mine**
of
The Singareni Collieries Company Ltd. (SCCL)
(A Government Company)
2022

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Summary

Initially the mining by underground method started in Kothagudem Area during 1937. In the early 70s, underground mines in the name of 8, 9, 10, 11 incline in an area of 408 Hectares were operational in the proposed study area, which were subsequently closed in 1992. From these underground mines, 5.56 million tons of coal have already been extracted. Subsequently, one opencast mine by the name of Goutham Khani (GKOC) started in the year 1993 in a total area of 902 Hectares and which has been closed during March 2022. This opencast was the conversion of the four underground mines, where the 74.29 million tons leftover of earlier underground operation. In total, 76.91 million tons (underground – 5.56 + OC – 71.35) of coal has been removed from this area.

An average of manpower spent in these underground mines was around 6000 to 7000 and in the GK Opencast was of 1611 in total. Besides that, many coal loaded lorries/ vehicles move from mines to different places on daily basis (300 to 400 lorries per day).

Since, last 50 years of mine operations in this area, already movement of vehicles, people, constructions have started and as such hardly any area left undisturbed. The impact of the mining on the flora and fauna was also observed to be minimal, and records were also found that the fauna has moved away from this area to the nearby adjacent forest areas, plantation areas developed by SCCL and forest department in the 10 Kms radius from the proposed area. SCCL and Forest Department has taken many individual initiatives and joint actions in protecting, enhancing, and sustaining the biodiversity and its habitats in the adjoining forest areas in the buffer areas of mines to the 10 Kms radius. Hence the impact is very less.

Also, a National Highway (NH 30) connecting Kothagudem to Vijayawada passes through the forest and mine area, connected with many small public roads which is used by people actively. So, this also shows that there is not any fresh intrusion to the biodiversity/ wildlife by this proposed mine.

In this quarried area, SCCL has now proposed to dump the overburden material going to be excavated from the proposed VKOC to save fresh land.

Background

As demand for energy increases, in absence of sufficient alternative energy source, Coal mining will remain an important part of global, national, and local economies in the foreseeable future. To meet the ever-increasing demand for Coal and to achieve the targets fixed by the Government of India from time to time, SCCL has embarked upon large-scale expansion of coal mining to increase coal production. Venkatesh Khani Coal Mine is one of the new Project identified in Ramavaram RF, Ramavaram Range of Kothagudem Forest Division.

At present there are two Underground mines viz., Venkatesh Khani No.7 Incline (384.40 Ha. R.F) and PVK No.5 Incline (789.78 Ha. R.F) for which forest permission was obtained for underground rights for 1174.18 Ha. vide MoEF, Government of India vide Lr.No.8-277/85-FC, dated 17.02.2009 with validity for 20 years i.e., till 16.02.2029.

S. No.	Purpose of RF diverted	Extent (in Ha.)	MoEF&CC Letter No.	Validity till
1.	Venkatesh Khani No.7 Inc.	384.40	Lr.No.8-277/85-FC, dated 17.02.2009	16.02.2029
2.	Padmavathi Khani(PVK) No.5	789.78	-Do-	-Do-
3.	Surface use for installation of Borewell in existing Padmavathi Khani No.5 Inc.	2.85*	Stage-I clearance granted by MoEF&CC vide letter No.8-277/1985 – FC (VOI), Dated: 22-06-2018.	Pending with the MoEF&CC, GoI/Forest dept., for issue of final approval.
	Total:	1174.18		*2.85 Ha. is the surface area of UG Mine of PVK-5 Incline.
4	Tella vagu (Stream) diversion to avoid seepage of water into UG Mine	11.96	MoEF&CC vide letter no. FCA/16.1/70/AP/MIN/07 dated.31.08.2005 Original course of stream was filled up with soil and planting done with local species as on today it is almost fully stocked. Further, there is no need to the re-divert/re-dig this stream. However, for the purpose of EC of total area of (1174.18+11.96) having mining lease. This is included in the total area of the Project.	

Similarly, permission under F (C) Act-1980, was also obtained for doing Opencast Mining on the name of Goutham Khani Opencast project (GKOCP), details of which are as follows:

S.No.	Purpose of RF diverted	Extent (in Ha.)	MoEF&CC Letter No.	Validity till
1.	1 st Renewal of GK OCP (Phase-I)	161.31	MoEF&CC Letter No.8-117/2002 – FC, Dated: 01-02-2010.	31.01.2030
2.	GK OCP (Phase-III)	154.96	MoEF&CC Letter No.8-62/2005 – FC, Dated: 09/15-07-2008.	14.07.2028
	Total:	316.27		

Similarly, an area of 124.965 Ha. was also diverted and it is under process with Forest department/ MoEF&CC, GoI, for renewal. Details of these diversions are as follows:

S.No.	Purpose of RF diverted	Extent (in Ha.)	MoEF&CC Letter No.
1.	1 st Renewal of GK OCP (Phase-II) (Extent increased as per DGPS Survey and Authentication by PCCF, Hyderabad).	124.065	MoEF&CC Letter No.8-17/98-FC, Dated: 08-02-1999 (for original diversion of 124.00 Ha.)
2.	Surface use for installation of Borewell Padmavathi Khani No.5 Inc.	0.90	1 st renewal of File No.8-277/1985FC(vol. I) Dated: 15-10-2019(Stage-I Letter).
	Total:	124.965	

In the present proposal, it is proposed to utilize parts of the existing forest area of the UG Mines of VK-7 incline and PVK-5 Incline by converting parts of underground mining into opencast **and continuing part UG Mining in 469.6336 Ha. This amalgamated mine will be called Venkatesh Khani coal mine.** The details of area proposed for utilization in the new project from underground mines is as follows:

S.No.	Name of the UG Mine	Extent of RF land proposed for conversion (in Ha.)	RF Area proposed for continuation under UG	Total
1.	Venkatesh Khani No.7 Inc.	237.8569	146.5431	384.40
2.	Padmavathi Khani(PVK) No.5	411.4445	378.3355	789.78
		649.3014	524.8786	1174.18

The balance extractable coal reserves of PVK No.5 & VK No.7 Inc is 190.11 million Tons of which about 64.18 million Tons is in Forest Land in Compartment Nos.2 (part), 3(part), 4(part), 5(part) & 11(part) of Ramavaram RF, and the balance of 125.93 million Tons is in non-Forest land. However, mining (OC) will simultaneously start both in forest and non-Forest land as per the approved Mining Plan.

The proposed fresh diversion of forest land for surface use from underground to opencast is 649.3014 Ha for which this permission is requested. However, this area will be mainly used for quarrying and excavated material will be taken into the left-over quarry as well over burden dumps of the GKOCP for which already permission is available and at appropriate time (before two years after expiry of permission) proposal will be submitted

for continuation of mining activities (dumping of excavated material of proposed Venkatesh Khani Coal Mine.

The total project area of **Venkatesh Khani Coal Mine** is 2403.17 Ha. This area is covered in 2 existing Mining Leases granted under MM (D&R) Act, 1957. The details of Mining Leases as per MMDR Act 1957 are as follows:

Fig in Ha.

Name of Mining Lease	Lease Area	NFL	FL	
			Surface rights	UG rights
Kothagudem Mining Lease (2 nd Renewal)	5158.00	3692.00	291.82	1174.18
GK OC Mining lease(1 st renewal)	261.31	0.00	261.31	0.00

The present proposed area is falling in Compartment Nos.2 (part), 3(part), 4(part), 5(part) & 11(part) of RF in Ramavaram R.F. of Kothagudem Division. The excavated material generated from the proposed OC mine will be transported through non-forest land for dumping into existing old mine of Goutham Khani Opencast. In the process the National Highway-30, passing through the non-forest land to the extent of 3.20 Kms will be diverted as per norms of the NHAI after obtaining suitable no objection certificate. Further, most of the forest area proposed for diversion either falls in to open forest, scrub forest or having grasses and degraded, wherever, better density is there it is because of plantations raised by the SCCL over the surface of the ongoing UG Mines.

Venkatesh Khani Coal Mine is planned to produce 6.3 (OC 5.3 + UG 1.0) million Tons of coal per annum (peak production) with a net capital out lay off about Rs.480.00 Crores and has a life of 40 years including pre-mining and post mining activities. The Mining plan including Mine closure plan has been approved by Ministry of Coal, Govt. of India vide Lr. No. 38011/12/2017-PCA, dated 27.01.2020. Further, the Nation will benefit by achieving increased coal production by exploiting coal reserves of the project and gets benefited financially by way of Royalty, excise Duty, Sales tax, and electricity supply continuously. Further, this project will also contribute benefit to the society by way of increased direct and indirect employment resources resultant improvement in standard of living and rise in per capital income of the population of surrounding villages of this area.

Generally, the activities of a mining could potentially pose some threats to biodiversity. A mining company must have a better understanding to appreciate the value of biodiversity in its long-term operations under its sustainable mining practice. It should consider all environmental impacts.

Habitat clearing during mining is generally unavoidable. However, impacts on fauna, including rare or threatened species, can be reduced through careful planning. Progressive clearing allows time for the animals to move into adjoining unmined/forest habitats. Despite the significant potential for negative impacts on biodiversity from mining operations, there are many opportunities for a mining company to enhance biodiversity conservation within their areas of operations. Being proactive in the assessment, monitoring, and management of biodiversity is important not only for new mine operations but also for those that have been operating for many years.

SCCL has been continuously adopting new and scientific approaches to managing biodiversity/wildlife as part of their commitments to establishing and maintaining the ecological balance. Prior to any mine expansion/operation in SCCL mines, the company reviews the biodiversity values and ensure that steps are taken to restore biodiversity wherever possible in scientific and sustainable manner. Removal of vegetation obviously has an immediate impact on local biodiversity, while ground disturbance may force biodiversity survival in rehabilitated areas.

Need of a baseline study:

A scientific intervention to assess the species diversity of an area which is selected for mining is necessary to understand the ecology, species composition and for enhancing the effectiveness of land management before and after mining.

Biodiversity is characteristically defined on three levels: genetic diversity, species diversity and ecosystem diversity. Biologists are aware of the importance of understanding diversity, at best with respect to the increasing loss of species due to the growing influence of human activities.

The term biodiversity describes the total number, variety, and variability of living organisms as well as the diversity of the ecosystem. Even though, there have been many different interpretations of diversity, the concept of biodiversity is the integration of biological variability across all scales, from genetic level, through species and ecosystems, to the landscapes that they form, or are part of, and the ecological processes that support them. The **world's biodiversity includes all living organisms (animals, plants, fungi, and microbial groups inclusive of genetic diversity and ecosystem/landscape diversity) in their interactive state contributing to a multitude of services of relevance to sustain the ecological integrity for the benefit of the humankind. It defines biodiversity as the variability among living organisms from all sources including, inter alia (among other things), terrestrial and aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems".** However, since the biodiversity of any ecosystem is far too complex to be comprehensively quantified, suitable indicators or surrogates of biodiversity are needed.

Conceptually, species richness appears as the most intuitive and straightforward parameter to measure biodiversity. In addition, measures of biodiversity have been developed; the Shannon index (H'), and Simpson index (D) was considered measures used to compare diversity among communities. In general, most studies have been carried out on specific selected taxa only. Scientific biodiversity interventions will reveal data on availability of endemic/range-restricted species, whereby policies could be formulated for their future preservation. Such knowledge of the presence/absence of important species also facilitates potential conservation of critical microhabitats in and around the operational area.

Hence, as per the standard ToR condition “A detailed biodiversity assessment study of the proposed area” (core zone and buffer zone, 10 Kms radius of the periphery of the mine lease) has been carried out. Details of flora and fauna have been documented and furnished here in this report. This report carries information related to wildlife populations, habitat, and information gaps (baseline data) of the proposed mine areas and its adjoining forests areas.

Aim and Objectives

Aim:

There is an urgent need for interpreting this inventory before initiating mine operations and disseminating this information for sustainable management of this un-explored habitat and for encouraging further research and conservation in the adjoining forest areas, which will be the new home-range to the species getting disturbed/moving from this habitat.

Objectives:

For sustainable and eco-friendly mining project development, biological environment is studied. The objectives of the study are:

1. To register and validate existing information on biodiversity of the proposed area
2. To undertake field studies to study the impact of mines and record selected floral and faunal species including prominent invertebrates & soil surface arthropods
3. To recommend mitigation plans for species and habitat concern.
4. To assess any adverse impact on the local fauna because of the proposed mine.
5. Indicate the impacts and suggest suitable mitigation measures against the adverse impacts if any,

Study Area

State	: Telangana
District	: Bhadradi – Kothagudem
Forest Division	: Kothagudem
Forest Range	: Ramavaram
Forest Section (s)	: Ramavaram & Penagadapa
Forest Beat (s)	: Ramavaram, Penuballi and Gareebpeta (Ramavaram Section) Musalivarre West (Penagadapa Section)
Total study area	: 649.3014 Ha (Part -A = 334.7372 Ha + Part -B = 258.6898 Ha + Part -C = 55.8744 Ha)
Forest Type:	Tropical Dry Deciduous Forest – Mainly Coppice growth
Habitat Type	: Mixed-dry-deciduous forest type with wide variety of microhabitats, ranging from open grasslands, water bodies and hillocks, plantations, and woodlands to scrub lands.

It is proposed to open a new coal mining project under the name of Venkatesh Khani Coal Mine (VK Coal Mine) by amalgamating the three mines (**Gautham Khani OC**, **Venkatesh Khani -7 Incline** and **Padmavathi Khani-5 Incline**) with 6.3 (OC - 5.3& UG - 1.0) MTPA capacity in mine lease area of 2403.17 ha (1568.22 ha Forest Land and 834.95 ha Non-Forest Land) located in Venkatesh Khani Village, Kothagudem town, District Bhadradi Kothagudem (Telangana State).

Physiographic Features of the study area:

To assess impacts of any set of activities, the environmental factors both within the core zone and buffer zone are to be analyzed. The core zone in this case covers project area while the buffer area covers the 10 Kms area around the core area.

Core zone: VK Coal Mine project area is of flat topography, Bolligutta hill stands out as a prominent landmark of this area along the northern boundary. The general topographic elevation of the project area varies from 160m above MSL to 100m above MSL. The south part of the project is covered by the existing GKOC project area.

Buffer zone: The buffer area is a plain terrain with relief of 160m in the south and 80m in the north and sloping towards north and northeast. A few hillocks located are Kanigiri gutta (432m) & an unnamed hillock (360m) in the northeast, Balusu gutta (328m) in the southeast, and Bolli gutta (340m) at the periphery of the project are existing in the buffer area.

Drainage:

Buffer zone: The buffer zone area drainage is drained by Murredu river. Edula vagu flowing in the western half and joins to Murredu river near Gollagudem village in the northern part of the buffer area. Tellavagu flows in the eastern part and joins Edulavagu near Penuballi village. The drainage of the area is dentritic to parallel type with a density of about 1.80 Kms/ sq.Kms. Singabhupalam Cheruvu a major irrigation tank is in the western part about 7 Kms away from the proposed VK Coal Mine project.

Core zone: There is no effective drainage developed in this area, due to sandy soil cover. Tellavagu, an ephemeral stream Tellavagu which is a tributary of Edula vagu is flowing in the northern part of the project area. Drainage is moderately developed, and a few ephemeral streams are flowing and join the Tellavagu. The drainage density of the block area is about 1.65 Kms/ sq.Kms.

Fig. 1. Google map showing VK Coal Mine along with study area



Fig. 2. Google map showing Part - A of the study area with Nature Trails (Padmavathi Khani Mine)

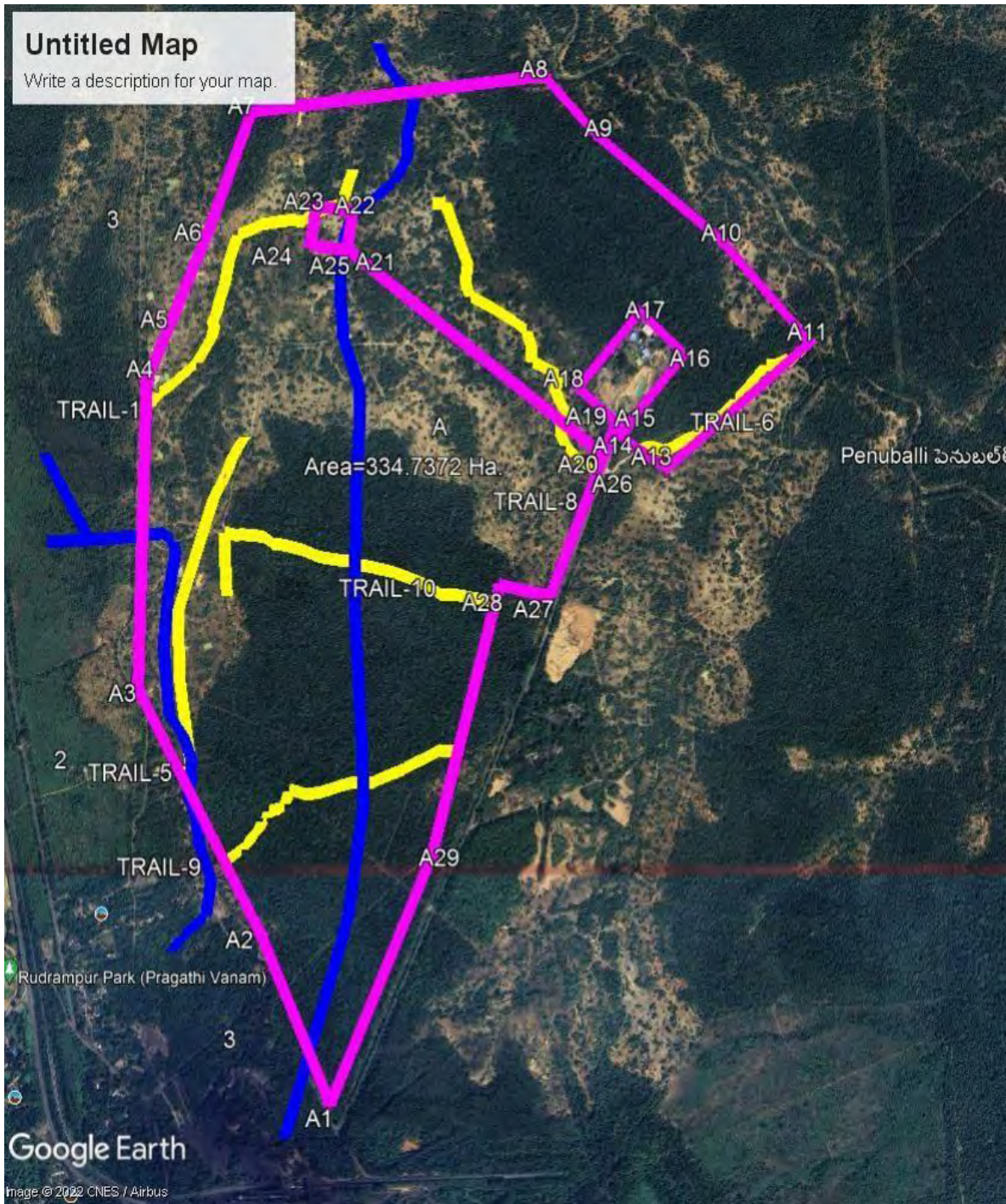


Fig. 3. Google map showing Part - B of the study area with Nature Trails (Venkatesh Khani 7 incline Mine)

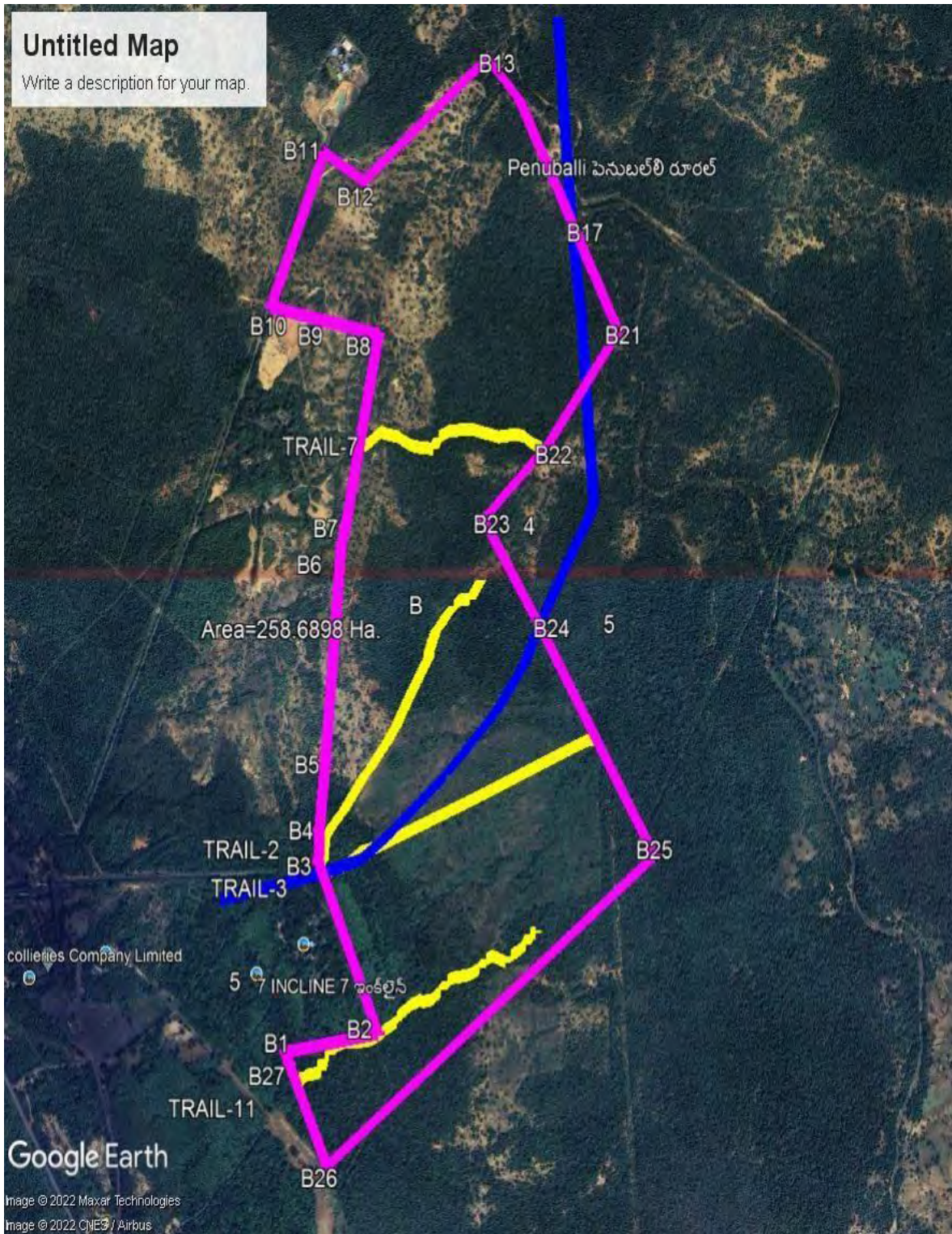


Fig. 4. Google map showing Part - C of the study area with Nature Trails (Gautham Khani Mine)

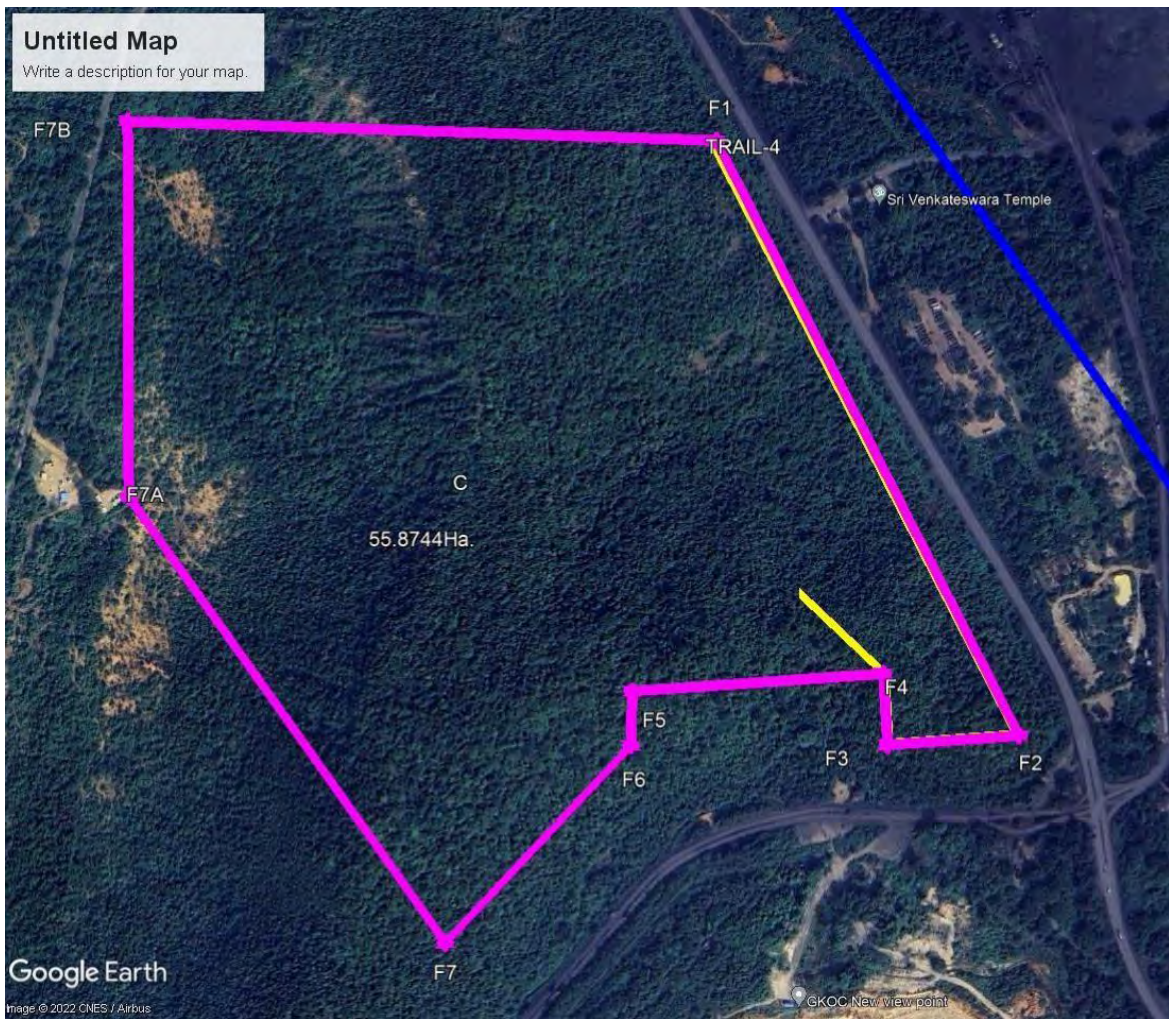
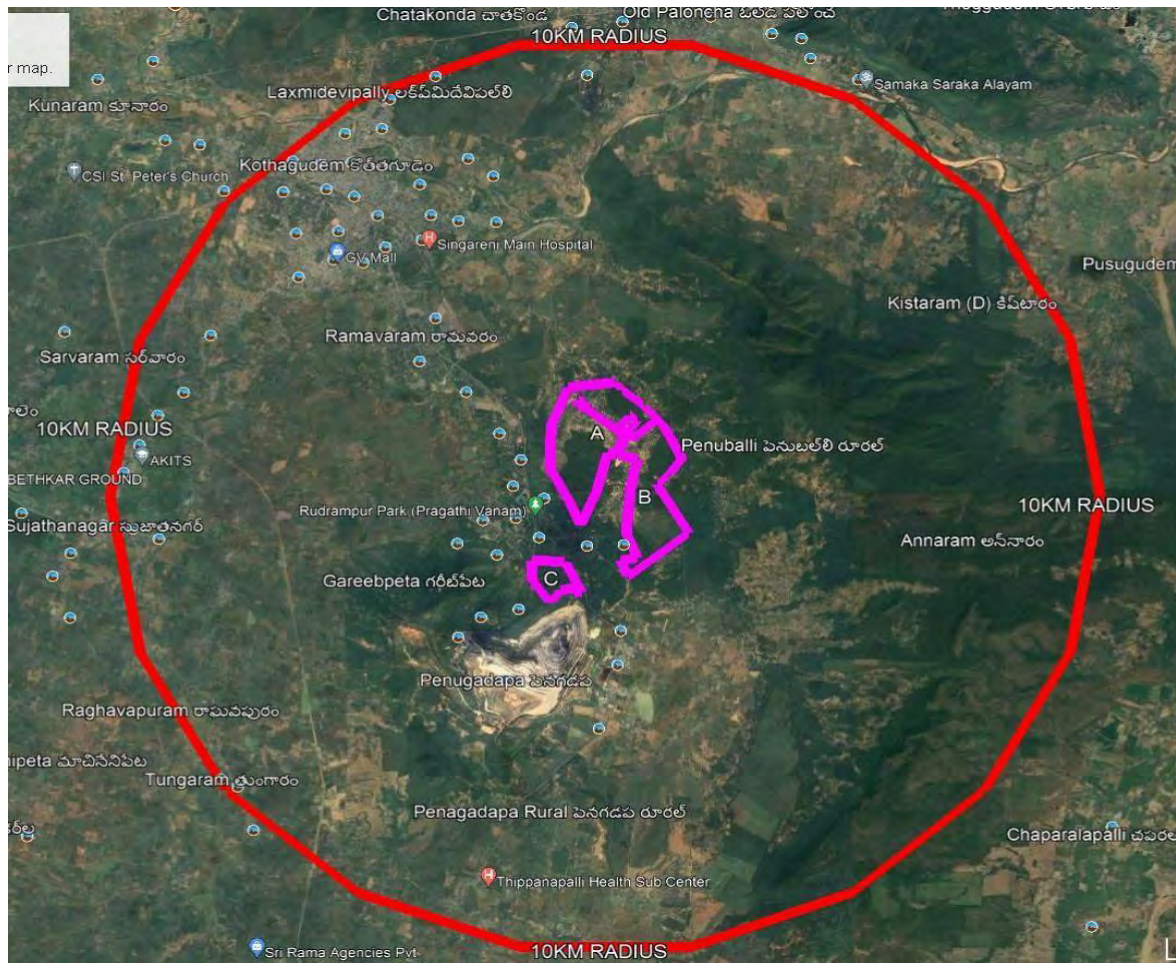


Fig. 5. Google map showing Core and Buffer Zones of GK OC, VK-7 and PVK-5 in 10Kms of radius



The study area does not form a part of any National Park or Sanctuary or Critical Wildlife habitat. No protected area is situated in the vicinity or within the Impact area of 10 Kms radius. The proposed study area is an existing mine. No important wild animals are noticed in the area. There is no endangered Flora and Fauna within study area. In the Impact area the important Schedule-I fauna found are Varanus and Python.

List of Villages within the 10Kms of radius from the proposed study area

1. Sitampuram
2. Anandapuram
3. Gurulagudem
4. Chinthalapadu
5. Patta Cheruvu
6. Gudipadu
7. Bangarujalu
8. Patha Palvancha
9. Palvancha
10. Sitaramesth Banjara
11. Chathakonda
12. Kothagudem
13. Penuballi
14. Gollagudem
15. Laxmidevipalli
16. Hemachandrapuram
17. Sarvaram
18. Chunchupalli
19. Ramavaram
20. Kotha Anjanapuram
21. Narasimha Nagar
22. Garibpeta
23. Garimellapadu
24. Mangapeta
25. Anjanapuram
26. Sujathanagar
27. Siripuram
28. Nimmalagudem
29. Sithampeta
30. Raghavapuram
31. Thungaram
32. Repallevada
33. Arlapadu
34. Ganugapadu
35. Ravikampadu
36. Chandraguda
37. Ayyannapalem
38. Thippanapalli
39. Sitayegudem
40. Mohammad Nagar
41. Satyanarayanapuram
42. Rampuram
43. Penagadapa
44. Rudrampur
45. Laxmipuram Thanda
46. Dhanbad
47. 4 Incline
48. Mulkagudem
49. Chaparalipalli
50. Kommagudem

Fig. 6. Map showing the forest compartments in the Core and Buffer Zones of GK OC, VK-7 and PVK-5 in 10Kms of radius

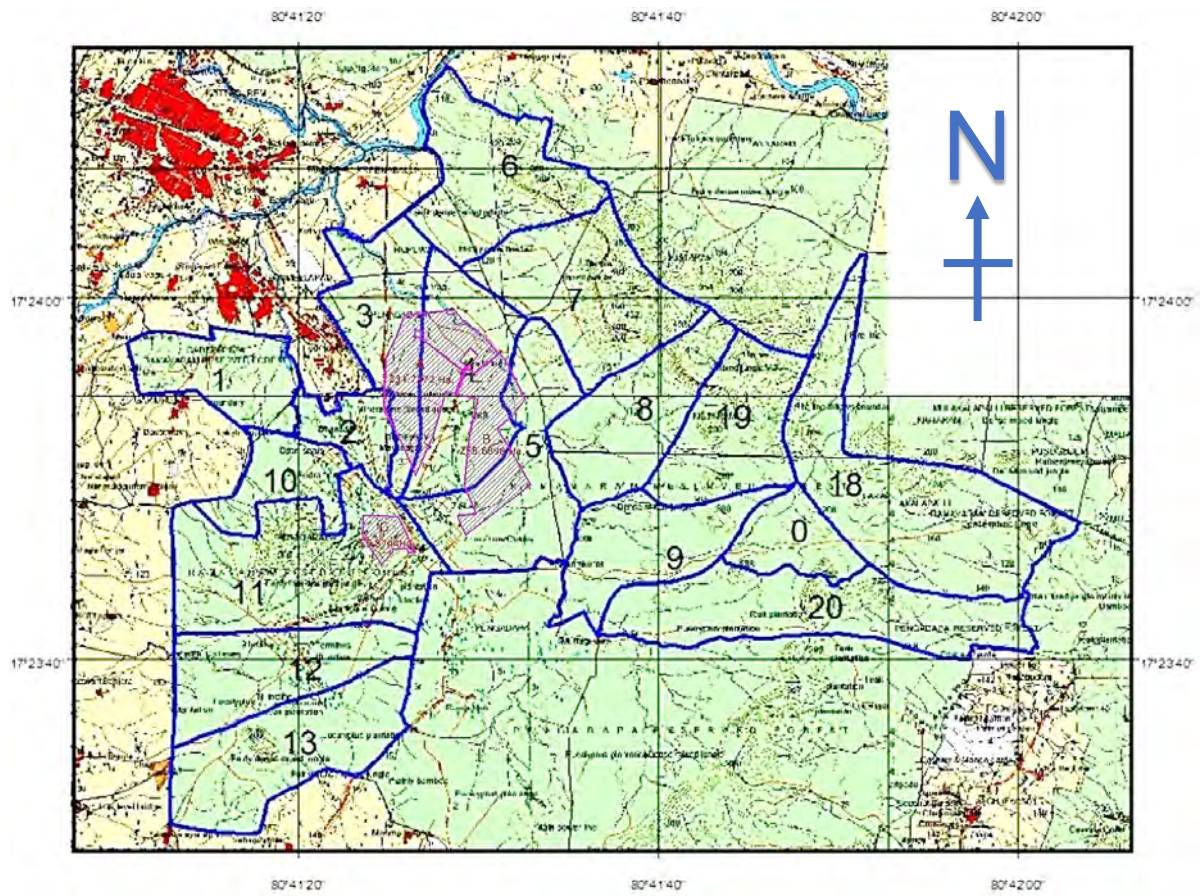
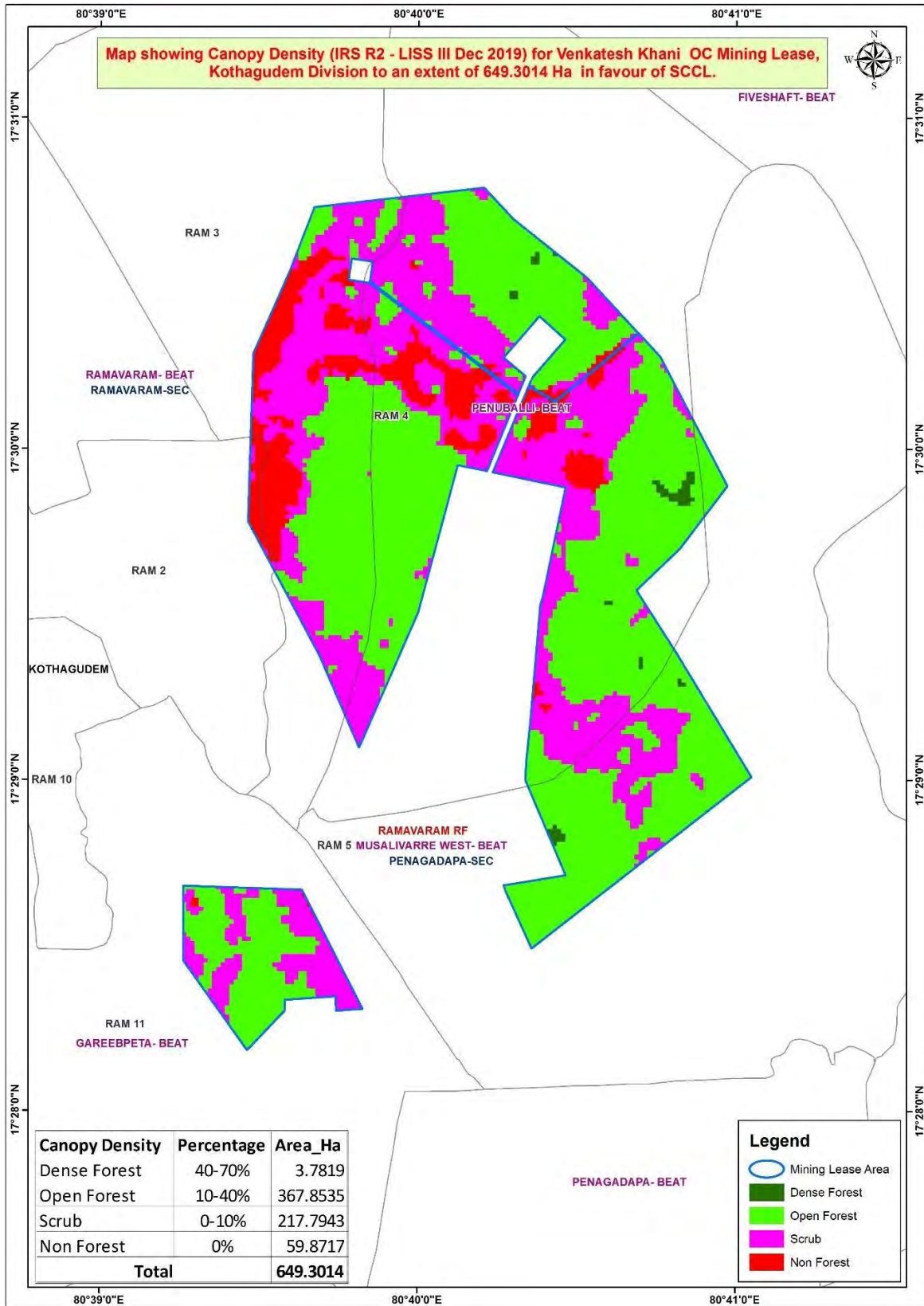


Fig. 7. Map showing the Canopy Density in the study area (Part A, B&C)



Methodology

The study was conducted in all the three proposed parts (A, B & C) (Fig. 2, 3 & 4) for mining lease. The varying habitats in these three parts give rise to diverse ecosystems providing nesting and roosting site for birds, mammals, reptiles, amphibians, insects, and butterflies.

The present study is an assessment of biodiversity in the proposed area over a period of about one year and again re-visited the area during October- November 2022.

The procedure therefore involved field surveys of selected components of biodiversity such as plants butterflies, amphibians, reptiles, birds, and mammals. Intensive survey methods (including night trails in the proposed area) were used involving Forest Beat Officers. The team walked the pre-identified nature trails (Fig. 2, 3 & 4) in the study area extensively covering the entire proposed study area to enumerate different species as and when they were encountered or sighted.

Studies on faunal diversity were performed during both diurnal and nocturnal timings. Point counts on the nature trails were performed to document the bird species, Opportunistic surveys and listing encounters in random trails were also performed.

All observations were conducted on foot and were aided by 80x40 binoculars. Photo records were obtained with the help of Nikon 24-3000 mm camera with 125x wide optical zoom lens.

Species were identified using

- “A pictorial guide to the mammals of the India”. Avifauna species were identified using “A pictorial guide to the birds of the Indian Sub-Continent”.
- Reptiles and amphibians were identified with the available identification keys include Fauna of British India.
- Field guides and published literature were used for the identification of Odonates, butterflies, arachnids, fishes, and other invertebrates.

Meteorological data:

Basic field conditions were recorded by observing visually. The collected data was compared with the online data portals providing meteorological data.

Floral sampling procedures:

Secondary data obtained from the Environment Management Plan already existing with the company was obtained and presented here in the report. (Fig. 7).

Faunal sampling procedures:

1. **Pre-existing tracts and roads were marked as Nature Trails** in each Part of the study area covering microhabitats within it (Fig. 2, 3 & 4). These tracts were walked during morning and evening hours and sampling was done using line transect method.

A total of 11 nature trails with 1100 mts each were walked during the survey. (Table.1). Six trails in Part – A, four trails in Part – B, and one Trail in Part – C, covering all the vegetation and habitat type in the proposed study area. (Fig. 2, 3 & 4).

Table 1. Geographic coordinates nature trails in the PART A, B & C study area

TRAILS	STARTING		ENDING		DISTANCE IN METERS
	LAT	LONG	LAT	LONG	
1.	N17°30'14.598"	E80°39'29.022"	N17°30'38.128"	E80°39'51.403"	1100
2.	N17°28'59.555"	E80°40'20.490"	N17°29'28.267"	E80°40'40.853"	1100
3.	N17°28'58.613"	E80°40'20.907"	N17°29'12.146"	E80°40'55.242"	1100
4.	N17°28'39.982"	E80°39'38.146"	N17°28'23.562"	E80°39'41.339"	1100
5.	N17°29'38.4"	E80°39'32.526"	N17°30'11.703"	E80°39'39.723"	1100
6.	N17°30'10.379"	E80°40'22.720"	N17°30'31.013"	E80°40'31.786"	1100
7.	N17°29'41.580"	E80°40'25.348"	N17°29'41.328"	E80°40'48.795"	1100
8.	N17°30'8.180"	E80°40'18.141"	N17°30'34.688"	E80°40'0.076"	1100
9.	N17°29'29.789"	E80°39'37.310"	N17°29'47.372"	E80°40'4.776"	1100
10.	N17°29'55.422"	E80°40'7.0173"	N17°29'55.960"	E80°39'37.669"	1100
11.	N17°28'37.455"	E80°40'17.723"	N17°28'53.052"	E80°40'48.081"	1100

Line Transect Method

The line transect method of Gaston (1975) is adopted in most of the population estimation studies.

Procedure: At the start of the transect, the transect name, transect bearing, locality, date, starting time and other details were noted in proforma, especially designed for the purpose. Then the team walked along the transect carefully and silently looking for animals on both sides of the transect. On sighting an animal or group of animals, the number is counted, and their position is noted. Then, their angular distance i.e., the distance from the observer to the animal was measured visually. The sighting angle was derived from the compass bearing of the animal's location and the transect compass bearing. The perpendicular distance of the animal from the transect was estimated by multiplying the angular distance with Sin of the sighting angle. The data obtained from different nature trails were pooled and mean perpendicular distance was estimated.

Then, the density of the animal was calculated using the following formula,

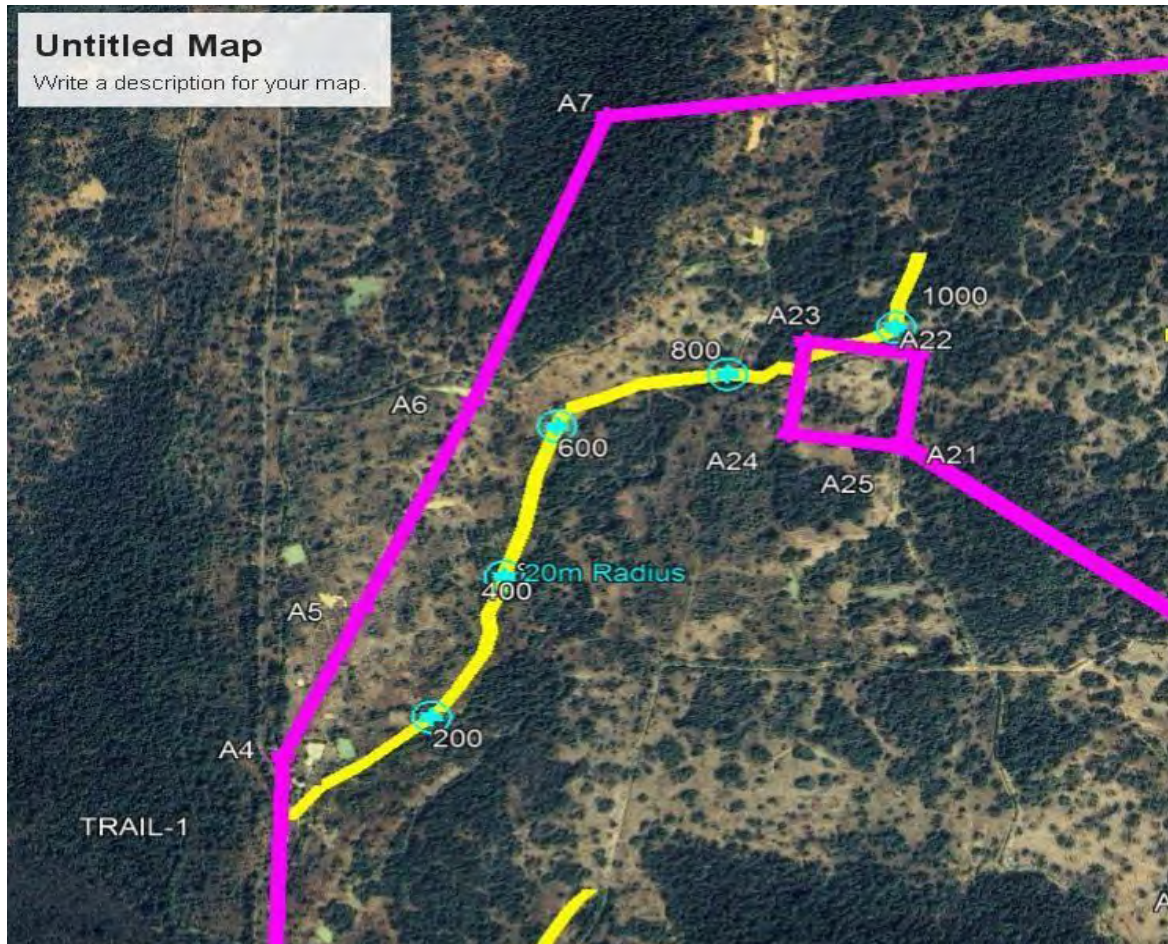
$$\text{Density} = n / 2l * r$$

Where, n= number of animals sighted l= total length of the transect r= Angular distance

2. **Mammalian herbivore** presence was assessed through direct sighting only along the trails, and around watering points.
3. **Carnivore** presences were also studied through direct sighting only.
4. **Direct sighting and vocalizations** were recorded to study bird presence and validate existing data on birds of the all the Parts in the study area. Early morning and evening studies were carried out when bird activity is at its peak. The point-count method was used on the nature trails by marking each point at 200mts interval along each trail and the bird count was performed within a radius of 25mts at each point. (Fig. 8.). A total of 5 points were marked and used for the bird point-count at each trail in all the three parts of the study area (Table. 2). We collected

the data from 55 points established systematically and have been marked in all 11 nature trails of 1100mts each in the study area. (Table 2)

Fig. 8. Google map showing Nature Trail with Bird Point-count locations



Bird Point Count Method

Procedure: A point count consists of standing in a specific location and counting birds. One counted the number of individual birds (of each species) within a circle of 20mts radius. When gathering data to compare one point count to the next, radius size was kept consistent. The radius of 20mts was as large as possible kept in the study area based on the vegetation type (mostly open forest) to maximize information gathering, and the birds could not be seen are heard and recorded throughout the nature trails in the study area. The 20mts radius point count at each point was performed to record all the birds seen or heard within a 5-minute period. We have recorded all birds that are seen or heard within the normal 20mts radius. At the same time, we have also recorded the birds that are heard or seen within a selected distance outside this 20mts radius. The birds counted within the 20mts radius were marked in the "Number of Birds" column of the data sheet and the birds seen or heard outside the 20mts radius (within a specified distance) are marked in the "Outside" column of the data sheet. Counting the same bird twice during the survey was avoided.

A bird that moves from the 0 - 20mts area was not counted twice. Counted the birds where it first appeared or sighted. The purpose of surveying birds in this manner is that it allows one to compare across sites.

Fig. 9. Diagrammatic representation of bird point-count design

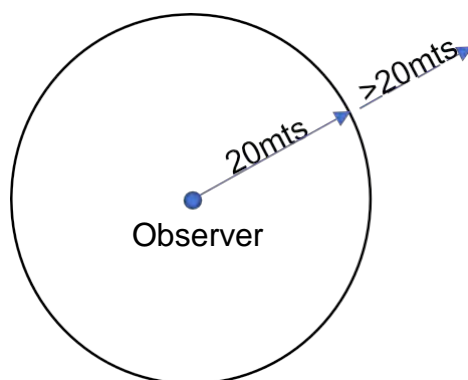


Table 2. Geographic coordinates of bird point-count points marked in the nature trails in all the PARTs A, B & C of the study area

Point No.	Latitude			Longitude			Trail No.
	Deg.	Min.	Sec.	Deg.	Min.	Sec.	
1	17	30	18.85598	80	39	34.08737	TRAIL-1
2	17	30	24.67052	80	39	36.66052	
3	17	30	30.91033	80	39	38.53268	
4	17	30	33.07393	80	39	44.58386	
5	17	30	35.00443	80	39	50.55766	
6	17	29	5.08251	80	40	23.53231	TRAIL-2
7	17	29	10.25375	80	40	27.62735	
8	17	29	15.67464	80	40	31.34328	
9	17	29	21.37146	80	40	34.45858	
10	17	29	26.24166	80	40	38.56585	
11	17	29	1.19389	80	40	27.01192	TRAIL-3
12	17	29	3.57506	80	40	33.31775	
13	17	29	6.04545	80	40	39.59193	
14	17	29	8.59187	80	40	45.83286	
15	17	29	11.1573	80	40	52.06552	
16	17	28	34.17069	80	39	41.11204	TRAIL-4
17	17	28	28.39292	80	39	44.23322	
18	17	28	22.61514	80	39	47.35436	
19	17	28	18.32158	80	39	47.712	
20	17	28	21.37383	80	39	43.75726	
21	17	29	44.00492	80	39	32.96772	TRAIL-5
22	17	29	50.47755	80	39	32.36692	
23	17	29	56.85014	80	39	33.10816	
24	17	30	3.02317	80	39	35.25616	
25	17	30	8.97316	80	39	37.93188	
26	17	30	11.83627	80	40	29.0699	TRAIL-6
27	17	30	16.12002	80	40	34.13094	
28	17	30	19.33687	80	40	39.49441	
29	17	30	23.89631	80	40	38.67032	
30	17	30	28.66663	80	40	34.05654	
31	17	29	42.04538	80	40	31.44358	TRAIL-7
32	17	29	43.25359	80	40	37.26235	
33	17	29	42.75506	80	40	43.93841	
34	17	29	42.3786	80	40	49.78611	
35	17	29	47.57437	80	40	53.87023	
36	17	30	12.89298	80	40	14.26144	TRAIL-8

37	17	30	18.38437	80	40	12.59121	
38	17	30	23.12239	80	40	8.92722	
39	17	30	26.85979	80	40	3.71859	
40	17	30	33.02159	80	40	2.18556	
41	17	29	34.25556	80	39	42.03252	TRAIL-9
42	17	29	36.4816	80	39	47.27233	
43	17	29	37.6769	80	39	53.8697	
44	17	29	40.31582	80	40	0.05682	
45	17	29	44.22869	80	40	3.9016	
46	17	29	56.47055	80	40	0.40638	TRAIL-10
47	17	29	58.69132	80	39	54.07332	
48	17	29	59.93205	80	39	47.43811	
49	17	30	1.8855	80	39	41.05976	
50	17	29	59.19858	80	39	37.43828	
51	17	28	41.15651	80	40	22.38711	TRAIL-11
52	17	28	42.92922	80	40	28.6734	
53	17	28	45.98556	80	40	34.26492	
54	17	28	48.81467	80	40	40.07795	
55	17	28	50.98344	80	40	45.74362	

The following details provide the protocol adopted for bird count:

- a. **Selection of points:** *The study are satellite images were captured, and the bird points at 200mts distance each was fixed on the image having the pre-existing nature trails covering the vegetation sampling grids. The centre point of each point has been chosen based using GPS and systematic sampling was followed.*
- b. **Duration and time of counts:** *Counts were done within three hours after sunrise. This is when birds are most active. Also done night-time surveys to count nocturnal species (done within three hours after sunset). During point counts, recorded all birds seen and heard within the survey area. The team initially stood for two minutes to allow some settling time for the birds that were disturbed. Observations were recorded for five minutes.*
- c. **Recording method:** *For each sighting, the number of individuals, and the sighting distance was recorded. Flying birds and calls of the birds were recorded separately.*
- d. **Counting FO (Flyovers):** *All higher-flying birds (above the tallest structure in the study area) were also noted if they are within the boundaries of the point count area.*
- e. **Counting Birds Outside of Survey Area:** *Only birds seen or heard within the point count area were recorded .*
- f. **Estimating Abundance:** *When multiple sightings of a species occurred within a point count, we have included only multiple entries for a species of sure that they are different individuals.*
- g. **Avoided Artificial Densities:** *No sounds used that can attract birds to our trail or in the study are. No recorded calls, or any other methods that encourage birds to show themselves was used.*

- h. Set-up:** *Before conducting the point count, the boundaries of the area marked visually by using some identifiable object (e.g., a large tree). Also, marked the centre spot where we stood and observed the birds with GPS. The exact place was used each time for the survey.*
 - i. Distance estimation:** *Ocular estimates of the distance were taken.*
 - j. Weather:** *While conducting the point count, the general climatic conditions were recorded; Wind intensity (calm, slight, gusty, strong) and sky condition (clear, cloudy). This is important because climatic variables are known to affect bird activity. Bird point count studies were avoided on rainy days or extremely windy days because birds don't produce calls during that time, hence affecting the detectability.*
- 5. Reptiles and amphibians** were recorded in through incidence rate along nature trails as well as occurrence and interception rates along water holes. Other than the day counts, sampling was also conducted during the early evening and night, when incidence rates are expected to be highest.
 - 6. Invertebrates** were estimated through incidence rates and direct sighting. Butterflies, ants, spiders, dragonflies, scorpions, bees, wasps, beetles, grasshoppers, and other prominent invertebrates were check-listed. Where identification is not possible in the field, photographs were taken for taxonomical purpose.
 - 7. Special habitats and eco-tones**, especially fields and grasslands were surveyed for estimating the presence of grassland birds, rodents, and small mammals.

Source of secondary information on wildlife:

- Secondary information on flora, fauna and their distribution were collected from Forest Department, Kothagudem (Working Plan/Management Plan of Kothagudem) Division, 2014-2024 of Bhadracharya Kothagudem district. Also, data were collected on wildlife census conducted, incidents of forest fires, man-animal conflicts, compensation cases/details, water sources (natural and man-made structures), density enrichment plantations by Forest Department and SCCL, grassplots developed.
- Faunal availability was also verified from the local people and staff working in the forest department.
- Conservation status of the flora and fauna were cross checked under IUCN Red list through published literature and online as well as Indian Wildlife Protection Act (IWPA), 1972 and further Amendments.

Source of secondary information on villages and livestock:

The methodology adopted for the study mainly includes review of published secondary data and primary field survey (District Census Statistical Handbooks- 2011 and Primary Census Abstract of Census-2011) with respect to population, sex ratio, average household size, density of population, social stratification, literacy rate and occupational structure for 10 Kms radius study area. The villages falling within the study area were visited to have first-hand information on the socioeconomic conditions of the people living in these villages.

Traffic Study:

The traffic study has been conducted to know the prevailing traffic volumes on the existing approach roads to the project area. Even though no coal transport is proposed through road mode in the project. It is essential to consider these details for assessing the anticipated future traffic volumes as a part of overall impacts assessment for the project.

Methodology adopted for studying the Socio-economic Status within the 10Kms radius from the proposed study area:

The methodology adopted for the study mainly includes review of published secondary data and primary field survey (District Census Statistical Handbooks- 2011 and Primary Census Abstract of Census-2011) with respect to population, sex ratio, average household size, density of population, social stratification, literacy rate and occupational structure for 10 Kms radius study area. The villages falling within the study area were visited to have firsthand information on the socioeconomic conditions of the people living in these villages.

The information gathered during the interview and Participatory Rural Appraisal (PRA)/ Rapid Rural Appraisal (RRA) covered different aspects of socio-economic indicators to evaluate the present quality of life of the people living in the area and to know the **people's** perception on the proposed project.

Results & Discussion

Meteorological Data:

Kothagudem area experiences typical tropical climate of a distinct hot summer from March to May with occasional dust storms, a good monsoon between middle of June and September and a pleasant winter from December to February. The temperature varies between 9.10 C and 48.60 C.

Fig. 10. Average Weather Data of the Study Duration (September 2022)

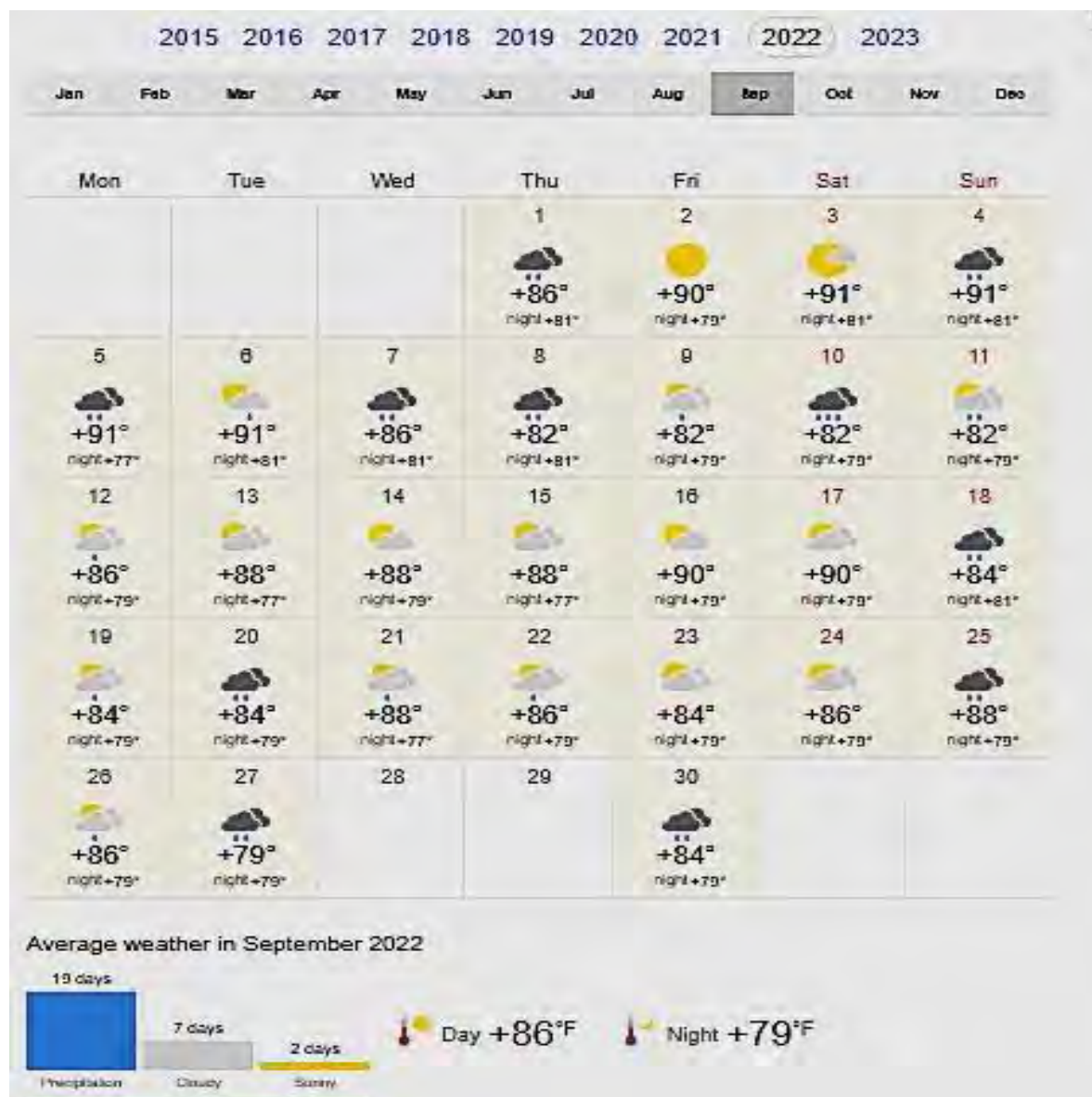
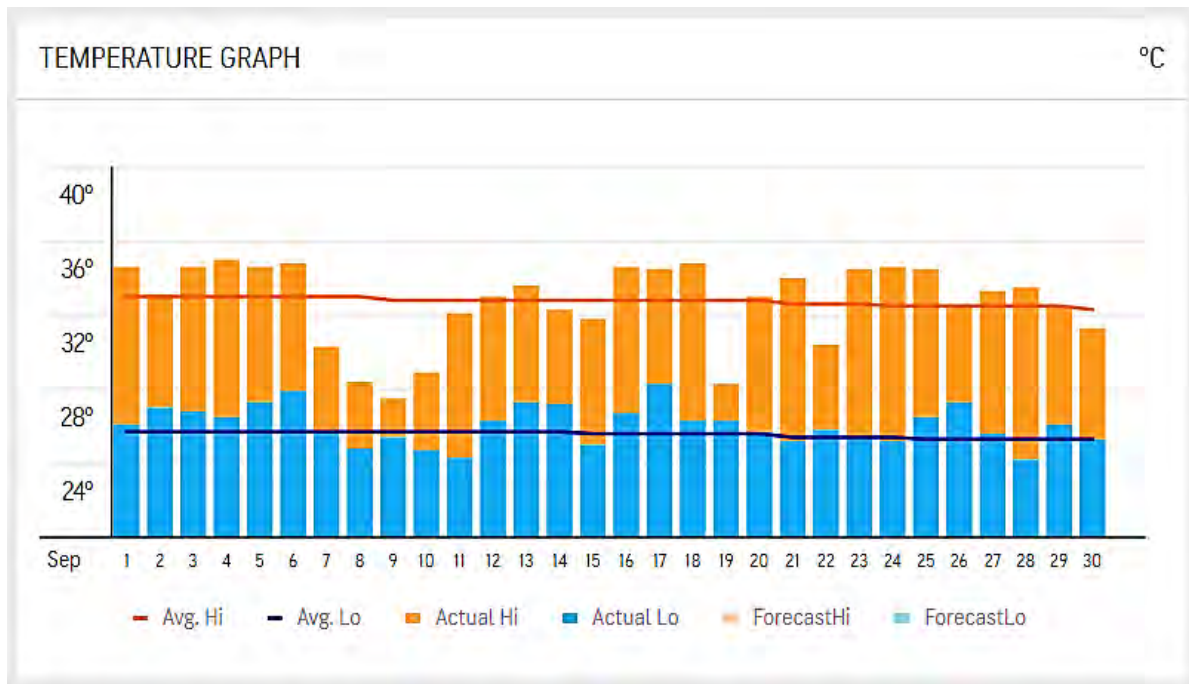


Fig. 11. Temperature Graph of the Study Duration



https://world-weather.info/forecast/india/kothagudem_7/september-2022/
<https://www.accuweather.com/en/in/kothagudem/186810/september-weather/186810>

Three seasons studies were carried out at the time of preparation of EMP. Again, study was carried out during October- November 2022. The season during the study period was post-monsoon season in the study area. Most of the days were sunny and had rains in the evening. The wind was also light during the study period. Sky was recorded always clear and cloudy during the rains. The weather conditions were favorable during the study period to record the existing species in the proposed study area.

Floral Diversity:

A total of 313 plant species belonging to 241 genera and 83 families were documented in the study area (Core and Buffer zone). Among 313 species listed: 89 species are trees, 41 shrubs, 14 lianas, 22 climbers, 117 herbs, 29 aquatic herbs and one is epiphyte.

As the vegetation analysis suggests there are more herbaceous species (117 species) in comparison to tree species or other life forms as shown in figure.

This infers to the study area of proposed project is medium density forests.

Among all 313 species, 23 species are recorded in core zone, 122 species in buffer zone and 168 are recorded in both core and buffer zone areas of the study area. The species listed in core zone includes 5 trees, 3 shrubs, 1 climber and 14 herbs; in buffer zone 19 trees, 14 shrubs, 4 lianas, 11 climbers, 48 herbs and 26 aquatic herbs; in core and buffer 65 trees, 24 shrubs, 10 lianas, 10 climbers, 55 herbs, 3 aquatic herbs and one is epiphyte.

Table 3. List of species of floral species documented

S. No.	Scientific Name	Family	Habit	Vernacular Name	Study Zone	IUCN Status
1	<i>Abildgaardia ovata</i>	Cyperaceae	H	-	B	LC
2	<i>Abrus precatorius</i>	Fabaceae	C	Guruginja	C&B	NA
3	<i>Abutilon hirtum</i>	Malvaceae	S	Palabenda	C&B	NA
4	<i>Abutilon indicum</i>	Malvaceae	S	Thuttutubenda	B	NA
5	<i>Acalypha capitata</i>	Euphorbiaceae	S	Chiru Kuppinta	C	NA
6	<i>Acalypha indica</i>	Euphorbiaceae	H	Muripinda	C&B	NA
7	<i>Achyranthes aspera</i>	Amaranthaceae	H	Uttareni	B	NA
8	<i>Acmella paniculata</i>	Asteraceae	H	Maratimoggalu	C&B	LC
9	<i>Actinoscirpus grossus</i>	Cyperaceae	AH	-	B	NA
10	<i>Adina cordifolia</i>	Rubiaceae	T	Rudraganapa, Patchabotraka	C&B	NA
11	<i>Aegle marmelos</i>	Rutaceae	T	Maredu, Bilvumu	C&B	NA
12	<i>Afrohybanthus enneaspermus</i>	Violaceae	H	Ratna purusha	C	NA
13	<i>Agave americana</i>	Asparagaceae	S	Kathaichettu	B	NA
14	<i>Ageratum conyzoides</i>	Asteraceae	H	Adavipudeena	C&B	NA
15	<i>Ailanthus excelsa</i>	Simaroubaceae	T	Pedda manu	C&B	NA
16	<i>Alangium salviifolium</i>	Cornaceae	T	Nallaoodaga	C&B	LC
17	<i>Albizia amara</i>	Leguminosae	T	Narlingi, Chigara	C&B	LC
18	<i>Albizia odoratissima</i>	Leguminosae	T	Chinduga	C&B	LC
19	<i>Albizia thompsonii</i>	Leguminosae	T	-	C&B	NT
20	<i>Alternanthera pungens</i>	Amaranthaceae	H	Mulla Ponnaganti	C&B	NA
21	<i>Alternanthera sessilis</i>	Amaranthaceae	H	Adavi Ponnaganti	C&B	LC
22	<i>Alysicarpus hamosus</i>	Leguminosae	H	-	C	NA
23	<i>Alysicarpus monilifer</i>	Leguminosae	H	Poosala mokka	B	NA
24	<i>Amaranthus spinosus</i>	Amaranthaceae	H	Mundla	C&B	NA
25	<i>Amaranthus viridis</i>	Amaranthaceae	H	Chilaka thotakura	B	NA
26	<i>Ammannia baccifera</i>	Lythraceae	AH	Nela Citramulam, Agnivendramu	B	LC
27	<i>Ammannia multiflora</i>	Lythraceae	AH	-	B	LC
28	<i>Andrographis echinoides</i>	Acanthaceae	H	-	C&B	NA
29	<i>Andrographis paniculata</i>	Acanthaceae	H	Belavemu	C&B	NA
30	<i>Annona squamosa</i>	Annonaceae	T	Seetaphalam	C&B	LC
31	<i>Aponogeton crispus</i>	Aponogetonaceae	AH	Nammappuvvu	B	LC
32	<i>Aristida adscensionis</i>	Poaceae	H	Cheepuru	C&B	NA
33	<i>Aristida hystrix</i>	Poaceae	H	Chinnameesala gaddi	C&B	NA
34	<i>Aristida setacea</i>	Poaceae	H	Chipurugaddi	C&B	NA
35	<i>Aristolochia indica</i>	Aristolochiaceae	C	Iswaraveru	C&B	NA
36	<i>Asparagus racemosus</i>	Asparagaceae	C	Sathavari	C&B	NA
37	<i>Ayenia herbacea</i>	Malvaceae	H	Magasirigadda	C&B	NA
38	<i>Azadirachta indica</i>	Meliaceae	T	Vepa chettu	C&B	LC

39	<i>Bacopa monnieri</i>	Plantaginaceae	AH	Brahmmi	B	LC
40	<i>Balanites aegyptiaca</i>	Zygophyllaceae	T	Ingudi, Garachettu	C	LC
41	<i>Bambusa bambos</i>	Poaceae	T	Veduru	C&B	NA
42	<i>Barleria prionitis</i>	Acanthaceae	H	Mullagorinta	B	NA
43	<i>Bauhinia racemosa</i>	Leguminosae	T	Arichettu	C&B	NA
44	<i>Bergia capensis</i>	Elatinaceae	AH	Neerupavila	B	LC
45	<i>Blepharis integrifolia</i>	Acanthaceae	H	Chatuspathri	C&B	NA
46	<i>Blepharis maderaspatensis</i>	Acanthaceae	H	Anthritapoolu	C&B	NA
47	<i>Blumea axillaris</i>	Compositae	H	Kukkapogaku	C	NA
48	<i>Blumea lacera</i>	Compositae	H	-	B	NA
49	<i>Boerhavia diffusa</i>	Nyctaginaceae	H	Punarnava, Atikimamidi	B	NA
50	<i>Boerhavia erecta</i>	Nyctaginaceae	H	Pandari punarnava	B	NA
51	<i>Bombax ceiba</i>	Malvaceae	T	Buruga	B	LC
52	<i>Bonnaya ciliata</i>	Linderniaceae	AH	-	B	LC
53	<i>Boswellia serrata</i>	Burseraceae	T	Anduga	B	NA
54	<i>Brachypterum scandens</i>	Leguminosae	L	Nallateega	C&B	NA
55	<i>Bridelia montana</i>	Phyllanthaceae	S	Adavi jama	C&B	NA
56	<i>Bridelia retusa</i>	Phyllanthaceae	T	Mullumaddi	C&B	LC
57	<i>Buchanania cochinchinensis</i>	Anacardiaceae	T	Chinna morli	C&B	NA
58	<i>Butea monosperma</i>	Leguminosae	T	Moduga	C&B	LC
59	<i>Butea superba</i>	Leguminosae	L	Teega modiga	C&B	NA
60	<i>Cajanus scarabaeoides</i>	Leguminosae	C	-	C&B	LC
61	<i>Calotropis gigantea</i>	Apocynaceae	S	Tella Jilledu	B	NA
62	<i>Calotropis procera</i>	Apocynaceae	S	Erra jilledu	B	NA
63	<i>Canavalia gladiata</i>	Leguminosae	L	Thammakaya	B	NA
64	<i>Canscora heteroclita</i>	Gentianaceae	AH	Thambakaya	B	NA
65	<i>Canthium coromandelicum</i>	Rubiaceae	S	Sinnabalusu, Balusu	C&B	NA
66	<i>Capparis sepiaria</i>	Capparaceae	S	Nallauppi	B	LC
67	<i>Capparis spinosa</i>	Capparaceae	L	-	C&B	LC
68	<i>Careya arborea</i>	Lecythidaceae	T	Budadarmi	C&B	NA
69	<i>Carissa carandas</i>	Apocynaceae	S	Kalivi	B	NA
70	<i>Cassia fistula</i>	Leguminosae	T	Rela chettu	C&B	LC
71	<i>Cassytha filiformis</i>	Lauraceae	C	Pasuputivva	C&B	NA
72	<i>Catunaregam spinosa</i>	Rubiaceae	S	Manga	C&B	NA
73	<i>Celastrus paniculatus</i>	Celastraceae	L	Jyothismathi, Teegapalleru	C&B	NA
74	<i>Ceratopteris thalictroides</i>	Pteridaceae	AH	-	B	LC
75	<i>Chara globularis</i>	Characeae	AH	Chara	B	LC
76	<i>Chloris barbata</i>	Poaceae	H	Jada kunchula gaddi	C&B	NA
77	<i>Chloroxylon swietenia</i>	Rutaceae	T	Billudu	C&B	VU
78	<i>Chromolaena odorata</i>	Compositae	S	Porangi	C&B	NA
79	<i>Chrozophora rotleri</i>	Euphorbiaceae	H	Lingamirapa	B	NA
80	<i>Chrysopogon fulvus</i>	Poaceae	H	-	C	NA
81	<i>Cleistanthus collinus</i>	Phyllanthaceae	T	Kodise	C&B	VU
82	<i>Cleome viscosa</i>	Cleomaceae	H	Kukka vominta	C&B	NA
83	<i>Clitoria ternatea</i>	Leguminosae	C	Dintena teega	B	NA
84	<i>Coccinia grandis</i>	Cucurbitaceae	C	Donda	B	NA

85	<i>Cocculus hirsutus</i>	Menispermaceae	C	Chinnadusar teega	C&B	NA
86	<i>Coldenia procumbens</i>	Boraginaceae	H	Bukkinaaku	C&B	LC
87	<i>Colocasia esculenta</i>	Araceae	H	Chemadumpa	B	LC
88	<i>Combretum albidum</i>	Combretaceae	L	Yadateega	B	NA
89	<i>Commelina benghalensis</i>	Commelinaceae	AH	Vennadevikura	C&B	LC
90	<i>Commelina imberbis</i>	Commelinaceae	H	-	C&B	LC
91	<i>Cordia dichotoma</i>	Boraginaceae	T	Iriki	B	LC
92	<i>Crateva adansonii</i>	Capparaceae	T	Uskimanu,	B	LC
93	<i>Crotalaria hebecarpa</i>	Fabaceae	H	-	C&B	NA
94	<i>Croton bonplandianus</i>	Euphorbiaceae	H	Vanamokka	B	NA
95	<i>Cryptolepis buchananii</i>	Apocynaceae	C	Adavipalateega	C	NA
96	<i>Curculigo orchoides</i>	Hypoxidaceae	H	Nelathadi	C&B	NA
97	<i>Curcuma pseudomontana</i>	Zingiberaceae	H	Adavipasupu	C&B	VU
98	<i>Cyanotis axillaris</i>	Commelinaceae	AH	Neelavanthi	C&B	LC
99	<i>Cyanthillium albicans</i>	Compositae	H	Garitakamma	C&B	NA
100	<i>Cyanthillium cinereum</i>	Compositae	H	Sahadevi	B	NA
101	<i>Cycas rumphii</i>	Cycadaceae	T	Ranhaguvva	C	VU
102	<i>Cymbopogon coloratus</i>	Poaceae	H	Bodagaddi	C&B	NA
103	<i>Cymbopogon martini</i>	Poaceae	H	Kamaanchi kasuvu	C&B	NA
104	<i>Cynodon dactylon</i>	Poaceae	H	Garika	C&B	NA
105	<i>Cyperus corymbosus</i>	Cyperaceae	AH	-	B	NA
106	<i>Cyperus difformis</i>	Cyperaceae	AH	-	B	LC
107	<i>Cyperus exaltatus</i>	Cyperaceae	AH	-	B	LC
108	<i>Cyperus michelianus</i>	Cyperaceae	AH	-	B	LC
109	<i>Cyperus mindorensis</i>	Cyperaceae	AH	Gandala	C&B	NA
110	<i>Cyperus pangorei</i>	Cyperaceae	AH	-	B	LC
111	<i>Cyperus rotundus</i>	Cyperaceae	H	Thunga	B	LC
112	<i>Dalbergia lanceolaria</i>	Leguminosae	T	Patchari	C&B	NA
113	<i>Dendrocalamus strictus</i>	Poaceae	T	Sadanam	C&B	NA
114	<i>Dendrophthoe falcata</i>	Loranthaceae	S	Jiddu, Yolinga	C&B	NA
115	<i>Dentella repens</i>	Rubiaceae	H	Katakura	B	LC
116	<i>Dentella repens</i> var. <i>serpyllifolia</i>	Rubiaceae	H	-	B	NA
117	<i>Dichanthium annulatum</i>	Poaceae	H	Errasangali gaddi	B	NA
118	<i>Dichrostachys cinerea</i>	Leguminosae	S	Velthuruchettu	C&B	LC
119	<i>Dioscorea pentaphylla</i>	Dioscoreaceae	C	Adaviginasu teega	C&B	NA
120	<i>Diospyros chloroxylon</i>	Ebenaceae	T	Ullinda	C&B	NA
121	<i>Diospyros melanoxylon</i>	Ebenaceae	T	Beediakulu, Thuniki	C&B	NA
122	<i>Diospyros montana</i>	Ebenaceae	T	Muchha thuniki	B	NA
123	<i>Dodonaea viscosa</i>	Sapindaceae	S	Bandaru, Pullivavili	C&B	LC
124	<i>Drimia indica</i>	Asparagaceae	H	Adavi ulli	C	NA
125	<i>Drypetes sepiaria</i>	Putranjivaceae	S	Putrajivika, Kuduru	B	NA
126	<i>Eclipta prostrata</i>	Asteraceae	H	Guntagalagara	C&B	LC
127	<i>Ehretia aspera</i>	Boraginaceae	T	Paldattam	C&B	DD
128	<i>Eleocharis geniculata</i>	Cyperaceae	AH	-	B	LC

129	<i>Elytraria acaulis</i>	Acanthaceae	H	Nela marri	B	NA
130	<i>Eragrostiella bifaria</i>	Poaceae	H	Noolugaddi	B	NA
131	<i>Eragrostis tenella</i>	Poaceae	H	Chinna garikagaddi	C&B	NA
132	<i>Eragrostis viscosa</i>	Poaceae	H	-	C&B	NA
133	<i>Eriocaulon quinquangulare</i>	Eriocaulaceae	H	-	C	NA
134	<i>Erythroxylum monogynum</i>	Erythroxylaceae	S	Gatiri, Adavi gongura	C&B	NA
135	<i>Euphorbia hirta</i>	Euphorbiaceae	H	Nanubalu	C&B	NA
136	<i>Euphorbia nivulia</i>	Euphorbiaceae	T	Aakujemudu, Bonthajemudu	B	NA
137	<i>Euphorbia thymifolia</i>	Euphorbiaceae	H	Reddivaari nanambralu	B	NA
138	<i>Evolvulus alsinoides</i>	Convolvulaceae	H	Vishnukrantha	B	NA
139	<i>Evolvulus nummularius</i>	Convolvulaceae	H	-	C&B	NA
140	<i>Ficus benghalensis</i>	Moraceae	T	Marri	C&B	NA
141	<i>Ficus hispida</i>	Moraceae	S	Bemmedu akulu	C&B	LC
142	<i>Ficus mollis</i>	Moraceae	T	Konda kalijuvvi	C&B	NA
143	<i>Ficus racemosa</i>	Moraceae	T	Medi	C&B	LC
144	<i>Ficus religiosa</i>	Moraceae	T	Ravi chettu	B	NA
145	<i>Fimbristylis aestivalis</i>	Cyperaceae	AH	-	B	NA
146	<i>Fimbristylis argentea</i>	Cyperaceae	AH	-	B	LC
147	<i>Fimbristylis quinquangularis</i>	Cyperaceae	AH	-	B	LC
148	<i>Flacourtia indica</i>	Salicaceae	S	Nakka neredu	C&B	LC
149	<i>Galactia striata</i>	Leguminosae	C	-	B	NA
150	<i>Gardenia gummifera</i>	Rubiaceae	T	Bikki	C&B	LC
151	<i>Gardenia latifolia</i>	Rubiaceae	T	Peddabikki	C&B	NA
152	<i>Garuga pinnata</i>	Burseraceae	T	Garuga, Kondavepa	B	NA
153	<i>Getonia floribunda</i>	Combretaceae	L	Pootangiteega	C&B	NA
154	<i>Gisekia pharnaceoides</i>	Gisekiaceae	H	Isukadantikura	B	NA
155	<i>Givotia moluccana</i>	Euphorbiaceae	T	Tella Poliki	C&B	NA
156	<i>Glinus lotoides</i>	Molluginaceae	H	Tellaporaku	B	LC
157	<i>Glinus oppositifolius</i>	Molluginaceae	H	Chayunta rashiaku	B	LC
158	<i>Gloriosa superba</i>	Colchicaceae	H	Naabhi, Adavinaabhi	C	LC
159	<i>Gmelina arborea</i>	Lamiaceae	T	Gummaditeku, Gambharee	C	LC
160	<i>Gmelina asiatica</i>	Lamiaceae	L	Chinna adavigummadi	B	LC
161	<i>Gomphrena serrata</i>	Amaranthaceae	H	Bendumalli	B	NA
162	<i>Grangea maderaspatana</i>	Compositae	H	Mastaru	C&B	LC
163	<i>Grewia flavescens</i>	Malvaceae	T	Bankajaana	C&B	LC
164	<i>Grewia hirsuta</i>	Malvaceae	S	Nalla Kattelu	C&B	NA
165	<i>Grewia tiliifolia</i>	Malvaceae	T	Budamara	C&B	NA
166	<i>Grewia villosa</i>	Malvaceae	S	Banta, Chenula	C&B	LC
167	<i>Gymnosporia emarginata</i>	Celastraceae	S	Danthi	C&B	NA
168	<i>Habenaria panigrahiana</i>	Orchidaceae	H	-	C	NA
169	<i>Hackelochloa granularis</i>	Poaceae	H	Naalipunuku	C	NA

170	<i>Hardwickia binata</i>	Leguminosae	T	Naarepi	C&B	LC
171	<i>Helicteres isora</i>	Malvaceae	S	Gooba thada	C&B	NA
172	<i>Heliotropium indicum</i>	Boraginaceae	H	Nagadanti	B	NA
173	<i>Heliotropium marifolium</i>	Boraginaceae	H	-	C	NA
174	<i>Hemidesmus indicus</i>	Apocynaceae	C	Sugandhapala	C&B	NA
175	<i>Heteropogon contortus</i>	Poaceae	H	Yeddigaddi/ Kes aragaddi	C&B	NA
176	<i>Hibiscus micranthus</i>	Malvaceae	S	Nityamalle	B	NA
177	<i>Holarrhena pubescens</i>	Apocynaceae	S	Kolamukhi	C&B	LC
178	<i>Holoptelea integrifolia</i>	Ulmaceae	T	Nemalinaara	C&B	NA
179	<i>Huberantha cerasoides</i>	Annonaceae	T	Chilakadudduga	B	NA
180	<i>Hydrilla verticillata</i>	Hydrocharitaceae	AH	Poonaachu	B	LC
181	<i>Hygrophila auriculata</i>	Acanthaceae	AH	Mulla gobbi	B	LC
182	<i>Indigofera linnaei</i>	Leguminosae	H	Yerrapalleru	C&B	NA
183	<i>Ipomoea aquatica</i>	Convolvulaceae	C	Thootilooru	B	LC
184	<i>Ipomoea carnea</i>	Convolvulaceae	C	Pandiri thooti	B	NA
185	<i>Ipomoea nil</i>	Convolvulaceae	C	Kolivitthulu	B	NA
186	<i>Ipomoea obscura</i>	Convolvulaceae	C	Nallateega	C&B	NA
187	<i>Ipomoea pes-tigridis</i>	Convolvulaceae	C	Mekamadugu	B	NA
188	<i>Ipomoea sagittifolia</i>	Convolvulaceae	C	Purititeega	B	NA
189	<i>Ixora pavetta</i>	Rubiaceae	S	Koravi	C&B	NA
190	<i>Jasminum auriculatum</i>	Oleaceae	L	Adavi teega malli	C&B	NA
191	<i>Jatropha gossypifolia</i>	Euphorbiaceae	S	Nela amudam	B	LC
192	<i>Justicia glauca</i>	Acanthaceae	H	-	C&B	NA
193	<i>Justicia vahliana</i>	Acanthaceae	H	-	C&B	NA
194	<i>Knoxia sumatrensis</i>	Rubiaceae	H	Kampurodda	C&B	NA
195	<i>Lagerstroemia parviflora</i>	Lythraceae	T	Chennangi	C&B	NA
196	<i>Lannea coromandelica</i>	Anacardiaceae	T	Gumpena	C&B	LC
197	<i>Lantana camara</i>	Verbenaceae	S	Seesa kammari	C&B	NA
198	<i>Lepidagathis cristata</i>	Acanthaceae	H	Nakka pintuka	B	NA
199	<i>Leptopetalum biflorum</i>	Rubiaceae	H	-	C&B	NA
200	<i>Leucaena leucocephala</i>	Leguminosae	T	Subabulu	C&B	NA
201	<i>Limonia acidissima</i>	Rutaceae	T	Velaga	C&B	NA
202	<i>Madhuca longifolia</i>	Sapotaceae	T	Ippa	C&B	NA
203	<i>Maerua apetala</i>	Capparaceae	T	Pilli Adugu	B	NA
204	<i>Malvastrum coromandelianum</i>	Malvaceae	H	-	B	NA
205	<i>Mangifera indica</i>	Anacardiaceae	T	Mamidi	B	DD
206	<i>Manilkara hexandra</i>	Sapotaceae	T	Pala chettu	C&B	NA
207	<i>Marsilea quadrifolia</i>	Marsileaceae	AH	Chandamama kura	B	LC
208	<i>Memecylon umbellatum</i>	Melastomataceae	T	Alli, Peddalli	B	NA
209	<i>Merremia gangetica</i>	Convolvulaceae	H	Elukagemudu	B	LC
210	<i>Mesosphaerum suaveolens</i>	Lamiaceae	H	Danthitulasi	C&B	NA
211	<i>Miliusa tomentosa</i>	Annonaceae	T	Barredudduga	C&B	NA
212	<i>Mimosa pudica</i>	Leguminosae	H	Attipatti, Mudatha thaamara	B	LC
213	<i>Mitragyna parvifolia</i>	Rubiaceae	T	Kadamba	C&B	NA
214	<i>Morinda coreia</i>	Rubiaceae	T	Togaru	C&B	NA
215	<i>Naringi crenulata</i>	Rutaceae	T	Kukka velaga	B	NA
216	<i>Nelumbo nucifera</i>	Nelumbonaceae	AH	Kamalam	B	NA

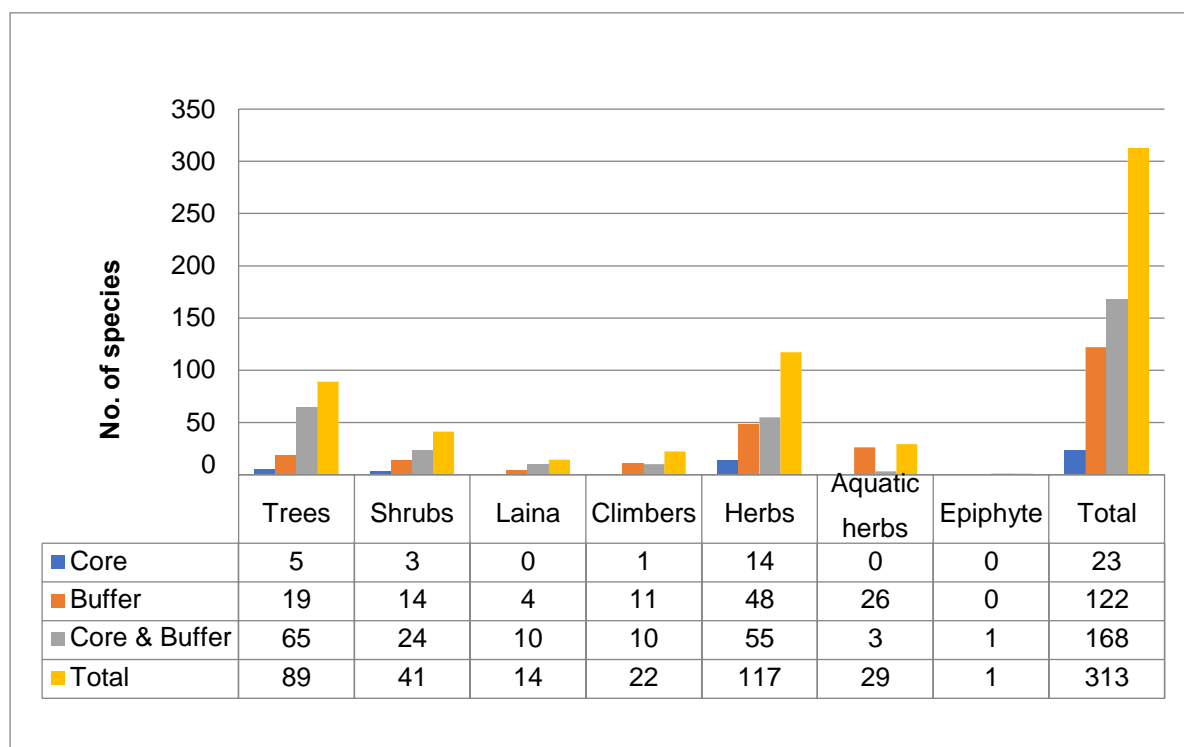
217	<i>Nyctanthes arbor-tristis</i>	Oleaceae	T	Parijatham	B	NA
218	<i>Nymphaea nouchali</i>	Nymphaeaceae	AH	Thamara	B	LC
219	<i>Ochna obtusata</i>	Ochnaceae	T	Raktha sirishamu	C&B	NA
220	<i>Ocimum basilicum</i>	Lamiaceae	H	Kammagaggiri aku	B	NA
221	<i>Ocimum tenuiflorum</i>	Lamiaceae	H	Thulasi	B	NA
222	<i>Olax scandens</i>	Olacaceae	L	Yelaka Nakkera	C&B	NA
223	<i>Oldenlandia umbellata</i>	Rubiaceae	H	Chiriveru	B	NA
224	<i>Opuntia stricta</i>	Cactaceae	S	Brahmma jemudu	C&B	LC
225	<i>Orthosiphon rubicundus</i>	Lamiaceae	H	Podathulasi	C&B	NA
226	<i>Osbeckia zeylanica</i>	Melastomataceae	H	Burada alli	C	NA
227	<i>Ouret lanata</i>	Amaranthaceae	H	Kondapindi	B	NA
228	<i>Parthenium hysterophorus</i>	Compositae	H	Vayyaribhama	C&B	NA
229	<i>Pavonia zeylanica</i>	Malvaceae	H	Karubenda	B	NA
230	<i>Pergularia daemia</i>	Apocynaceae	C	Dustapa teega	C&B	LC
231	<i>Persicaria glabra</i>	Polygonaceae	AH	Neetiganneru, Burada Gogu	B	LC
232	<i>Phoenix loureiroi</i>	Arecaceae	S	Konda itha	C&B	LC
233	<i>Phoenix sylvestris</i>	Arecaceae	T	Itha chettu	C&B	NA
234	<i>Phyllanthus amarus</i>	Phyllanthaceae	H	Nelausiri	B	NA
235	<i>Phyllanthus emblica</i>	Phyllanthaceae	T	Usirikaya	C&B	LC
236	<i>Phyllanthus maderaspatensis</i>	Phyllanthaceae	H	Pedda Nela Usiri	C&B	LC
237	<i>Phyllanthus reticulatus</i>	Phyllanthaceae	S	Purugudu	B	LC
238	<i>Phyllanthus virgatus</i>	Phyllanthaceae	H	Gadhausiri	C&B	NA
239	<i>Pleurolobus gangeticus</i>	Leguminosae	H	Kolakuponna	C&B	NA
240	<i>Pongamia pinnata</i>	Leguminosae	T	Kanuga	B	LC
241	<i>Portulaca oleracea</i>	Portulacaceae	H	Payalaku	B	LC
242	<i>Premna mollissima</i>	Lamiaceae	T	Kondamanga	C&B	NA
243	<i>Prosopis juliflora</i>	Leguminosae	T	Sarkar tumma	C&B	NA
244	<i>Pseudarthria viscida</i>	Fabaceae	C	Adavi chikkudu	B	NA
245	<i>Pteris argyrea</i>	Pteridaceae	AH	-	B	NA
246	<i>Pterolobium hexapetalum</i>	Leguminosae	L	Korintha	C&B	NA
247	<i>Pterospermum xylocarpum</i>	Malvaceae	T	Loluguchettu, Thada	C&B	NA
248	<i>Pulicaria wightiana</i>	Asteraceae	H	Adavipoddutir ugudu	C&B	NA
249	<i>Pupalia lappacea</i>	Amaranthaceae	H	Yerra utthareni	C&B	LC
250	<i>Rhynchosia rufescens</i>	Leguminosae	C	-	B	NA
251	<i>Rivea hypocrateriformis</i>	Convolvulaceae	L	Bodditeega	C&B	NA
252	<i>Ruellia tuberosa</i>	Acanthaceae	H	Chitapatakayal a mokka	C&B	NA
253	<i>Saccharum spontaneum</i>	Poaceae	H	Naagaswaram, Adavicheruku	B	LC
254	<i>Santalum album</i>	Santalaceae	T	Swethagandham	C	VU
255	<i>Sapindus emarginatus</i>	Sapindaceae	T	Kunkudu	B	NA
256	<i>Schleichera oleosa</i>	Sapindaceae	T	Poosuga	C&B	LC
257	<i>Schoenoplectiella articulata</i>	Cyperaceae	H	-	C&B	LC
258	<i>Schrebera swietenoides</i>	Oleaceae	T	Magalinga	C&B	NA

259	<i>Scleria lithosperma</i>	Cyperaceae	H	-	C&B	NA
260	<i>Scoparia dulcis</i>	Plantaginaceae	H	Godathulasi	C&B	NA
261	<i>Senegalia chundra</i>	Leguminosae	T	Sandra	C&B	NA
262	<i>Senegalia torta</i>	Leguminosae	S	Korinta teega	B	NA
263	<i>Senna auriculata</i>	Leguminosae	S	Thangedi	B	NA
264	<i>Senna occidentalis</i>	Leguminosae	H	Kasinda	B	LC
265	<i>Senna tora</i>	Leguminosae	H	Thantepu mokka	B	NA
266	<i>Sida acuta</i>	Malvaceae	H	Katari kaanaaku	B	NA
267	<i>Sida cordifolia</i>	Malvaceae	H	Badiyalaku	B	NA
268	<i>Solanum virginianum</i>	Solanaceae	H	Nela vaakudu	B	NA
269	<i>Soymida febrifuga</i>	Meliaceae	T	Somi	B	NA
270	<i>Spermacoce articularis</i>	Rubiaceae	H	Madanaku	B	NA
271	<i>Spermacoce pusilla</i>	Rubiaceae	H	Chukkakaada	B	NA
272	<i>Sphaeranthus indicus</i>	Compositae	H	Bodasaramu	B	LC
273	<i>Stemodia viscosa</i>	Plantaginaceae	H	Bodasaramamu	C&B	NA
274	<i>Sterculia urens</i>	Malvaceae	T	Thapassi	C&B	NA
275	<i>Stereospermum tetragonum</i>	Bignoniaceae	T	Ummrttha	C	NA
276	<i>Streblus asper</i>	Moraceae	T	Barraniki	B	LC
277	<i>Striga angustifolia</i>	Orobanchaceae	H	Jonnamalle	C&B	NA
278	<i>Striga asiatica</i>	Orobanchaceae	H	Raathibadanika	C&B	NA
279	<i>Strobilanthes pavala</i>	Acanthaceae	H	-	C	NA
280	<i>Strychnos nux-vomica</i>	Loganiaceae	T	Mustichettu	C&B	NA
281	<i>Strychnos potatorum</i>	Loganiaceae	T	Chillanginja chettu	C&B	NA
282	<i>Tacca leontopetaloides</i>	Dioscoreaceae	H	Ritthakanda	C	LC
283	<i>Tamarindus indica</i>	Leguminosae	T	Chinta	C&B	LC
284	<i>Tarenna asiatica</i>	Rubiaceae	S	Konda Papidi	C&B	NA
285	<i>Tectona grandis</i>	Lamiaceae	T	Teku	C&B	NA
286	<i>Tephrosia purpurea</i>	Leguminosae	H	Vempali	C&B	NA
287	<i>Tephrosia villosa</i>	Leguminosae	H	Noogu vempalli	B	LC
288	<i>Terminalia anogeissiana</i>	Combretaceae	T	Sirimanu	C&B	NA
289	<i>Terminalia arjuna</i>	Combretaceae	T	Tellamaddhi	C&B	NA
290	<i>Terminalia bellirica</i>	Combretaceae	T	Thani	C&B	LC
291	<i>Terminalia elliptica</i>	Combretaceae	T	Nallamaddi	B	NA
292	<i>Trianthema portulacastrum</i>	Aizoaceae	H	Galijeru	C&B	NA
293	<i>Tridax procumbens</i>	Compositae	H	Gaddichamanthi	B	NA
294	<i>Trigastrotheca pentaphylla</i>	Molluginaceae	H	Pichichatraku	C	NA
295	<i>Triumfetta rotundifolia</i>	Malvaceae	S	-	C	NA
296	<i>Typha angustifolia</i>	Typhaceae	S	Jammu	B	LC
297	<i>Urochloa ramosa</i>	Poaceae	H	-	B	LC
298	<i>Vachellia leucophloea</i>	Leguminosae	T	Tella thumma	C&B	LC
299	<i>Vachellia nilotica</i>	Leguminosae	T	Nalla thumma	C&B	LC
300	<i>Vanda tessellata</i>	Orchidaceae	ES	Badanika	C&B	LC
301	<i>Ventilago denticulata</i>	Rhamnaceae	L	Erra sanguru	B	NA
302	<i>Viscum articulatum</i>	Santalaceae	S	Jilledu badanika	C	NA
303	<i>Vitex negundo</i>	Lamiaceae	S	Nalla vavilli	C&B	LC
304	<i>Waltheria indica</i>	Malvaceae	S	Nallabenda	C&B	LC
305	<i>Woodfordia fruticosa</i>	Lythraceae	S	Jargi seringi	C&B	LC

306	<i>Wrightia tinctoria</i>	Apocynaceae	T	Palamaneru	C&B	NA
307	<i>Xanthium strumarium</i>	Compositae	S	Marulamathangi	B	NA
308	<i>Xenostegia tridentata</i>	Convolvulaceae	C	Mududantla	B	NA
309	<i>Xylia xylocarpa</i>	Leguminosae	T	Bojja	C&B	LC
310	<i>Ziziphus jujuba</i>	Rhamnaceae	T	Regu	C&B	LC
311	<i>Ziziphus oenopolia</i>	Rhamnaceae	L	Pariki kampa	C&B	LC
312	<i>Ziziphus xylopyrus</i>	Rhamnaceae	T	Gotti	C&B	NA
313	<i>Zornia gibbosa</i>	Fabaceae	H	Nelabariki	C&B	NA

*Note: T-Trees; S-Shrubs; H-Herbs; C-Climbers; L-Lianas; AH-Aquatic herb; EP-Epiphyte; C-Core zone; B-Buffer zone; LC-Least Concern; NA-Not Assessed; VU-Vulnerable; NT-Near Threatened

Fig. 12. Vegetation Analysis



Twenty-nine Aquatic species observed in the study area of which, 19 are Angiosperms (*Actinoscirpus grossus*, *Ammannia baccifera*, *A. multiflora*, *Aponogeton crispus*, *Bacopa monnieri*, *Bergia capensis*, *Bonnaya ciliate*, *Canscora heteroclite*, *Commelina benghalensis*, *Cyanotis axillaris*, *Cyperus corymbosus*, *C. difformis*, *C. exaltatus*, *C. mindorensis* subsp. *pygmaeus*, *C. mindorensis*, *C. pangorei*, *Eleocharis geniculata*, *Fimbristylis aestivalis*, *F. argentea*, *F. quinquangularis*, *Hydrilla verticillata*, *Hygrophila auriculata*, *Nelumbo nucifera*, *Nymphaea nouchali* and *Persicaria glabra*), three are Pteridophytes (*Ceratopteris thalictroides*, *Marsilea quadrifolia* and *Pteris argyrea*) and *Chara globularis* is Algae.

The most dominant families are Fabaceae represented by 40 species of 31 genera followed by Poaceae 18/14, Malvaceae 18/13, Rubiaceae 16/14, Cyperaceae 15/7, Asteraceae 14/12, Acanthaceae 12/9, Convolvulaceae 11/5, Lamiaceae 9/7, Euphorbiaceae 9/6, Apocyanaceae 8/7, Amaranthaceae 8/6, Phyllanthaceae 8/3, Combretaceae 6/3, Moraceae 6/2, Boraginaceae 5/4, Rutaceae 4/4, Capparaceae & Lythraceae each with 4/3, Rhamnaceae 4/2, Anacardiaceae, Annonaceae, Asparagaceae, Oleaceae, Plantaginaceae and Sapindaceae each with 3/3, Commelinaceae & Molluginaceae each

with 3/2, Ebenaceae 3/1, Burseraceae, Celastraceae, Dioscoreaceae, Melastomataceae, Meliaceae, Orchidaceae, Pteridaceae, Santalaceae & Sapotaceae each with 2/2, Arecaceae, Loganiaceae, Nyctaginaceae & Orobanchaceae each with 2 species in 1 genera and 41 families are represented each with one species of one genera.

Top ten families are Fabaceae, Poaceae, Malvaceae, Rubiaceae, Cyperaceae, Asteraceae, Acanthaceae, Convolvulaceae, Lamiaceae and Euphorbiaceae are occupied 52% of the total vegetation structure.

Fig. 13. Top Ten Dominated Families

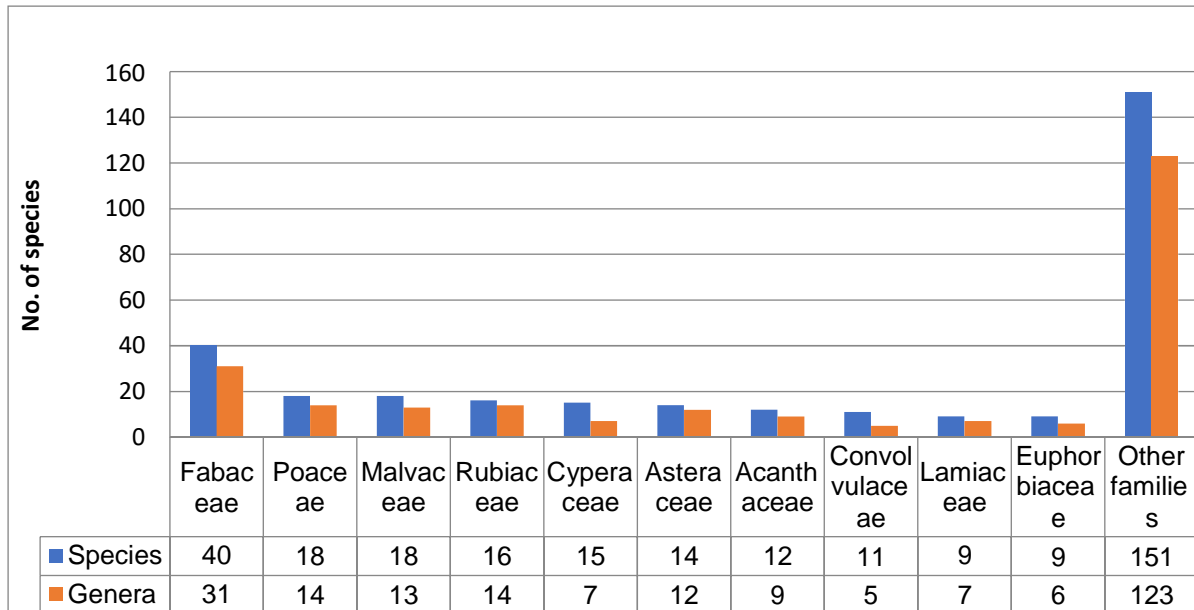
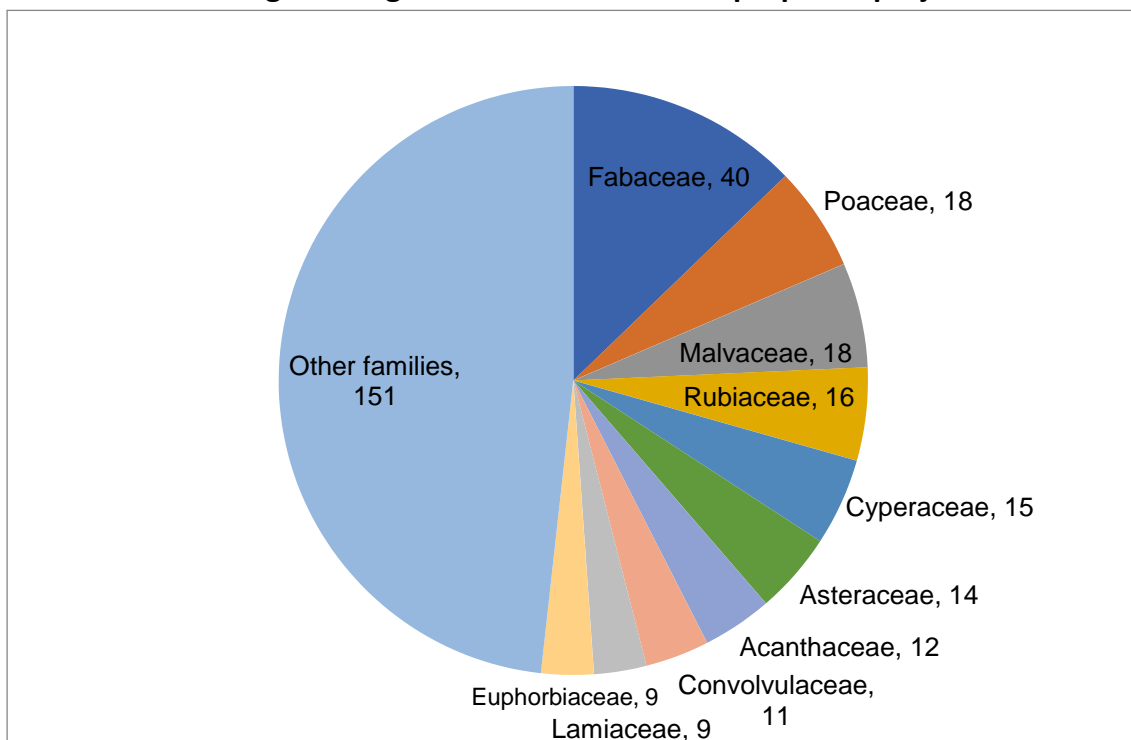


Fig. 14. Vegetation structure in the proposed project



Phyto-sociological features of trees, shrubs and herbs observed in core & buffer zones:

Core Zone

- A. Trees** – From Importance Value Index (IVI), it is inferred that for trees the dominant species is *Tectona grandis* is with 34.71 of Importance Value Index followed by *Cleistanthus collinus* (22.97), *Xylia xylocarpa* (20.24) and *Boswellia serrata* (18.73). **Simpson's Index value (0.07) and Shannon Wiener Index value (1.24)** for trees shows that diversity is more in comparison to species dominance.
- B. Shrubs** – *Butea superb* is identified as the most dominant species with 51.6 of Importance Value Index followed by *Helicteres isora* (42.07), *Waltheria indica* (37.56), *Dioscorea pentaphylla* and *Derris scandens* each with 33.98. **Simpson's Index value is 0.13 and the Shannon Wiener Index value is 0.93**, which shows that diversity is more.
- C. Herbs** – *Drimia indica* is identified as the most dominant species with 43.85 of Importance Value Index followed by *Andrographis paniculata* and *Cyanthillium albicans* each with 39.21 and *Gloriosa superba* (37.89). **Simpson's Index value is 0.13 and the Shannon Wiener Index value is 0.92**, which shows that diversity is more.

Table 4. Phyto-sociological features observed in core zone

Core zone				
31.62 x 31.62 m for Trees				
S.No.	Name	IVI	Simpson	Shannon
1	<i>Tectona grandis</i>	34.71	0.028	-0.13
2	<i>Albizia odoratissima</i>	8.53	0	-0.04
3	<i>Givotia moluccana</i>	10.87	0.001	-0.05
4	<i>Cleistanthus collinus</i>	22.97	0.009	-0.1
5	<i>Lannea coromandelica</i>	3.74	0	-0.01
6	<i>Diospyros melanoxylon</i>	17.88	0.004	-0.08
7	<i>Boswellia serrata</i>	18.73	0.005	-0.08
8	<i>Dalbergia lanceolaria</i> subsp. <i>paniculata</i>	13.42	0.002	-0.06
9	<i>Stereospermum tetragonum</i>	8.53	0	-0.04
10	<i>Lagerstroemia parviflora</i>	15.33	0.002	-0.06
11	<i>Hardwickia binata</i>	9.7	0.001	-0.04
12	<i>Acacia leucophloea</i>	11.51	0.001	-0.05
13	<i>Grewia flavescens</i>	13.22	0.002	-0.06
14	<i>Hardwickia binata</i>	10.87	0.001	-0.05
15	<i>Firmiana simplex</i>	12.82	0.001	-0.05
16	<i>Acacia chundra</i>	17.9	0.004	-0.08
17	<i>Aegle marmelos</i>	13.22	0.002	-0.06
18	<i>Chloroxylon swietenia</i>	15.56	0.003	-0.07
19	<i>Ficus mollis</i>	3.74	0	-0.01
20	<i>Ochna obtusata</i>	9.19	0	-0.04
21	<i>Xylia xylocarpa</i>	20.24	0.005	-0.08
22	<i>Wrightia tinctoria</i>	7.37	0	-0.03
			0.07	-1.24

5 x 5 m for Shrubs				
1	<i>Butea superba</i>	51.6	0.047	-0.14
2	<i>Cajanus scarabaeoides</i>	25.89	0.006	-0.09
3	<i>Waltheria indica</i>	37.56	0.019	-0.12
4	<i>Phoenix loureiroi</i>	21.5	0.003	-0.07
5	<i>Helicteres isora</i>	42.07	0.025	-0.13
6	<i>Grewia hirsuta</i>	10.99	0	-0.03
7	<i>Dioscorea pentaphylla</i>	33.98	0.014	-0.11
8	<i>Derris scandens</i>	33.98	0.014	-0.11
9	<i>Catunaregam spinosa</i>	17.81	0.002	-0.06
10	<i>Tarenna asiatica</i>	24.63	0.003	-0.07
			0.13	-0.93
1 x 1 m for Herbs				
1	<i>Gloriosa superba</i>	37.89	0.02	-0.12
2	<i>Evolvulus nummularius</i>	26.09	0.006	-0.09
3	<i>Cyanthillium albicans</i>	39.21	0.02	-0.12
4	<i>Orthosiphon rubicundus</i>	41.51	0.026	-0.13
5	<i>Andrographis paniculata</i>	39.21	0.02	-0.12
6	<i>Byttneria herbacea</i>	29.55	0.006	-0.09
7	<i>Drimia indica</i>	43.85	0.026	-0.13
8	<i>Scleria lithosperma</i>	24.8	0.004	-0.07
9	<i>Phyllanthus virgatus</i>	17.92	0.002	-0.06
			0.13	-0.92

Buffer Zone

- A. Trees** – From Importance Value Index (IVI), it is inferred that, for trees *Xylocarpa* is the most dominant species with 21.00 of Importance Value Index followed by *Tectona grandis* (16.27), *Lannea coromandelica* (15.85), *Anogeissus latifolia* (14.76), *Schleichera oleosa* and *Cleistanthus collinus* each with (10.3) and *Cleistanthus collinus* (10.36). Simpson's Index value is 0.042 and the Shannon Wiener Index value is 1.47, which shows that diversity is more.
- B. Shrubs** – *Woodfordia fruticosa* is identified as the most dominant species with 35.44 of Importance Value Index followed by *Canthium coromandelicum* (22.86), *Chromolaena odorata* (21.26), *Helicteres isora* (20.55) and *Getonia floribunda* (20.2). Simpson's Index value is 0.07 and the Shannon Wiener Index value is 1.19, which shows that diversity is more.
- C. Herbs** – *Hybanthus enneaspermus* is identified as the most dominant species with 25.95 of Importance Value Index followed by *Orthosiphon rubicundus* (25.18), *Oldenlandia umbellata* and *Scleria terrestris* each with 23.84, *Byttneria herbacea* (22.88) and *Lepidagathis cristata* (21.02). Simpson's Index value is 0.07 and the Shannon Wiener Index value is 1.18, which shows that diversity is more.

This infers the buffer zone of woody species has more diversity when compared to other life forms of plants. Most of the natural growth recorded is of coppice in nature.

Table 5. Phyto-sociological features observed in core zone

Buffer zone				
31.62 x 31.62 m for Trees				
1	<i>Xylia xylocarpa</i>	21	0.01	-0.1
2	<i>Lannea coromandelica</i>	15.85	0.005	-0.08
3	<i>Anogeissus latifolia</i>	14.76	0.004	-0.07
4	<i>Madhuca longifolia</i> var. <i>latifolia</i>	9.62	0.001	-0.05
5	<i>Mitragyna parvifolia</i>	7	0	-0.03
6	<i>Schleichera oleosa</i>	10.37	0.001	-0.05
7	<i>Terminalia alata</i>	9.17	0.001	-0.05
8	<i>Miliusa tomentosa</i>	10.08	0.001	-0.05
9	<i>Hardwickia binata</i>	8.71	0.001	-0.04
10	<i>Cleistanthus collinus</i>	10.36	0.001	-0.05
11	<i>Boswellia serrata</i>	8.01	0.001	-0.04
12	<i>Buchanania cochinchinensis</i>	8.26	0.001	-0.04
13	<i>Soymida febrifuga</i>	7	0	-0.03
14	<i>Bombax ceiba</i>	9.17	0.001	-0.05
15	<i>Albizia odoratissima</i>	8.51	0.001	-0.04
16	<i>Givotia moluccana</i>	8.09	0.001	-0.04
17	<i>Diospyros melanoxylon</i>	7	0	-0.03
18	<i>Bridelia retusa</i>	6.33	0	-0.03
19	<i>Dalbergia lanceolaria</i> subsp. <i>paniculata</i>	9.02	0.001	-0.05
20	<i>Careya arborea</i>	7.5	0.001	-0.04
21	<i>Lagerstroemia parviflora</i>	9.02	0.001	-0.05
22	<i>Tectona grandis</i>	16.27	0.005	-0.08
23	<i>Pterospermum xylocarpum</i>	6.33	0	-0.03
24	<i>Terminalia bellirica</i>	4.49	0	-0.02
25	<i>Grewia tiliifolia</i>	6.92	0	-0.03
26	<i>Butea monosperma</i>	4.49	0	-0.02
27	<i>Gardenia latifolia</i>	6.33	0	-0.03
28	<i>Chloroxylon swietenia</i>	4.49	0	-0.02
29	<i>Albizia amara</i>	5.99	0	-0.03
30	<i>Bauhinia racemosa</i>	5.99	0	-0.03
31	<i>Aegle marmelos</i>	4.48	0	-0.02
32	<i>Wrightia tinctoria</i>	9.75	0.001	-0.04
33	<i>Ochna obtusata</i>	7.49	0	-0.03
34	<i>Acacia leucophloea</i>	4.48	0	-0.02
35	<i>Euphorbia nivulia</i>	4.48	0	-0.02
36	<i>Naringi crenulata</i>	3.23	0	-0.01
			0.042	-1.47
5 x 5 m for Shrubs				
1	<i>Woodfordia fruticosa</i>	35.44	0.025	-0.13
2	<i>Tarennia asiatica</i>	18.09	0.004	-0.08
3	<i>Ixora pavetta</i>	15.97	0.003	-0.07
4	<i>Helicteres isora</i>	20.55	0.005	-0.08
5	<i>Canthium coromandelicum</i>	22.86	0.005	-0.08
6	<i>Getonia floribunda</i>	20.2	0.006	-0.09

7	<i>Chromolaena odorata</i>	21.26	0.007	-0.09
8	<i>Catunaregam spinosa</i>	19.14	0.005	-0.08
9	<i>Erythroxylum monogynum</i>	18.09	0.004	-0.08
10	<i>Grewia hirsuta</i>	12.3	0.001	-0.05
11	<i>Ziziphus oenopolia</i>	15.72	0.003	-0.07
12	<i>Carissa carandas</i>	12.3	0.001	-0.05
13	<i>Butea superba</i>	12.3	0.001	-0.05
14	<i>Olex scandens</i>	11.31	0.001	-0.04
15	<i>Acalypha alnifolia</i>	6.46	0	-0.02
16	<i>Dichrostachys cinerea</i>	8.89	0	-0.03
17	<i>Flacourtia indica</i>	6.46	0	-0.02
18	<i>Phoenix loureiroi</i>	6.46	0	-0.02
19	<i>Triumfetta rotundifolia</i>	16.16	0.001	-0.05
			0.07	-1.19
1 x 1 m for Herbs				
1	<i>Byttneria herbacea</i>	22.88	0.008	-0.09
2	<i>Orthosiphon rubicundus</i>	25.18	0.01	-0.1
3	<i>Andrographis paniculata</i>	15.6	0.002	-0.06
4	<i>Spermacoce articularis</i>	18.51	0.004	-0.08
5	<i>Sida cordifolia</i>	17.06	0.003	-0.07
6	<i>Scleria lithosperma</i>	23.84	0.008	-0.09
7	<i>Oldenlandia umbellata</i>	23.84	0.008	-0.09
8	<i>Phyllanthus virgatus</i>	17.74	0.004	-0.08
9	<i>Hybanthus enneaspermus</i>	25.95	0.011	-0.1
10	<i>Lepidagathis cristata</i>	21.02	0.006	-0.09
11	<i>Desmodium gangeticum</i>	16.26	0.003	-0.07
12	<i>Fimbristylis ovata</i>	20.91	0.003	-0.07
13	<i>Evolvulus nummularius</i>	11.5	0.001	-0.04
14	<i>Eragrostis viscosa</i>	8.36	0	-0.03
15	<i>Elytraria acaulis</i>	11.5	0.001	-0.04
16	<i>Cyanthillium albicans</i>	8.36	0	-0.03
17	<i>Alysicarpus monilifer</i>	11.5	0.001	-0.04
			0.07	-1.18

IUCN Red list species

During primary data collection, identified *Chloroxylon swietenia*, *Cleistanthus collinus*, *Curcuma pseudomontana*, *Cycas rumphii* (Planted in core zone) and *Santalum album* which are falls under Vulnerable (Vu) category and *Albizia thompsonii* listed in Near Threatened category as per IUCN Red list.

Seed collection and rising of saplings may also be taken up by SCCL in their nurseries and planted in open areas to restore the ecosystem. *Cycas rumphii* was planted 30 years ago in Project Office of GK-OCP campus.

Density enrichment plantations by Forest Department within the 10 Kms radius:

The forest department has raised density enrichment plantations in a total of 234 Hectares, comprising 5 forest beats within the radius of 10 Kms, which is being home range for varied wildlife existing and moving in the adjoining forests outside the mine boundaries.

Also, the department has developed a 15 acres of grass plot in Tippanapalli forest beat as a fodder/ feeding ground for the ungulates present in the forest areas within the 10 Kms radius.

Table 6. Total area of Beat wise plantations by forest department

S.No.	Beat	Plantation in Ha			Grass land		
		Ha	Latitude	Longitude	Ha	Latitude	Longitude
1	Tungaram	30	17.44781	80.61903	0		
		20	17.4386	80.61918			
		20	17.43909	80.62068			
		10	17.4454	80.62151			
		5	17.44800	80.61940			
		14	17.43915	80.62355			
	Sub-Total:	99			0		
2	Tippanapalli	20	17.4364	80.62889	15	17.43769	80.64544
		25	17.4296	80.62501			
		25	17.4287	80.61866			
		20	17.42656	80.63245			
		25	17.42041	80.62945			
	Sub-Total:	115			15		
3	Penagadapa	20	17.42395	80.68048	0		
	Sub-Total:	20			0		
4	Ramavaram	0			0		
	Sub-Total:	0			0		
5	Gareebpeta	0			0		
	Sub-Total:	0			0		
	Grand Total:	234			15		

The proposed core zone of the project is falls in Ramavaram reserve forest and Buffer zone is occupied by Five RFs namely falling in Ramavaram RF, Chatakonda RF, Penagadapa RF, Mulakalapalli RF and Paloncha East RF of Kothagudem and Paloncha divisions.

There are no National Parks, Biosphere Reserve, Tiger Reserves and Elephant Reserve/Corridor in the study area.

Density enrichment plantations by SCCL within the 10 Kms radius:

A total of 1106 Hectares of (block, OB, and avenue) plantations have been raised by SCCL since 1984 in this area during ecological restoration processes. These restoration practices are highly upsurging in reversing the habitat degradation happened in and around the mine areas.

During the survey, it is observed that all the plantations are helping to restore organisms and their interactions with one another and with the physical environment. Observations of varied faunal groups shows the success of the ecological restoration practices of the mines, which focusses on the processes such as perseverance of species through natural recruitment and survival, functioning food webs, system-wide nutrient conservation via relationships among plants, and animals.

Table 7. Kothagudem Block plantations from 1984-2020 by SCCL

Year of raising	Location	Name of the Species planted	Area in Ha	Lat & Long
1984	Cashew plantation	Cashew	27	N 17.5267 E 80.6424
1999	Block pl' at CRP Camp	EC	9	N 17.5263 E 80.6311
1999	Garemellapadu	EC	11	N 17.5267 E 80.6424
2000	7 Shaft dispensary	EC	14	N 17.4725 E 80.6656
2000	Garemellapadu	EC	5	N 17.5191 E 80.6442
2001	Garemellapadu	EC	5	
2003	3 Incline	EC	12	N 17.5074 E 80.6479
2003	Hemachandrapuram	EC	10	N 17.5535 E 80.5916
2003	Garemellapadu	EC	19	N 17.5209 E 80.6467
2004	Rly.siding	EC	7	N 17.5050 E 80.6518
2004	St. Josephs	EC&M	7	N 17.4983 E 80.6510
2004	VK Timberyard	EC	5	N 17.4692 E 80.6668
2004	Coal Testing Lab	EC	8	N 17.5061 E 80.6528
2005	GPF Nursery	EC	25	N 17.5345 E 80.6314
2005	GKOCP	M	10	N 17.5345 E 80.6315
2005	5 & 7 Shaft	EC,M&B	35	N 17.4830 E 80.6647
2005	VK compound wall	EC&M	7	N 17.4783 E 80.6729
2006	Vanamanagar	EC&M	5	N 17.4702 E 80.6682
2006	Goutampur	M	4	N 17.4815 E 80.6446
2006	5Shaft	M	10	N 17.4968 E 80.6692
2006	Gadalamadugu	EC	13	N 17.5423 E 80.5562
2006	GKOCP	M	10	N 17.5423 E 80.5563
2007	Tilaknagar	EC	5	N 17.4802 E 80.6474
2007	Goutampur	EC&M	3	N 17.4828 E 80.6463
2007	Behind 3 Incline	EC	5	N 17.5100 E 80.6414
2007	7 Incline	EC&M	5	N 17.4748 E 80.6678
2007	7 Incline (S)	EC&M	8	N 17.4838 E 80.6719
2007	2 Incline	EC	4	N 17.5300 E 80.6382
2007	Tellavagu	M	6	N 17.4931 E 80.6850
2008	Subsidence panel 1 & 1A	M	6	N 17.4922 E 80.6625
2009	Behind VK-7 Incline Mine-RF	EC	9	N17.5770 E 80.6379
2009	Evacuated Colony of VK-7 Incline	EC	7	N 17.4761 E 80.6680

2009	Gaps in cashew pl' near Dhanbad and ITI	EC	24	N 17.5223 E 80.6411
2009	Gaps in cashew pl' near Christian graveyards 2 incline	EC	6	N 17.4923 E 80.6584
2009	Gaps in cashew pl' near B CF	EC	8	N 17.5147 E 80.6439
2009	Behind Central Nursery, KGM	M	9	N 17.5770 E 80.6378
2010	GKOCP-Block	EC&M	8	N 17.4466 E 80.6609
2011	RF area in KGM near Deport.	M	15	N 17.5724 E80.6327
2012	GKOCP Vacant patches	M	4	N 17.4622 E80.65163
2012	VK-7 Incline Vacant patches	M	4	N 17.4816 E80.67233
2013	Gaps in Cashew plantations at Garimellapadu	M	33	N 17.3130 E80.3835
2014	VK-7 Incline	EU	10	N 17.2848 E80.4014
2016	RF plantation near Gaddalamadugu	M	22	N 17.3301 E80.3830
2016	RF plantation near 5B shaft	M	42	N 17.3012 E80.4018
2016	Euc.clonal planatation near CRP camp, Ramavaram	EC	2	N 17.5283 E80.6309
2016	Vacant patches in writer basthi. KGM/Corp	M	2	N 17.5283 E80.6310
2017	RF plantation at Gaddalamadugu	EC & M	50	N 17.4947 E.80.657457
	Gap plantation from writer basthi to main hospital area, Kothagudem	M	10	N 17.5500 E80.608049
2019	Garimellapadu	M	2	N 17.5272 E.80.648357
Total			567.00	

(EC- Eucalyptus; B – Bamboo; M – Mixed/Miscellaneous)

Table 8. Kothagudem Avenue plantations by SCCL

Year of raising	Location	Name of the Species planted	Area in Ha	Lat & Long
2001	Goutampur	M	2	N 17.4809 E 80.6478
2002	Rudrampur	M	5	N 17.4984 E 80.6527
2003	GKOCP, Writer basthi, Rudrampur colony	M	13	N 17.4555 E 80.6283
2004	Rudrampur,5shaft	M	5	N 17.4984 E 80.6527
2005	5&7 shaft	M	5	N 17.4842 E 80.6679
2008	Kothagudem area	M	2	N 17.4988 E 80.6530
2009	Gaps in Writer basthi, KGM	M	3	N 17.5467 E 80.6156
2010	GKOCP	M	2	N 17.4466 E 80.6591
2014	PVK-Guest House	M	1	N 17.2911 E80.3929
Total			38.00	

Table 9. GKOCP OB plantations by SCCL

Year of raising	Location	Name of the Species planted	Area in Ha	Lat & Long
1999	GKOCP, OB	M	2	N 17.4457 E 80.6456
2001	GKOCP, OB	M	10	N 17.4495 E 80.6441
2002	GKOCP, OB	M	23	N 17.4578 E 80.6285
2003	GKOCP, OB	M	52	N 17.4558 E 80.6329
2004	GKOCP, OB	M	65	N 17.4585 E 80.6294
2005	GKOCP, OB	M	48	N 17.4640 E 80.6298
2006	GKOCP, OB	M	31	N 17.4618 E 80.6328
2007	GKOCP, OB	M	7	N 17.4600 E 80.6368
2008	GKOCP, OB	M	8	N 17.2086 E 80.8122
2009	GKOCP-West Dump-RF, OB	M	44	N 17.4618 E 80.6328
2010	GKOCP-OB	M	28	N 17.4466 E 80.6591
2011	GKOCP, OB	M	19	N17.44881 E80.65703
2012	GKOCPOB dumps	M	25	N17.44663 E80.65681
2013	GKOCP, OB	M	33	N17.2643 E80.3919
2014	GKOCP, OB	M	12	N17.2871 E80.3949
2015	GKOCP, OB	M	12	N17.2718 E80.3815
2016	GKOCP, OB	M	24	N17.2871 E80.3949
2017	GKOCP, OB	M	12	N17.4519 E80.6466
2018	GKOCP, OB	EC & M	46	N17.4511 E80.6478
Total for Kothagudem			501.00	

Planting suitable vegetation can help to re-establish habitats relatively rapidly after mining disturbance. This may benefit varied biodiversity/wildlife of the area.

List of mixed/miscellaneous species planted by SCCL:

- | | | |
|----------------------------------|-------------------------------------|------------------------------------|
| 1. <i>Hardwickia binata</i> | 16. <i>Annona squamosa</i> | 30. <i>Sterculia urens</i> |
| 2. <i>Dendrocalamus strictus</i> | 17. <i>Terminalia bellarica</i> | 31. <i>Tectonia grandis</i> |
| 3. <i>Ficus religiosa</i> | 18. <i>Spathodea campanulata</i> | 32. <i>Dalbergia sissoo</i> |
| 4. <i>Pterocarpus santalinus</i> | 19. <i>Pongamia pinnata</i> | 33. <i>Cassia siamea</i> |
| 5. <i>Azadirachta indica</i> | 20. <i>Ficus mollis</i> | 34. <i>Adina cordifolia</i> |
| 6. <i>Limonia acidissima</i> | 21. <i>Lagerstroemia parviflora</i> | 35. <i>Putranjeeva rasuburgi</i> |
| 7. <i>Ficus bengalensis</i> | 22. <i>Bauhinia purpurea</i> | 36. <i>Bombax ceiba</i> |
| 8. <i>Aegle marmelos</i> | 23. <i>Millingtonia harrtensis</i> | 37. <i>Mimusops elangii</i> |
| 9. <i>Mitragyna parvifolia</i> | 24. <i>Madhuka indica</i> | 38. <i>Terminalia chebula</i> |
| 10. <i>Dalbergia latifolia</i> | 25. <i>Ficus carica</i> | 39. <i>Peltophorum ferruginum</i> |
| 11. <i>Pterocarpus marsupium</i> | 26. <i>Tamarindus indica</i> | 40. <i>Albizzia lebbek</i> |
| 12. <i>Embllica officinalis</i> | 27. <i>Cassia fistula</i> | 41. <i>Couravpita guinensis</i> |
| 13. <i>Syzygium cumini</i> | 28. <i>Anthocephalus kadamba</i> | 42. <i>Holoptelea integrifolia</i> |
| 14. <i>Alstonia scholaris</i> | 29. <i>Pithecelobium dulce</i> | |
| 15. <i>Albizzia procera</i> | | |

Fauna Diversity:

Mammals: In the study area, a total of **19 species** of mammals distributed in 16 Genera belonging to 6 orders and 13 families were recorded. The species include Wild Boar, Common Mongoose, Greater Indian fruit bat, Rhesus Macaque, Bonnet Macaque, Indian Palm Squirrel, Little Indian Field Mouse, Indian hare are common in their occurrence.

Table 10. List of Mammals recorded from the proposed study area

S.No.	Common Name	Scientific Name	Family	Order	IUCN Status	IWPA Schedule
1	Nilgai	<i>Boselaphus tragocamelus</i>	Bovidae	Artiodactyla	LC	III
2	Indian Spotted Deer	<i>Axis axis</i>	Cervidae	Artiodactyla	LC	III
3	Indian Sambar	<i>Rusa unicolor</i>	Cervidae	Artiodactyla	VU	III
4	Jungle Cat	<i>Felis chaus</i>	Felidae	Artiodactyla	LC	II
5	Common Grey Mongoose	<i>Urva edwardsii</i>	Herpestidae	Artiodactyla	LC	IV
6	Wild Boar	<i>Sus scrofa</i>	Suidae	Artiodactyla	LC	III
7	Indian Spotted Chevrotain	<i>Moschiola indica</i>	Tragulidae	Artiodactyla	LC	NL
8	Indian Fox	<i>Vulpes bengalensis</i>	Canidae	Carnivora	LC	II
9	Indian Flying Fox	<i>Pteropus medius</i>	Pteropodidae	Chiroptera	LC	IV
10	Indian Hare	<i>Lepus nigricollis</i>	Leporidae	Lagomorpha	LC	IV
11	Rhesus Macaque	<i>Macaca mulatta</i>	Cercopithecidae	Primates	LC	II
12	Bonnet Macaque	<i>Macaca radiata</i>	Cercopithecidae	Primates	VU	II
13	Hanuman Langur	<i>Semnopithecus entellus</i>	Cercopithecidae	Primates	LC	II
14	Indian Crested Porcupine	<i>Hystrix indica</i>	Hystriidae	Rodentia	LC	IV
15	Lesser Bandicoot Rat	<i>Bandicota bengalensis</i>	Muridae	Rodentia	LC	IV
16	Greater Bandicoot Rat	<i>Bandicota indica</i>	Muridae	Rodentia	LC	IV
17	Little Indian Field Mouse	<i>Mus booduga</i>	Muridae	Rodentia	LC	IV
18	House Mouse	<i>Mus musculus</i>	Muridae	Rodentia	LC	IV
19	Indian Palm Squirrel	<i>Funambulus palmarum</i>	Sciuridae	Rodentia	LC	IV

Herpetofauna: It is represented with **26 species** belonging to 23 genera, 3 orders and 13 families; it includes reptiles and amphibians consisting of two major classes namely Squamata and Anura, of which 20 species of reptiles belonging to orders Squamata and Testudines and 6 species of amphibians belonging to order Anura.

Table 11. List of Herpetofauna recorded from the proposed study area

S.No.	Common Name	Scientific Name	Family	Order	Class	IUCN Status	IWPA Schedule
1	Asian Grass Frog	<i>Fejervarya limnocharis</i>	Dicroglossidae	Anura	Amphibia	LC	IV
2	Common Tree Frog	<i>Polypedates leucomystax</i>	Rhacophoridae	Anura	Amphibia	LC	IV
3	Asian Common Toad	<i>Duttaphrynus melanostictus</i>	Bufo	Anura	Amphibia	LC	IV
4	Indian Skipper Frog	<i>Euphlyctis cyanophlyctis</i>	Dicroglossidae	Anura	Amphibia	LC	IV
5	Green Pond Frog	<i>Euphlyctis hexadactylus</i>	Dicroglossidae	Anura	Amphibia	LC	IV
6	Indian Bullfrog	<i>Hoplobatrachus tigerinus</i>	Dicroglossidae	Anura	Amphibia	LC	IV
7	Common Garden Lizard	<i>Calotes versicolor</i>	Agamidae	Squamata	Reptilia	LC	IV
8	Forest Blood Sucker	<i>Monilesaurus rouxii</i>	Agamidae	Squamata	Reptilia	LC	NL
9	Pondichéry Fan-throated Lizard	<i>Sitana ponticeriana</i>	Agamidae	Squamata	Reptilia	LC	NL
10	Red sand boa	<i>Eryx johnii</i>	Boidae	Squamata	Reptilia	NT	IV
11	Rough-scaled Sand Boa	<i>Gongylophis conicus</i>	Boidae	Squamata	Reptilia	NT	IV
12	Indian Chameleon	<i>Chamaeleo zeylanicus</i>	Chamaeleonidae	Squamata	Reptilia	LC	II
13	Bronze-backed Tree Snake	<i>Dendrelaphis tristis</i>	Colubridae	Squamata	Reptilia	LC	IV
14	Checkered Keelback	<i>Fowlea piscator</i>	Colubridae	Squamata	Reptilia	LC	II
15	Indian Wolf Snake	<i>Lycodon aulicus</i>	Colubridae	Squamata	Reptilia	LC	IV
16	Common Kukri Snake	<i>Oligodon arnensis</i>	Colubridae	Squamata	Reptilia	LC	IV

17	Green Vine Snake	<i>Oxybelis fulgidus</i>	Colubridae	Squamata	Reptilia	LC	IV
18	Indian Rat Snake	<i>Ptyas mucosa</i>	Colubridae	Squamata	Reptilia	LC	IV
19	Indian Cobra	<i>Naja naja</i>	Elapidae	Squamata	Reptilia	LC	II
20	Brooke's House Gecko	<i>Hemidactylus brookii</i>	Gekkonidae	Squamata	Reptilia	LC	NL
21	Common House Gecko	<i>Hemidactylus frenatus</i>	Gekkonidae	Squamata	Reptilia	LC	NL
22	Termite Hill Gecko	<i>Hemidactylus triedrus</i>	Gekkonidae	Squamata	Reptilia	LC	NL
23	Keeled Indian Mabuya	<i>Eutropis carinata</i>	Scincidae	Squamata	Reptilia	LC	NL
24	Common Indian Monitor	<i>Varanus bengalensis</i>	Varanidae	Squamata	Reptilia	NT	I
25	Russell's Viper	<i>Daboia russelii</i>	Viperidae	Squamata	Reptilia	LC	II
26	Indian Flapshell Turtle	<i>Lissemys punctata</i>	Trionychidae	Testudines	Reptilia	VU	IV

Avifauna: A total of **86 bird species** belongs to 70 genera, 18 orders and 42 families were recorded in core and buffer zone areas. Among them, order Passeriformes represented with high number of species (37 species distributed in 28 genera of 19 families), followed by Pelecaniformes (8/7/3), Columbiformes & Gruiformes each with 5/4/1, Accipitriformes (4/4/1), Coraciiformes (4/3/3), Galliformes (4/3/1), Apodiformes (3/2/1), Bucerotiformes & Charadriiformes each with 2/2/2, Anseriformes, Ciconiiformes & Cuculiformes each with 2/2/1, Psittaciformes (2/1/1), Falconiformes, Piciformes, Podicipediformes and Strigiformes are represented with 1 species belong to 1 genera of 1 family respectively

Table 12. List of Avifauna recorded from the proposed study area

S.No.	Common Name	Scientific Name	Family	Order	IUCN Status	IWPA Schedule
1	Shikra	<i>Accipiter badius</i>	Accipitridae	Accipitriformes	LC	IV
2	White-eyed Buzzard	<i>Butastur teesa</i>	Accipitridae	Accipitriformes	LC	IV
3	Black-winged Kite	<i>Elanus caeruleus</i>	Accipitridae	Accipitriformes	LC	IV
4	Black Kite	<i>Milvus migrans</i>	Accipitridae	Accipitriformes	LC	IV
5	Lesser Whistling Duck	<i>Dendrocygna javanica</i>	Anatidae	Anseriformes	LC	IV
6	Cotton Teal	<i>Nettapus coromandelianus</i>	Anatidae	Anseriformes	LC	IV

7	Common Swift	<i>Apus apus</i>	Apodidae	Apodiformes	LC	IV
8	House Swift	<i>Apus nipalesis</i>	Apodidae	Apodiformes	LC	IV
9	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	Apodidae	Apodiformes	LC	IV
10	Indian Grey Hornbill	<i>Ocyrceros birostris</i>	Bucerotidae	Bucerotiformes	LC	IV
11	Eurasian Hoopoe	<i>Upupa epops</i>	Upupidae	Bucerotiformes	LC	IV
12	Red-wattled Lapwing	<i>Vanellus indicus</i>	Charadriidae	Charadriiformes	LC	IV
13	Bronze-winged Jacana	<i>Metopidius indicus</i>	Jacanidae	Charadriiformes	LC	IV
14	Asian Openbill	<i>Anastomus oscitans</i>	Ciconiidae	Ciconiiformes	LC	IV
15	Painted Stork	<i>Mycteria leucocephala</i>	Ciconiidae	Ciconiiformes	NT	IV
16	Rock Pigeon	<i>Columba livia</i>	Columbidae	Columbiformes	LC	IV
17	Spotted Dove	<i>Spilopelia chinensis</i>	Columbidae	Columbiformes	LC	IV
18	Laughing Dove	<i>Spilopelia senegalensis</i>	Columbidae	Columbiformes	LC	IV
19	Oriental Turtle Dove	<i>Streptopelia orientalis</i>	Columbidae	Columbiformes	LC	IV
20	Yellow-footed Green Pigeon	<i>Treron phoenicoptera</i>	Columbidae	Columbiformes	LC	IV
21	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae	Coraciiformes	LC	IV
22	Little Green Bee-eater	<i>Merops orientalis</i>	Meropidae	Coraciiformes	LC	IV
23	Blue-tailed Bee-eater	<i>Merops philippinus</i>	Meropidae	Coraciiformes	LC	IV
24	Indian Roller	<i>Coracias benghalensis</i>	Coraciidae	Coraciiformes	LC	IV
25	Pied Crested Cuckoo	<i>Clamator jacobinus</i>	Cuculidae	Cuculiformes	LC	IV
26	Asian Koel	<i>Eudynamis scolopaceus</i>	Cuculidae	Cuculiformes	LC	IV
27	Common Kestrel	<i>Falco tinnunculus</i>	Falconidae	Falconiformes	LC	IV
28	Rain Quail	<i>Coturnix coromandelica</i>	Phasianidae	Galliformes	LC	IV
29	Common Quail	<i>Coturnix coturnix</i>	Phasianidae	Galliformes	LC	IV
30	Grey Francolin	<i>Ortygornis pondicerianus</i>	Phasianidae	Galliformes	LC	IV
31	Indian Peafowl	<i>Pavo cristatus</i>	Phasianidae	Galliformes	LC	I
32	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Rallidae	Gruiformes	LC	IV

33	Common Coot	<i>Fulica atra</i>	Rallidae	Gruiformes	LC	IV
34	Watercock	<i>Gallixrex cinerea</i>	Rallidae	Gruiformes	LC	IV
35	Common Moorhen	<i>Gallinula chloropus</i>	Rallidae	Gruiformes	LC	IV
36	Purple Swamphen	<i>Porphyrio porphyrio</i>	Rallidae	Gruiformes	LC	IV
37	Paddyfield Warbler	<i>Acrocephalus agricola</i>	Acrocephalidae	Passeriformes	LC	IV
38	Booted Warbler	<i>Iduna caligata</i>	Acrocephalidae	Passeriformes	LC	IV
39	Common Iora	<i>Aegithina tiphia</i>	Aegithinidae	Passeriformes	LC	IV
40	Ashy-crowned Sparrow Lark	<i>Eremopterix griseus</i>	Alaudidae	Passeriformes	LC	IV
41	Ashy Woodswallow	<i>Artamus fuscus</i>	Artamidae	Passeriformes	LC	IV
42	Small Minivet	<i>Pericrocotus cinnamomeus</i>	Campephagidae	Passeriformes	LC	IV
43	Common Tailorbird	<i>Orthotomus sutorius</i>	Cisticolidae	Passeriformes	LC	IV
44	Plain Prinia	<i>Prinia inornata</i>	Cisticolidae	Passeriformes	LC	IV
45	Ashy Prinia	<i>Prinia socialis</i>	Cisticolidae	Passeriformes	LC	IV
46	Jungle Prinia	<i>Prinia sylvatica</i>	Cisticolidae	Passeriformes	LC	IV
47	Large-billed Crow	<i>Corvus macrorhynchos</i>	Corvidae	Passeriformes	LC	IV
48	House Crow	<i>Corvus splendens</i>	Corvidae	Passeriformes	LC	V
49	Rufous Treepie	<i>Dendrocitta vagabunda</i>	Corvidae	Passeriformes	LC	IV
50	Tickell's Flowerpecker	<i>Dicaeum erythrorhynchos</i>	Dicaeidae	Passeriformes	LC	IV
51	White-bellied Drongo	<i>Dicrurus caerulescens</i>	Dicruridae	Passeriformes	LC	IV
52	Black Drongo	<i>Dicrurus macrocercus</i>	Dicruridae	Passeriformes	LC	IV
53	Indian Silverbill	<i>Euodice malabarica</i>	Estrildidae	Passeriformes	LC	IV
54	Scaly-breasted Munia	<i>Lonchura punctulata</i>	Estrildidae	Passeriformes	LC	IV
55	Red-rumped Swallow	<i>Cecropis daurica</i>	Hirundinidae	Passeriformes	LC	IV
56	Barn Swallow	<i>Hirundo rustica</i>	Hirundinidae	Passeriformes	LC	IV
57	Wire-tailed Swallow	<i>Hirundo smithii</i>	Hirundinidae	Passeriformes	LC	IV
58	Long-tailed Shrike	<i>Lanius schach</i>	Laniidae	Passeriformes	LC	IV
59	Common Babbler	<i>Argya caudata</i>	Leiothrichidae	Passeriformes	LC	IV
60	Large Grey Babbler	<i>Argya malcolmi</i>	Leiothrichidae	Passeriformes	LC	IV
61	Indian Paradise flycatcher	<i>Terpsiphone paradisi</i>	Monarchidae	Passeriformes	LC	IV

62	Paddyfield Pipit	<i>Anthus rufulus</i>	Motacillidae	Passeriformes	LC	IV
63	White Wagtail	<i>Motacilla alba</i>	Motacillidae	Passeriformes	LC	IV
64	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	Motacillidae	Passeriformes	LC	IV
65	Purple Sunbird	<i>Cinnyris asiaticus</i>	Nectariniidae	Passeriformes	LC	IV
66	Purple-rumped Sunbird	<i>Leptocoma zeylonica</i>	Nectariniidae	Passeriformes	LC	IV
67	Yellow-throated Sparrow	<i>Gymnoris xanthocollis</i>	Passeridae	Passeriformes	LC	IV
68	House Sparrow	<i>Passer domesticus</i>	Passeridae	Passeriformes	LC	IV
69	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae	Passeriformes	LC	IV
70	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Pycnonotidae	Passeriformes	LC	IV
71	White-browed Bulbul	<i>Pycnonotus luteolus</i>	Pycnonotidae	Passeriformes	LC	IV
72	Common Myna	<i>Acridotheres tristis</i>	Sturnidae	Passeriformes	LC	IV
73	Brahminy Myna	<i>Sturnia pagodarum</i>	Sturnidae	Passeriformes	LC	IV
74	Grey Heron	<i>Ardea cinerea</i>	Ardeidae	Pelecaniformes	LC	IV
75	Purple Heron	<i>Ardea purpurea</i>	Ardeidae	Pelecaniformes	LC	IV
76	Indian Pond Heron	<i>Ardeola grayii</i>	Ardeidae	Pelecaniformes	LC	IV
77	Cattle Egret	<i>Bubulcus ibis</i>	Ardeidae	Pelecaniformes	LC	IV
78	Little Egret	<i>Egretta garzetta</i>	Ardeidae	Pelecaniformes	LC	IV
79	Little Cormorant	<i>Microcarbo niger</i>	Phalacrocoracidae	Pelecaniformes	LC	IV
80	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	Phalacrocoracidae	Pelecaniformes	LC	IV
81	Red-naped Ibis	<i>Pseudibis papillosa</i>	Threskiornithidae	Pelecaniformes	LC	IV
82	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	Megalaimidae	Piciformes	LC	IV
83	Little Grebe	<i>Tachybaptus ruficollis</i>	Podicipedidae	Podicipediformes	LC	IV
84	Plum-headed Parakeet	<i>Psittacula cyanocephala</i>	Psittacidae	Psittaciformes	LC	IV
85	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Psittacidae	Psittaciformes	LC	IV
86	Spotted Owlet	<i>Athene brama</i>	Strigidae	Strigiformes	LC	IV

Table 13. Bird species richness in the all the three parts of the study area

PART	MIN	MAX	MEAN (n=2)	SD	Cum Richness
A	6	8	7.00	0.63	25
B	4	10	7.17	2.56	25
C	3	7	4.50	1.38	14

The total numbers of individuals recorded in all the points are analysed and tabulated.

From the table 12, it is found that the highest number of (20max & 5 min) individuals was recorded in the Part - B (Table 12). The overall density of birds in this point is 49.2 hac.

Table 14. Bird densities in the all the three parts of the study area

PART	MIN	MAX	MEAN (n=2)	SD	DENSITY in hectare
A	6	12	8	2.2	40.7
B	5	20	9.7	5.5	49.2
C	3	8	5.7	1.9	28.8

The reason behind the highest record of the individuals in the Part - B is due to the habitat type. The Part has shrub jungle with thick canopies, water sources and less anthropogenic and cattle movements. Hence it shows a high number of species and as well as the highest record of individuals in this part. The minimum number of birds recorded was in Part - C. This is due to rocky terrain and located roadside.

In most of the cases the birds prefer a good habitat for the survival, fulfil their food requirements. So here, on seeing the density of the species we can conclude that the reason for the abundant density in this part is due to their characteristic feature of the habitats.

Bees, Dragonflies, Spiders and Butterflies (Invertebrates): A total of **46 species of Invertebrates**, of which Butterflies under the order Lepidoptera represented with 31 species belong to 26 genera of 5 families. Dragonflies under the order Odonata (9 species belong to 7 genera of 4 families). Hymenoptera is with 4 species belongs to 2 genera of one family. Spiders under the order Araneae represented with 1 species belong to 1 genus of Lycosidae family.

Table 15. List of Invertebrates recorded from the proposed study area

S. No.	Common Name	Scientific Name	Family	Order	Class	IUCN Status	IWPA Schedule
1	Common Funnel Web Spider	<i>Hippasa agelenoides</i>	Lycosidae	Araneae	Arachnida	NA	NL
2	Indian Honeybee	<i>Apis cerana</i> subsp. <i>indica</i>	Apidae	Hymenoptera	Insecta	NA	NL
3	Honeybee	<i>Apis mellifera</i>	Apidae	Hymenoptera	Insecta	NA	NL

4	Violet Carpenter Bee	<i>Xylocopa violacea</i>	Apidae	Hymenoptera	Insecta	NA	NL
5	Carpenter Bee	<i>Xylocopa tenuiscapa</i>	Apidae	Hymenoptera	Insecta	NA	NL
6	Paper Wasp	<i>Ropalidia marginata</i>	Vespidae	Hymenoptera	Insecta	NA	NL
7	Common Bush Hopper	<i>Ampittia dioscorides</i>	Hesperiidae	Lepidoptera	Insecta	NA	NL
8	Common Awl	<i>Hasora badra</i>	Hesperiidae	Lepidoptera	Insecta	NA	NL
9	Indian Grizzled Skipper	<i>Spialia galba</i>	Hesperiidae	Lepidoptera	Insecta	NA	NL
10	Dark Palm Dart	<i>Telicota ancilla</i>	Hesperiidae	Lepidoptera	Insecta	NA	NL
11	Angled Pierrot	<i>Caleta decidia</i>	Lycaenidae	Lepidoptera	Insecta	NA	NL
12	Common Pierrot	<i>Castalius rosimon</i>	Lycaenidae	Lepidoptera	Insecta	NA	NL
13	Lime Blue	<i>Chilades lajus</i>	Lycaenidae	Lepidoptera	Insecta	NA	NL
14	Grass Jewel	<i>Freyeria trochylus</i>	Lycaenidae	Lepidoptera	Insecta	NA	NL
15	Pale Grass Blue	<i>Pseudozizeeria maha</i>	Lycaenidae	Lepidoptera	Insecta	NA	NL
16	Dark Grass Blue	<i>Zizeeria karsandra</i>	Lycaenidae	Lepidoptera	Insecta	NA	NL
17	Blue Grass	<i>Zizina labradus</i>	Lycaenidae	Lepidoptera	Insecta	NA	NL
18	Tiny Grass Blue	<i>Zizula hylax</i>	Lycaenidae	Lepidoptera	Insecta	NA	NL
19	Tawny Coster	<i>Acraea terpsicore</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
20	Common Castor	<i>Ariadne merione</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
21	Plain Tiger	<i>Danaus chrysippus</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
22	Common Tiger	<i>Danaus genutia</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
23	Common crow	<i>Euploea core</i>	Nymphalidae	Lepidoptera	Insecta	LC	NL
24	Danaid Eggfly	<i>Hypolimnas misippus</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
25	Peacock Pansy	<i>Junonia almana</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
26	Yellow Pansy	<i>Junonia hierta</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
27	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
28	Blue Pansy	<i>Junonia orithya</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL

29	Common Bushbrown	<i>Mycalesis perseus</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
30	Dark Tiger	<i>Tirumala hamata</i>	Nymphalidae	Lepidoptera	Insecta	NA	NL
31	Common Banded Peacock	<i>Papilio crino</i>	Papilionidae	Lepidoptera	Insecta	NA	NL
32	Common Mormon	<i>Papilio polytes</i>	Papilionidae	Lepidoptera	Insecta	NA	NL
33	Mottled Emigrant	<i>Catopsilia pyranthe</i>	Pieridae	Lepidoptera	Insecta	NA	NL
34	Plain Orange Tip	<i>Colotis aurora</i>	Pieridae	Lepidoptera	Insecta	NA	NL
35	Common Jezebel	<i>Delias eucharis</i>	Pieridae	Lepidoptera	Insecta	NA	NL
36	Common Grass Yellow	<i>Eurema hecabe</i>	Pieridae	Lepidoptera	Insecta	NA	NL
37	Yellow Orange Tip	<i>Ixias pyrene</i>	Pieridae	Lepidoptera	Insecta	NA	NL
38	Pale-spotted Emperor	<i>Anax guttatus</i>	Aeshnidae	Odonata	Insecta	LC	NL
39	Golden Dartlet	<i>Ischnura aurora</i>	Coenagrionidae	Odonata	Insecta	NA	NL
40	Indian Common Clubtail	<i>Ictinogomphus rapax</i>	Gomphidae	Odonata	Insecta	LC	NL
41	Common scarlet-darter	<i>Crocothemis erythraea</i>	Libellulidae	Odonata	Insecta	LC	NL
42	Ground Skimmer	<i>Diplacodes trivialis</i>	Libellulidae	Odonata	Insecta	NA	NL
43	Blue Marsh Hawk	<i>Orthetrum glaucum</i>	Libellulidae	Odonata	Insecta	NA	NL
44	Green Marsh Hawk	<i>Orthetrum sabina</i>	Libellulidae	Odonata	Insecta	NA	NL
45	Wandering Glider	<i>Pantala flavescens</i>	Libellulidae	Odonata	Insecta	NA	NL
46	Crimson Marsh Glider	<i>Trithemis aurora</i>	Libellulidae	Odonata	Insecta	NA	NL

Pisces: 14 species of fish belong to 5 orders and 5 families. The order Cypriniformes and Siluriformes each with 5 species in 3 genera of 1 family followed Synbranchiformes (2/1/1), Anabantiformes & Mugiliformes are represented with one species in one genus.

Table 16. List of Pisces recorded from the proposed study area

S.No.	Common/Local Name	Scientific Name	Family	Order	IUCN Status	IWPA Schedule
1	Climbing Perch/Goraka	<i>Anabas testudineus</i>	Anabantidae	Anabantiformes	LC	NL
2	Catla	<i>Labeo catla</i>	Cyprinidae	Cypriniformes	LC	NL
3	Rohu/Seelavathi	<i>Labeo rohita</i>	Cyprinidae	Cypriniformes	LC	NL
4	Buradamatta	<i>Channa punctata</i>	Cyprinidae	Cypriniformes	LC	NL
5	Korrameenu	<i>Channa striata</i>	Cyprinidae	Cypriniformes	LC	NL
6	Chittrai	<i>Cirrhinus reba</i>	Cyprinidae	Cypriniformes	LC	NL
7	Corsula	<i>Rhinomugil corsula</i>	Mugilidae	Mugiliformes	LC	NL
8	Long Whiskers Catfish/Jella	<i>Mystus gulio</i>	Bagridae	Siluriformes	LC	NL
9	Errajella	<i>Mystus vittatus</i>	Bagridae	Siluriformes	LC	NL
10	Golden Barb/Perka	<i>Puntius gelius</i>	Bagridae	Siluriformes	LC	NL
11	Buddajella	<i>Rita chrysea</i>	Bagridae	Siluriformes	LC	NL
12	Bondu	<i>Rita kuturnee</i>	Bagridae	Siluriformes	LC	NL
13	Bommidai	<i>Macrognathus guentheri</i>	Mastacembelidae	Synbranchiformes	NA	NL
14	Indian Spiny Eel/Kontemukku	<i>Macrognathus pacalus</i>	Mastacembelidae	Synbranchiformes	LC	NL

Faunal composition in the study area:

Component	Mammals	Herpetofauna	Birds	Invertebrates	Fishes	Total
Orders	6	3	18	4	5	36
Family	13	13	42	12	5	85
Genera	16	23	70	38	9	156
No. of species	19	26	86	46	14	191

Scheduled species:

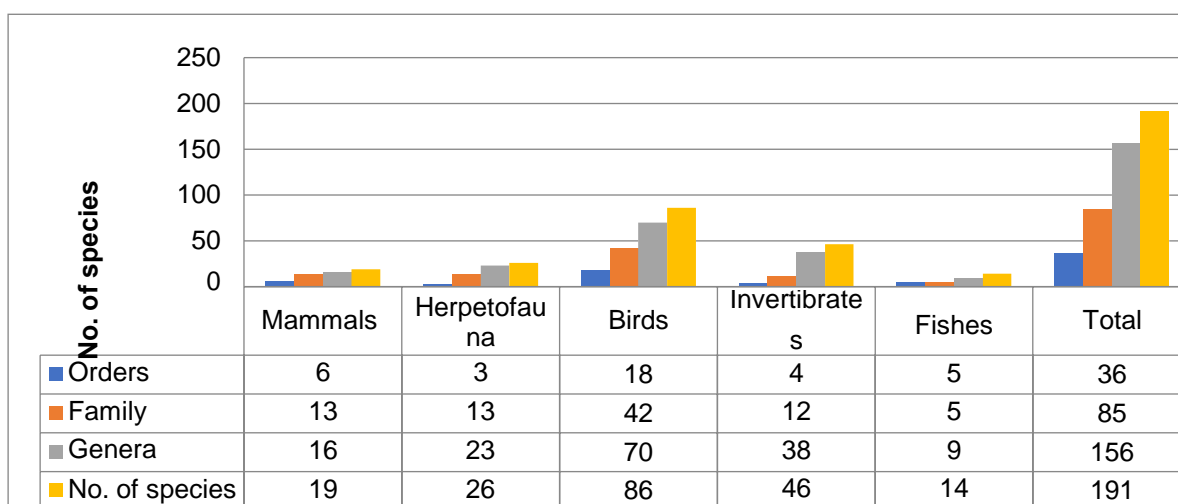
- Common Indian Monitor and Indian Peafowl falls under Schedule-I category as per Indian Wildlife Protection Act (IWPA)-1972, Common Indian Monitor also falls under Near Threatened category as per IUCN red list.
- Jungle Cat, Common Fox, Rhesus Macaque, Bonnet Macaque, Hanuman Langur, **Indian Chameleon, Checkered Keelback, Indian Cobra, Russell's viper**, are the common species that falls under Schedule-II category as per IWPA-1972.

- Nilgai, Indian Spotted Deer, Indian Sambar and Wild Boar falls under Schedule-III category as per IWPA-1972.
- A total of 108 faunal species (Mammals-9, Herpatofauna-15and birds-84) fall under Schedule-IV and Common Crow Schedule-V category according to IWPA- 1972.

Species richness:

Species richness: was high in Avifauna (86 species) followed by Spiders and Butterflies (46 species), Herpetofauna (26 species), Mammals (19 species) and Fishes (14 species), are depicted in Figure 15.

Fig.15. Species richness



The diversity values recorded high for birds (0.108) followed by Invertebrates (0.031), herpetofauna (0.009) Mammals (0.005) and fishes (0.002).

Threatened Fauna Recorded in the Study Area as per IUCN:

Species	IUCN Status
Indian Sambar <i>Rusa unicolor</i>	Vulnerable
Bonnet Macaque <i>Macaca radiata</i>	Vulnerable
Indian Flapshell Turtle <i>Lissemys punctata</i>	Vulnerable
Red sand boa <i>Eryx johnii</i>	Near Threatened
Rough-scaled Sand Boa <i>Gongylophis conicus</i>	Near Threatened
Common Indian Monitor <i>Varanus bengalensis</i>	Near Threatened
Painted Stork Mycteria <i>leucocephala</i>	Near Threatened

Wildlife Conservation Plan:

A Wildlife conservation plan was prepared for conservation of the schedule-I species i.e., Indian Monitor Lizard and Indian Peafowl with an amount of Rs. 478.6 lakhs and was approved by the PCCF (HoFF) & CWLW, Telangana State Forest Department, vide reference No. 5694/2021/WI-1 dated: 12.10.2021.

Natural streams available in the adjoining forests in 10 Kms radius from the proposed study area:

Table 17. List of natural streams in the forest beats providing water to the wildlife in the 10 Kms radius

S.No	Beat Name	Streams	
		Nos	Names
1	Tungaram	1	Isuka Vagu
	Sub-Total:	1	
2	Tippanapalli	1	Edumelikala Vagu
	Sub-Total:	1	
3	Penagadapa	1	Tella Vagu
		1	Edumelikala Vagu
	Sub-Total:	2	
4	Ramavaram	1	Tella Vagu
	Sub-Total:	1	
5	Gareebpeta	3	Marri Vagu
			Dargaiah Vagu
			Uppenala Vagu
	Sub-Total:	3	
	Grand Total:	8	

Habitat improvement infrastructures & Water Management Initiatives of the Forest Department to sustain and enhance the wildlife population in the 10 Kms radius:

Table 18. No. of fire-line points developed by the Forest Department to avoid/control forest fires within 10 Kms radius

S.No.	Beat Name	Forest Fire Points
1	Tungaram	0
	Sub-Total:	0
2	Tippanapalli	2
	Sub-Total:	2
3	Penagadapa	1
	Sub-Total:	1
4	Ramavaram	0
	Sub-Total:	0
5	Gareebpeta	5
	Sub-Total:	5
	Grand Total:	8

Table 19. No. of PTs developed by the Forest Department

S.No	Beat Name	Percolation Tank (PTs)		
		Nos	Latitude	Longitude
1	Tungaram	1	17.44470	80.62874
	Sub-Total:	1		
2	Tippanapalli	1	17.43644	80.64424
		1	17.43769	80.64544
	Sub-Total:	2		
	Grand Total:	3		

Table 20. List of forest fringe villages within the 10 Kms radius with people depending on the forest for livelihoods and livestock rearing – biotic pressure to existing forest areas:

S.No.	Beat Name	No of Villages		Population	No. of Cattles
		Nos.	Names		
1	Tungaram	6	Tungaram	3900	2000
			Sunkara Banjara		
			Tekula Banjara		
			Jarpula Thanda		
			Seemla Thanda		
			Mala Banjara		
	Sub-Total:	6		3900	2000
2	Tippanapalli	5	Tippanapalli	4400	3200
			Ahmednagar		
			Venkata Puram		
			Satyanarayana Puram		
			Repallewada		
	Sub-Total:	5		4400	3200
3	Penagadapa	3	Penagadapa	3000	1500
			Rampuram		
			Ambedkarnagar		
	Sub-Total:	3		3000	1500
4	Ramavaram	8	Garimellapadu	4300	280
			Ramavaram		
			3 Incline		
			2 Incline		
			4 Incline		
			5 Incline		
			Dhanbad		
			Barium Thanda		
	Sub-Total:	8		4300	280
5	Gareebpeta	15	Gareebpeta	9375	560
			Laxmipuram Thanda		
			Rudrampur		

			Laxmidevipalli		
			Nimmalagudem		
			Nimmalagudem Colony		
			Marrithanda		
			Chintal Thanda		
			Komatpalli		
			Seethampeta		
			Seethampeta Banjara		
			Reddipalem		
			Ramji Thanda		
			Sujathanagar		
			Mangapeta		
	Sub-Total:	15		9375	560
	Grand Total:	37		24975	7540

Socio-economic status within the 10 Kms radius from the proposed study area:

Based on the 2011 Census data, in the study area the Schedule caste (SC) population is 16.44%, and the Schedule Tribe (ST) population is 22.08%. Literacy rate in the project area is 66%.

Educational status has improved from generation to generation in this region. Schooling and collages are available up to engineering education. The working population is 41.91% and the non-working population is 58.09%. Infrastructure facilities such as the Road network, Banks, Post office, public distribution system and transport facility and communication facilities are good.

A sample survey of 440 households was surveyed in 15 villages of the study area. The number of females per 1000 males is 1016, showing healthy ratio of female population. Among the surveyed total population, 66% people were literate and 34% were illiterate. This shows that the educational facilities have improved in the sample area.

Distribution of population

As per 2011 census the study area consisted of 2,89,491 persons inhabited in the study area. The distribution of Population in the study area is shown in Table 21.

Table 21. Distribution of population

Particulars	0-2 km	2-5 km	5-10 km	0-10 km
No. of households	4308	4398	66146	74852
Male Population	8623	8394	126544	143561
Female Population	8497	8441	128992	145930
Total Population	17120	16835	255536	289491
Average household size	3.97	3.83	3.86	3.87
Sex ratio	985	1006	1019	1017

*Source: Census 2011

Table 22. Distribution of population by social structure

Particulars	0-2 km	2-5 km	5-10 km	0-10 km
Schedule caste	4589	1724	41267	47580
% of SC	26.80	10.24	16.15	16.44
Schedule Tribes	1256	6783	55878	63917
% of ST	7.34	40.29	21.87	22.08
Total SC & ST	5845	8507	97145	111497
% of total SC & ST	34.14	50.53	38.02	38.51
Total Population	17120	16835	255536	289491

*Source: Census 2011

Household Energy Sources

About 91% of the sample households were using LPG connection, 3% are using both gas and firewood while firewood are used occasionally or in absence of gas. 6% households were using firewood for cooking purpose as they are not having gas connection or immigrants. None of the House Holds are using Kerosene/coal as cooking fuel in the sample households. The LPG connection usage is very high as they are utilising the government subsidy scheme for the LPG connection.

Type of Fuel	No's	%
Gas	401	91
Wood + gas (Dependency on forest)	14	3
Wood (Dependency on forest)	25	6
Total	440	100

Agricultural Scenario

The study area is not agrarian area and there are only a few farmers cultivating Paddy, Mirchi, vegetables and few are growing fodder for their own cattle. 20% of the sample population involved in the other occupation such as services, business, and daily labour works. Sample household survey reveals that only 38% farmers have their own agricultural lands. They were classified as marginal (below 1.00 ha) 37%, small holdings (1-2 ha) 1%, semi-medium no one family found (2 – 4 ha) holdings, medium (4 to 10 ha) and large holdings (10 ha & above) are nil. **The remaining 62% doesn't possess any land, as shown in below Table.** The major crops cultivated in the study area include Paddy, Mirchi and secondary crop is Maize and millets. The contributions of the agricultural sector to household income are relatively less in 31% of the families are, forming households.

Table 23. Agriculture Hodings

Agriculture land Size Group	Farmers	%
Marginal	162	37
Small	6	1
Small-Medium	0	0
Medium	0	0
Large	0	0
Not having agricultural land	272	62
Total	440	100

Besides land, both in absolute acreage and quality, the ownership of plough bullocks, tractors, and other farm equipment significantly affects the agricultural income. In the study area only 2% possess agricultural related items like tractor and plough. Even though most of them do not possess agricultural related items but they have access to these services through payment/rental basis.

Livestock Farming

Livestock ownership details obtained in the study area during the socio-economic survey for 440 households. A total of 82 households has cattle as secondary source of income. 108 households have Poultry, and 13 families have the Goat/Sheep.

Table 24. Livestock ownership in the 10 Kms around the study area

Herd Size	Cow/Buffalo	Goat/Sheep	Poultry
Not having	358	427	332
1 to 3	68	0	86
4 to 7	14	0	19
8 & above	0	13	3
Total	440	440	440

Infrastructure

Transport facility, mobile communication and postal services are good in the study area. Banks and agricultural societies need to be improved. Women self-help groups are very active and public distribution system is good for ration supply. The details of the facilities are provided below.

Table 25. Infrastructure and Educational facilities in the Study area

Infra structure Facility	% Coverage () 2011				2020 (coverage %)			
	0-2 km	2-5 km	5-10 km	0-10 km	0-2 km	2-5 km	5-10 km	0-10 km
Post Office	50	25	43	39	100	63	74	73
Mobile Phone Coverage	100	100	97	97	100	100	100	100
Public Bus Service	50	75	87	82	100	100	100	100
Black Topped (pucca) Road	100	100	100	100	100	100	100	100
Banks	50	12.5	22	22	100	63	70	70
Self - Help Group	100	100	100	100	100	100	100	100
Public Distribution System	100	100	100	100	100	100	100	100

Table 26. List of floral species documented by the forest department in the adjacent forest areas within the 10 Kms of radius from the proposed study area

Trees		
Sl. No	Species	Common Name
1	<i>Acacia chundra</i>	Sundra
2	<i>Acacia leucophloea</i>	Tella Thumma
3	<i>Aegle marmelos</i>	Maredu
4	<i>Alangium salvifolium</i>	Uduga
5	<i>Albizia amara</i>	Nalla regu
6	<i>Albizia lebbek</i>	Dirishanam
7	<i>Albizia odoratissima</i>	Chinduga
8	<i>Andina cordifolia</i>	Bandaru
9	<i>Anogeissus latifolia</i>	Chirumanu Yelama
10	<i>Azadirachta indica</i>	Vepa
11	<i>Bauhinia racemosa</i>	Ari
12	<i>Bombax ceiba</i>	Buruga
13	<i>Boswellia serrata</i>	Andugu
14	<i>Buchanania lanzan</i>	Sarapapu, Mori
15	<i>Cassia fistula</i>	Rela
16	<i>Cassine glauca</i>	Bhutangi
17	<i>Chloroxylon swietenia</i>	Billudu
18	<i>Cleistanthus collinus</i>	Bankanakkiri, Kodisa
19	<i>Cochlospermum religiosum</i>	Kondagogu
20	<i>Cordia dichotoma</i>	Iriki/BankaNakkera
21	<i>Dalbergia latifolia</i>	Jetregi
22	<i>Dalbergia paniculata</i>	Soppera/Pachari
23	<i>Dichrostachys cinerea</i>	
24	<i>Diospyros chloroxylon</i>	Illintha
25	<i>Diospyros melanoxylon</i>	Tuniki
26	<i>Erythroxylum monogynum</i>	Devadaru
27	<i>Eucalyptus tereticornis</i>	Nilagiri
28	<i>Feronia elephantum</i>	Velaga
29	<i>Ficus mollis</i>	Juvvi
30	<i>Ficus racemosa</i>	Medi
31	<i>Gardenia lucida</i>	Yerra bikki, Karinga
32	<i>Garuga pinnata</i>	Garga - Garugu
33	<i>Givotia rottleriformis</i>	Tella poliki
34	<i>Gmelina arborea</i>	Gummadi Teak
35	<i>Grewia tiliaefolia</i>	Jana/Thada
36	<i>Hardwickia binata</i>	Yepa
37	<i>Holarrhena pubescens</i>	Kodisepala
38	<i>Holoptelea integrifolia</i>	Nauli
39	<i>Ixora pavetta</i>	Koravi
40	<i>Lagerstroemia parviflora</i>	Chennangi
41	<i>Lannea coromandeliana</i>	Gumpena
42	<i>Madhuca longifolia</i>	Ippa

43	<i>Mangifera indica</i>	Mango
44	<i>Manilkara hexandra</i>	Pala/Pedda pala
45	<i>Miliusa tomentosa</i>	Nuluva/ Barre duddi
46	<i>Mitragyna parviflora</i>	Batta ganapa
47	<i>Morinda pubescens</i>	Thogarmogali
48	<i>Naringi crenulata</i>	Torrivelaga
49	<i>Nyctanthes arbor-tristis</i>	Parijatham
50	<i>Paasi</i>	
51	<i>Phyllanthus emblica</i>	Usiri
52	<i>Polyalthia cerasoides</i>	Chilakaduddi
53	<i>Pongamia pinnata</i>	Kanuga
54	<i>Premna tomentosa</i>	Nagur
55	<i>Pterocarpus marsupium</i>	Yegisa
56	<i>Pterospermum xylocarpum</i>	Loluga
57	<i>Schleichera oleosa</i>	Rakot/Pusugu
58	<i>Schrebera swietenoides</i>	Mokkep, Makkam
59	<i>Semecarpus anacardium</i>	Jeedi
60	<i>Soymida febrifuga</i>	Somi
61	<i>Sterculia urens</i>	Thapsi chettu
62	<i>Strychnos nux-vomica</i>	Visha Mushti
63	<i>Strychnos potatorum</i>	Chilla
64	<i>Tamarindus indica</i>	Chintha
65	<i>Tectona grandis</i>	Teak
66	<i>Terminalia alata</i>	Nalla maddi
67	<i>Terminalia arjuna</i>	Tella/Veru maddi
68	<i>Terminalia bellirica</i>	Thani - Thandra
69	<i>Terminalia chebula</i>	Karaka
70	<i>Viscum heyneanum</i>	Karisha
71	<i>Ximenia americana</i>	Udutanakkera
72	<i>Xylia xylocarpa</i>	Bojja/Konda tangedu
73	<i>Ziziphus xylopyrus</i>	Gotti - Gotiki
Shrubs		
1	<i>Canthium parviflorum</i>	Balusu
2	<i>Cissus vitiginea</i>	Gummadi Podha
3	<i>Dodonaea viscosa</i>	Bandaru
4	<i>Grewia hirsuta</i>	Bontha
5	<i>Helicteres isora</i>	Nulithada
6	<i>Jasminum arborescens</i>	Adavi malli
7	<i>Lawsonia inermis</i>	Kommi
8	<i>Maytenus emarginata</i>	Danthi
9	<i>Phyllanthus reticulatus</i>	Sunnambatti
10	<i>Randia spinosa</i>	Manga chettu
11	<i>Woodfordia fruticosa</i>	Jaji
12	<i>Ziziphus oenoplia</i>	Parikatheega

Climbers		
1	<i>Acacia pinnata</i>	Chenchu campa
2	<i>Aganasma caryophyllata</i>	Gudapala
3	<i>Asparagus racemosus</i>	Pilli bitiri
4	<i>Cocculus hirsutus</i>	Dusari teega
5	<i>Mucuna pruriens</i>	Adavi ulava
6	<i>Tylophora indica</i>	Teega Gaddi
Herbs		
1	<i>Acalypha indica</i>	Muripindi teega
2	<i>Achyranthes aspera</i>	Uttareni/Antisa
3	<i>Aerva lanata</i>	Konda pindi
4	<i>Ageratum conyzoides</i>	Goat weed
5	<i>Andrographis paniculata</i>	Nelavemu
6	<i>Atylosia scarabaeoides</i>	Showy pigeonpea
7	<i>Combretum decandrum</i>	Yedagaddi
8	<i>Curculigo orchioides</i>	Eethakula Gaddi
9	<i>Hemidesmus indicus</i>	Sugandipala
10	<i>Hybanthus enneaspermus</i>	Ratnapurusa
11	<i>Hyptis suaveolens</i>	Sima tulasi/ Mahaveera
12	<i>Ocimum americanum</i>	Kukka tulasi
13	<i>Ocimum sanctum</i>	Adavi tulasi
14	<i>Phyllanthus niruri</i>	Nela usiri
15	<i>Sida acuta</i>	Chittemu
Grasses		
1	<i>Aristida setacea</i>	Cheepuru gaddi
2	<i>Cymbopogon martinii</i>	Kasha gaddi
3	<i>Cynodon dactylon</i>	Garika gaddi
4	<i>Cyperus pertenus</i>	Nalla Tunga
5	<i>Cyperus rotundus</i>	Tunga
6	<i>Dioscorea bulbifera</i>	Adavi gaddu
7	<i>Echinochloa colona</i>	Kaproda gaddi
8	<i>Eclipta alba</i>	Gutta gaddi
9	<i>Eragrostia bifarice</i>	
10	<i>Eragrostis tenella</i>	Chinna Garika Gaddi

BAMBOOS		
S. No.	Scientific Name	Common Name
1	<i>Bambusa arundinacea</i>	Mullam Bongu
2	<i>Dendrocalamus strictus</i>	Sadanam

Table 26. List of faunal species documented by the forest department in the adjacent forest areas within the 10 Kms of radius from the proposed study area

S.No.	Scientific Name	Common Name
1	<i>Boselaphus tragocamelus</i>	Nilgai
2	<i>Tetracerus quadricornis</i>	Four horned antelope
3	<i>Antelope cervicapra</i>	Black buck
4	<i>Cervus unicolor</i>	Sambar
5	<i>Axis axis</i>	Spotted deer
6	<i>Sus scrofa</i>	Wild boar
7	<i>Bos gaurus</i>	Indian bison
8	<i>Melurus ursinus</i>	Sloth bear
9	<i>Herpestes edw ardej</i>	Common mongoose
10	<i>Canis aureus</i>	Jackal
11	<i>Vulpes bengalensis</i>	Indian fox
12	<i>Macaca mulatt</i>	Rhesus monkey
13	<i>Presbytis entellus</i>	Common langur
14	<i>Panthera tigris</i>	Tiger
15	<i>Panthera pardus</i>	Leopard
16	<i>Felis chaus</i>	Jungle cat
17	<i>Cuon alpinus</i>	Wild dog

Conclusion

The 313 species of plants and 191 animals that were identified during the brief preliminary survey have highlighted the maximum potential magnitude of biodiversity of the study area. The groups of organisms such as spiders, scorpions, millipedes, insects including butterflies are apparently diverse.

The fauna study reveals the presence of schedule-I faunal species i.e., Indian Monitor lizard, Indian Rock Python and Indian Peafowl falls in the study area of the project. Further, the field survey team have not sighted their presence and did not find any indirect evidence i.e., pug marks, squats, feathers, or dead remains etc. of any wild animals in the study area of the project during field survey. Since, no migratory route / corridors found in the core area. Hence, there is no effect on wildlife migration due to mining.

Recommendations

Restoration and reclamation process during and after mining in the proposed study area and compensatory measures of SCCL with the forest department in the adjoining forests will provide alternate habitats for these species without much competition in resource partition with other existing species around the study area.

These processes should be monitored by a wildlife expert from the beginning of the mining operations, in a long-term period continuously without fail. The long-term monitoring will provide inputs and advisories to maintain and sustain the ecological balance of the study area. One wildlife expert at least for 10 years to monitor the impact of mining in adjoining forest area in the buffer may be engaged.

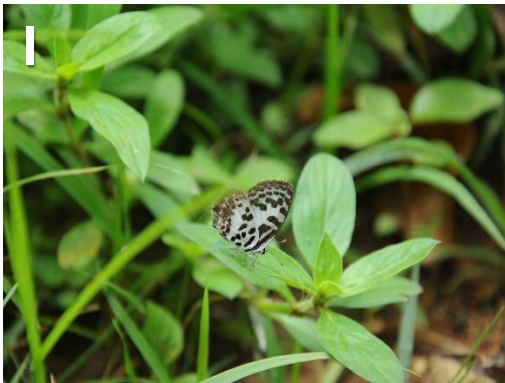
Also, the monitoring will help in creating a database by conducting the research throughout the mining project covering all seasons as these may also lead to the management of the proposed study area and the adjoining forest areas. Such studies may also raise questions on urban wildlife conservation and its importance in and around the mine operational areas.

A wildlife Conservation/ Mitigation plan was prepared was approved by the Chief Wildlife Warden, TS, vide reference 5694/2021/WL-I Dt.12.10.2021 for Rs.4.78 Crores. This plan shall be implemented within 3 years from the start of mining.

Photo Plates

Butterflies





No.	Common Name	Scientific Name
A.	Tawny Coster	<i>Acraea violae</i>
B.	Chocolate Pansy	<i>Junonia iphita</i>
C.	Common Rose	<i>Pachliopta aristolochiae</i>
D.	Lime	<i>Papilio demoleus</i>
E.	Plain Tiger	<i>Danaus chrysippus</i>
F.	Lemon Pansy	<i>Junonia lemonias</i>
G.	Yellow Orange Tip	<i>Ixias pyrene</i>
H.	Common Grass Yellow	<i>Eurema hecabe</i>
I.	Common Pierrot	<i>Castalius rosimon</i>
J.	Common Indian Crow	<i>Euploea core</i>
K.	Common Banded Awl	<i>Hasora chromu</i>
L.	Indian Cupid	<i>Everes lacturnus</i>
M.	Common Jezebel	<i>Delias eucharis</i>
N.	Common Evening Brown	<i>Melanitis leda</i>

Odonates



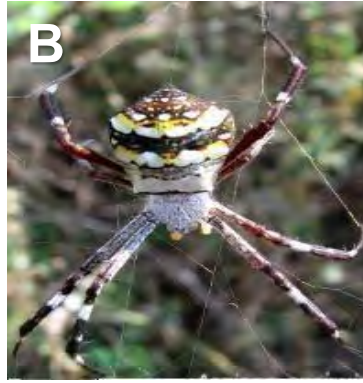
No.	Common Name	Scientific Name
A.	Green Marsh Hawk	<i>Orthetrum sabina</i>
B.	Ground Skimmer	<i>Diplacodes trivialis</i>
C.	Golden Dartlet	<i>Ischnura aurora</i>
D.	Ditch Jewel	<i>Brachythemis contaminata</i>
E.	Common Picture Wing	<i>Rhyothemis variegata</i>
F.	Blue-tailed Green Darner	<i>Anax guttatus</i>

Other Invertebrates



No.	Common Name	Scientific Name
A.	Six-spot Ground Beetle	<i>Anthia sexguttata</i>
B.	Brown Grasshopper	<i>Melanoplus sanguinipes</i>
C.	Painted Grasshopper	<i>Poeciloceris pictus</i>
D.	Palm Rhinoceros Beetle	<i>Oryctes nasicornis</i>
E.	Common Godzilla ant	<i>Componatus compressus</i>
F.	Procession Ant	<i>Leptogenys processionalis</i>

Arachnids



No.	Common Name	Scientific Name
A.	Giant Forest Scorpion	<i>Heterometrus swammerdami</i>
B.	Signature Spider	<i>Argiope anasuja</i>
C.	Common Two Tail	<i>Hersilia savignyi</i>
D.	Decorated Spider	<i>Leucauge decorata</i>
E.	Yogesh's Green Lynx Spider	<i>Peucetia yogesh</i>
F.	Pawan's Green Lynx Spider	<i>Oxyopes pawani</i>

Reptiles



No.	Common Name	Scientific Name
A.	Indian Garden Lizard	<i>Calotes versicolor</i>
B.	Fan-throated lizard	<i>Sitana ponticeriana</i>
C.	South Indian Rock Agama	<i>Psammophilus dorsalis</i>
D.	Keeled Grass Skink	<i>Eutropis carinata</i>
E.	Bengal Monitor	<i>Varanus bengalensis</i>
F.	Indian Flap-shelled Turtle	<i>Lissemys punctata</i>
G.	Checkered Keelback	<i>Xenochrophis piscator</i>
H.	Russell's Viper	<i>Daboia russelii</i>

Amphibians



No.	Common Name	Scientific Name
A.	Skittering Frog	<i>Euphlyctis cyanophlyctis</i>
B.	Common Indian Toad	<i>Duttaphrynus melanostictus</i>
C.	Indian Cricket Frog	<i>Fejervarya limnocharis</i>
D.	Indian Bull Frog	<i>Hoplobatrachus tigerinus</i>
E.	Common Tree Frog	<i>Polypedates maculatus</i>
F.	Indian Pond Frog	<i>Euphlyctis hexadactylus</i>
G.	Marbled narrow-mouthed frog	<i>Uperdon variegatus</i>
H.	Marbled Balloon Frog	<i>Uperodon systoma</i>

Aves







No.	Common Name	Scientific Name
A.	Asian Koel	<i>Eudynamys scolopacea</i>
B.	Black Drongo	<i>Dicrurus macrocercus</i>
C.	Red-vented Bulbul	<i>Pycnonotus cafer</i>
D.	Bay-backed Shrike	<i>Lanius vittatus</i>
E.	Spotted Dove	<i>Streptopelia chinensis</i>
F.	Eurasian Golden Oriole	<i>Oriolus oriolus</i>
G.	Cattle Egret	<i>Bubulcus ibis</i>
H.	Green Bee-eater	<i>Merops orientalis</i>
I.	Purple-rumped Sunbird	<i>Nectarinia zeylonica</i>
J.	Brown-capped pygmy woodpecker	<i>Yungipicus nanus</i>
K.	Red-rumped Swallow	<i>Hirundo daurica</i>
L.	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>
M.	White-throated Kingfisher	<i>Halcyon smyrnensis</i>
N.	Common Babbler	<i>Turdoides caudatus</i>
O.	Shikra	<i>Accipiter badius</i>
P.	Scaly-breasted Munia	<i>Lonchura punctulata</i>
Q.	Gray Francolin	<i>Francolinus pondicerianus</i>
R.	Indian Gray Hornbill	<i>Ocyrceros birostris</i>
S.	Spotted Owlet	<i>Athene brama</i>
T.	Pied Bushchat	<i>Saxicola caprata</i>
U.	Rose-ringed Parakeet	<i>Psittacula krameri</i>
V.	Alexandrine Parakeet	<i>Psittacula eupatria</i>
W.	Indian Nightjar	<i>Caprimulgus asiaticus</i>
X.	Common Iora	<i>Aegithina tiphia</i>

Mammals



No.	Common Name	Scientific Name
A.	Rhesus Macaque	<i>Macaca mulatta</i>
B.	Bonnet Macaque	<i>Macaca radiata</i>
C.	Hanuman Langur	<i>Semnopithecus entellus</i>
D.	Common Grey Mongoose	<i>Herpestes edwardsii</i>
E.	Three-striped Palm Squirrel	<i>Funambulus palmarum</i>

Fieldwork Glimpses in the Nature Trails along with the Forest Beat Officers



Latitude: 17.424793
 Longitude: 80.581159
 Elevation: 134.58+15 m
 Accuracy: 15.9 m
 Time: 27-09-2022 17:17
 Note:



Latitude: 17.492574
 Longitude: 80.670346
 Elevation: 2100.61479 m
 Accuracy: 51.6 m
 Time: 09-24-2022 10:11
 Note: galteepata Beat

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**GOVERNMENT OF TELANGANA
FOREST DEPARTMENT**

From
Sri Laxman Ranjeet Nayak, IFS.,
District Forest Officer,
Bhadradi Kothagudem District.

To
The Conservator of Forests,
Bhadradi Circle,
Kothagudem.

Rc. No. 241/2020/D1, dt: 28.02.2023

Sir,

Sub: - TSFD – F (C) Act, 1980 – Diversion of 649.3014 Ha of forest land in Ramavaram RF of Ramavaram Range of Kothagudem Forest Division for grant of mining lease for proposed Venkateshkhanani OCP from Underground rights to Surface rights – Kothagudem area of Bhadradi Kothagudem District in favour of M/s Singareni Collieries Company Limited – Additional information Sought by Got, MoEF& CC, New Delhi– Submitted - Reg.

Ref: 1. Prl. CCF, T.S., Hyderabad, Rc. No. FC4/FC29/6/2022, Dt: 12.11.2022.
3. FDO, Kothagudem Rc. No. 631/2019/A5, dt: 04.12.2022 (Received on 28.02.2023).



With reference to the subject and references cited above, it is submitted that, as per the instructions of the Principal Chief Conservator of Forests (HoFF), T.S. Hyderabad vide reference 1st cited, regarding the information called for, i.e., the “details / KML files of the DFL identified for carrying out one half time CA with reference to the safety zone” for the proposals for Diversion of 649.3014 Ha of forest land in Ramavaram RF of Ramavaram Range of Kothagudem Forest Division for grant of mining lease for proposed Venkateshkhanani OCP from Underground rights to Surface rights, Kothagudem area of Bhadradi Kothagudem District in favour of M/s Singareni Collieries Company Limited, the Forest Divisional Officer, Kothagudem vide reference 2nd cited has submitted the KML File for the safety zone area of 11.00 Ha identified in Compartment No. 29 of Penagadapa RF, Ramavaram Range of Kothagudem Division. The same is submitted herewith for favour of kind further necessary action.

This is submitted for favour of kind information and necessary action.

Encl: As above(KML File).

Yours faithfully,


District Forest Officer,
Bhadradi Kothagudem District.

Copy submitted to the Principal Chief Conservator of Forests (HoFF), T.S. Hyderabad along with KML File for favour of kind information.

Copy to the General Manager, the Singareni Collieries Company Limited, Kothagudem area for information.

Copy to the Forest Divisional Officer, Kothagudem for information.

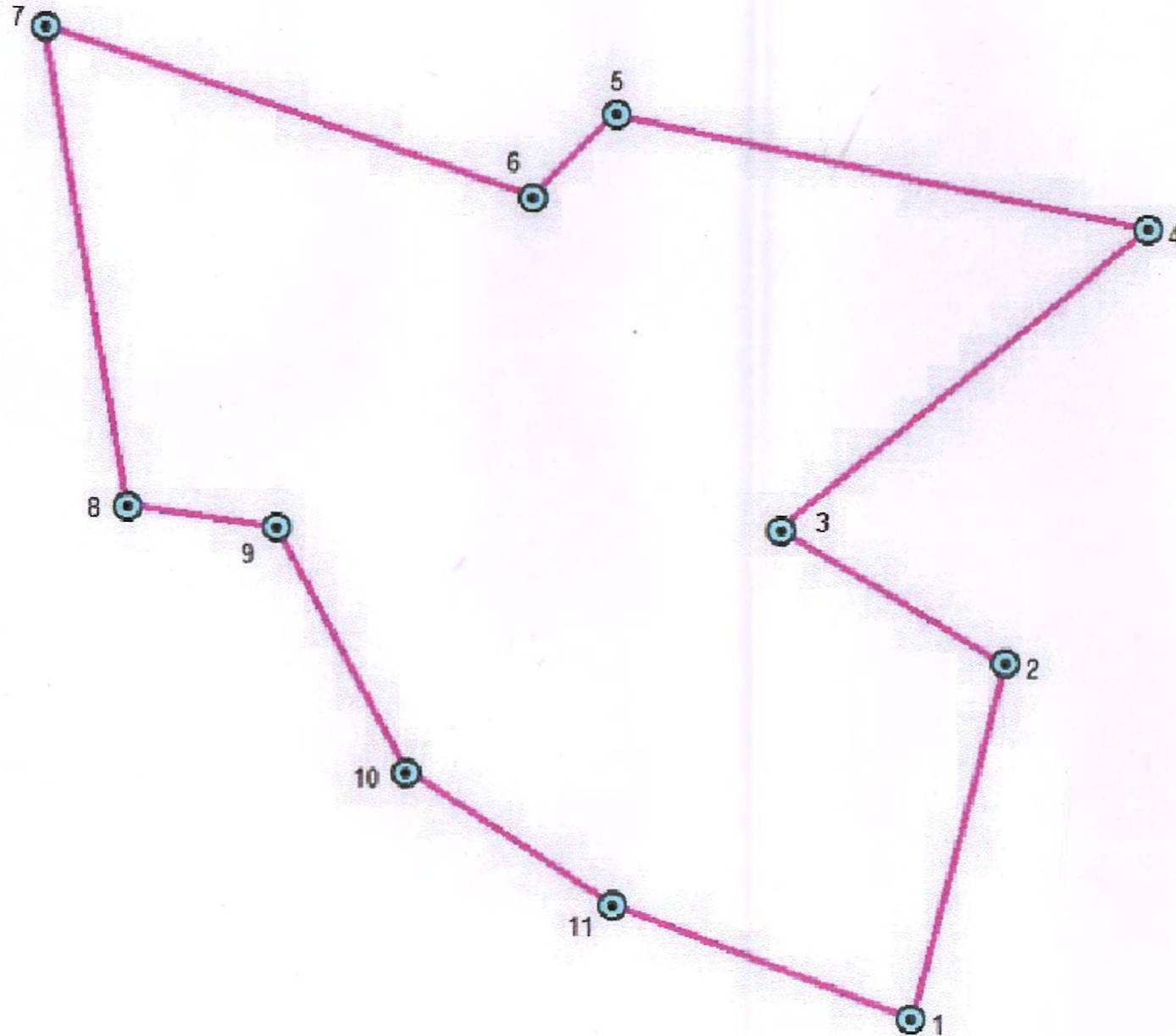

District Forest Officer,
Bhadradi Kothagudem District.

**Location map of Diversion of 649.3014 Ha of Forest land for Venkatesh Khani Coal mine
from underground rights to Surface rights in Ramavaram RF of Kothagudem Division
in favour of M/s Singareni Collieries Company Limited, Kothagudem**



**Gross Area: 12.776 Ha
Net Area: 11 Ha**

**Compt.No.29
Beat: Penagadapa
Section: Penagadapa
Range: Ramavaram**



Sl.No	Latitude	Longitude
1	17.43648	80.68816
2	17.43800	80.68856
3	17.43856	80.68760
4	17.43984	80.68916
5	17.44032	80.68688
6	17.43996	80.68652
7	17.44068	80.68444
8	17.43864	80.68480
9	17.43856	80.68544
10	17.43752	80.68600
11	17.43696	80.68688

 **Area**

[Handwritten Signature]
**FOREST DIVISIONAL OFFICER
Kothagudem.**

Location map of Diversion of 649.3014 Ha of Forest land for Venkatesh Khani Coal mine from underground rights to Surface rights in Ramavaram RF of Kothagudem Division in favour of M/s Singareni Collieries Company Limited, Kothagudem

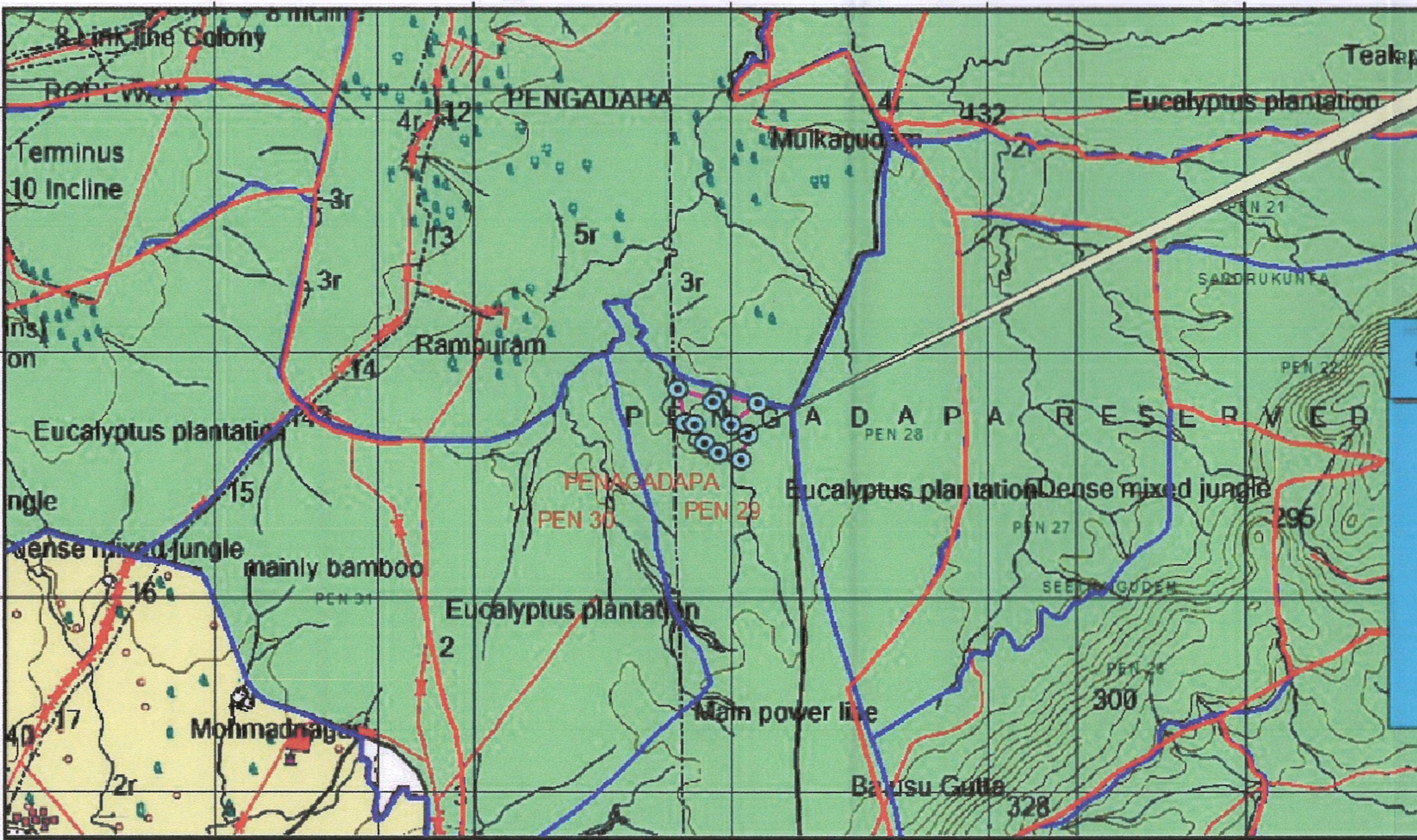
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8	17.43864	80.68480
9	17.43856	80.68544
10	17.43752	80.68600
11	17.43696	80.68688

□ Area
□ Beat Boundary
□ Compt. Boundary



80°39'25" 80°40'20" 80°41'15" 80°42'10" 80°43'05"

[Signature]
FOREST DIVISIONAL OFFICER
Kothagudem.