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Directorate of Forests
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Memo No. 713 /3A-1 **Dated: 24/05/2024**

To: The Principal Chief Conservator of Forests &
Head of Forest Force, West Bengal.

PCCF, HOFF 27/05/24

(**Through Proper Channel:** Principal Chief Conservator of Forests, General, West Bengal)

Sub.: Preparation of SMC Planning for 338.74 Ha of Forest Land Diversion Work in Barjora North Coal Mine Area (Revised).

Ref.: Bankura (North) Division's memo no. 1114../8 dated 24.05.2024

Sir,

With reference to above, this is to bring to your kind notice that the Divisional Forest Officer, Bankura (North) Division have submitted revised SMC plan after making needful correction as suggested from your kind end for 338.74 Ha. Of forest land diversion work in Barjora North Coal Mine Area (in quintuplicate) for your kind perusal.

Therefore, you are kindly requested to do the needful for approval from your kind end.

Encl.: *as stated*

Appd. & Signed. 20/5

Yours faithfully,

Chief Conservator of Forests
Central Circle, West Bengal.

Memo No. 713/1(4)/3A-1 **Dated: 24/05/2024**

CCF/HQ

Copy forwarded for information to:

1. The Principal Chief Conservator of Forests, Wildlife & CWLW, West Bengal
2. Addl. Principal Chief Conservator of Forests & Nodal Officer, FCA.
3. The Divisional Forest Officer, Bankura (North) Division

Chief Conservator of Forests
Central Circle, West Bengal

PREPARATION OF SMC PLANNING FOR 338.74 HA OF FOREST LAND DIVERSION WORK IN BARJORA NORTH COAL MINE AREA

Prepared By:
Bankura (North) Division, Central Circle
Directorate of Forest
Government of West Bengal

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EXECUTIVE SUMMARY

Soil composition and the moisture content within its layers are the key factors that enhance the healthy growth of vegetation in any ecosystem, least to mention a forest ecosystem. It is the same factor that also contributes to the growth of sufficient undergrowth along a forest floor. The tall foliage cover trees, mid-high shrubs and herbs and lush undergrowth cover contribute to soil binding capacity, thus preventing soil erosion activity which is one of the major reasons for habitat degradation, apart from the various anthropogenic interference.

A Soil Moisture Conservation (SMC) planning has been proposed for the habitats of Barjora, Gangajalghati, Beliatore, Sonamukhi and Patrasayer where there is wildlife movement but due to the typical topographic feature of the district of Bankura and the contour of the landscape of the study area, the mentioned regions suffer from scarcity in water content along the forest land along with soil erosion during monsoon.. This plan will help assess the soil composition and moisture content and strategically implement measures that will help restore the moisture content of the soil all along the forest cover in the study area that will help combat soil erosion and at the same time facilitate the growth of healthy vegetation cover. This SMC work will as a whole help in enriching the existing forest cover in the study area, thus its implementation is necessary at the present scenario.

CHAPTER 1: INTRODUCTION

The major part of the district of Bankura is characterized by undulating topography. The average slope of land varies from 0.4% to 10%. The soil is mostly lateritic, light in texture and acidic in nature. The fertility status is also very low. The soil is light and porous in nature with low organic matter and low water holding capacity. However, eastern and southern part of this district is more productive than western part. Soils of the district fall in seven slope classes. Major soil erosion of the district is none to slight erosion (58.56%) followed by moderate erosion(19.01%), moderate to severe erosion(12.03%), slight to moderate erosion (4.64) and severe erosion only (0.37%). This district also has a considerable reserve for coal mine stretched over the fields of Saltora, Mejia and Barjora.

Fig.01: Satellite view of the Project area of Barjora North Coal Mine including forest land

Rainfall is scanty in this district even though good rainfall is recorded in the eastern part of the district. The average annual rainfall ranges between 130 cm to 140cm. Relative humidity is generally high throughout the year. Average percentage of humidity varies from 50 in April to 82 in August (Nandi et. al., 2007). The range of temperature in winter broadly remains within 15° Celsius to 22° Celsius, while in the summer the temperature varies between 25° Celsius to 43° Celsius. The annual rainfall is around 1380mm as per official records.

Bankura though being a rain-fed district, it is widely known as the drought prone district of the State. Drought is a regular feature in the North-West part of the district covering Chhatna, Saltora, Gangajalghati, Barjora, Bankura-I, Bankura-II, Mejia, Indpur, Hirbandh & Ranibandh Blocks. Though this district receives a good amount of rainfall, around 1400 mm. annually, yet cultivation and production of crop primarily depends on constricted period of erratic rainfall. About 80% to 90% rainfall is generally received by the district from June to September depending on the onset of monsoon. A conspicuous feature of this district is the absence of significant rainfall in the month of September and October. High runoff rate of rain water, inadequate storage facilities of the surface – runoff and low water holding capacity of the soil accelerate the drought situation. High run off because of undulating terrain and lack of proper water-harvesting & micro watershed developments makes situation more precarious. After the arrival of monsoon the district registers many cases of flash-flood and inundation of many low-lying areas of the district like a part of Mejia, Barjora, Patrasayar, Kotulpur, Indus, Sonamukhi, Raipur, Sarenga Blocks adjoining the major rivers & tributaries flowing through the district like Damodar, Dwarakeswar, Kangsabati, Shali and others. There is no drainage problem in the district due to its undulating topography, yet the incidence of flood is not uncommon, due to siltation of rivers resulting in overflowing in case of heavy rain. However, heavy rainfall in the district & in the upper catchment areas of Damodar River, coupled with breaches of river embankments and release of excess water from Kangsabati and D.V.C. Irrigation Project inundate Kharif Cropped areas in different parts of the district, especially, in the Bishnupur Sub-division. That results in loss of crops, damage of houses and other properties. Flood or flood like situation has attributed a new dimension to soil erosion by formation of "GULLY" due to tendency of the river (specially Shali at Sonamukhi & at Patrasayer block) to change its course of direction. This problem may interfere with the livelihood and habitat of the people, in the downstream areas in a severe manner in future. Apart from drought and flood, hail storm, thunderstorm, Road accident etc. are also of common occurrence in this district, although the extent of damage in these cases are not as expensive as it caused by draught or flood. Soil and water form two major components of a forest ecosystem and they directly influence the status, health and nature of the flora and fauna that such ecosystem is likely to support. It is obvious therefore that while managing the forest, the Forest Department has to deal with these components and make their best efforts for their conservation to

sustain the plants and animals. SMC (Soil Moisture Conservation) is a scientific method of strategically implementing various plans in the project area depending upon its habitat and wildlife, both flora and fauna, that will access the soil quality and prevent it from erosion and infertility while certain developmental projects are ongoing in the specific region, in this case mining activity.

The main objective of soil moisture conservation is to minimize the amount of water lost from the soils through evaporation (water loss directly from the soil) and transpiration (water loss occurring through the plants) – or combined, the evapotranspiration. Preserving soil moisture is important means to maintain the necessary water for agricultural production, and also helps minimize irrigation needs of the crops. This is especially important in areas where rainwater and/or groundwater resources for irrigation are scarce or decreasing due to climate change or other causes.

There are a variety of methods that can be used to conserve soil moisture. Most of these soil moisture conservation techniques are relatively lowcost and complexity approaches, primarily relying on the presence of required materials and technical capacity locally. Many of the methods rely on providing some kind of cover for the soil to minimize evapotranspiration and direct soil exposure to heat and sun. Generally, most methods used for soil quality improvement and conservation, will also yield benefits to soil moisture conservation. Examples of methods for reducing excess soil moisture loss include following:

- Spreading manure or compost over the soil – this minimizes evapotranspiration and also provides valuable nutrients to the soil through processes of decomposition
- Mulching – mulch is a layer of organic (or inorganic) material that is placed on the root zone of the plants. Examples of mulch materials include straw, wood chips, peat. Inorganic mulch in form of plastic sheeting is also used. Mulching is most suited for low to medium rainfall areas, and less suited for areas with very wet conditions.
- Conservation tillage – reducing or, in extreme cases, completely eliminating the tillage to maintain healthy soil organic levels which increases the soils capacity to absorb and retain water. Conservation tillage is a specific type of such approach where crop residue is left on the soil to reduce evapotranspiration, and protect soil surface from wind, sun and heavy rain impacts.

- Crop rotation – growing different types of crops every season helps improve soil structure and thus water holding capacity. Examples include rotating deep-rooted and shallow rooted crops that make use of previously unused soil moisture, as plants draw water from different depth levels within the soil. Crop rotation may also improve soil fertility and help control pests and diseases.
- Green manuring – growing of plant materials with the sole purpose of adding to the soil for improved organic matter and nutrients. The improved soil quality then also improves water retention capacity.
- Deep tillage – suited for some areas and soils, deep tillage can help increase porosity and permeability of the soil to increase its water absorption capacity.
- Mixed cropping and interplanting - cultivating a combination of crops with different planting times and different length of growth periods.
- Contour ploughing – by ploughing the soil along the contour instead of up- and downward slopes, the velocity of runoff is reduced, creating even barriers, and more water is retained in the soils and distributed more equally across the cropland.
- Strip cropping - growing erosion permitting crops and erosion resisting crops in alternate strips. Other soil moisture conservation techniques may include rainwater harvesting to minimize runoff and collect water for use on site. For more technologies on this see technology sheet Rainwater harvesting for infiltration.

Benefits of SMC work:

- The benefits of many soil conservation methods, depending on the material used, may also include better control of weeds, provision of additional nutrients to the soil, soil temperature control and protection of soil surface from the impacts of heavy rain and wind.
- Active reuse of waste organic materials also reduces waste management needs, returning the residue crops and plants to the soil through decomposition.
- Potential to reduce water irrigation needs, increase crop productivity and improve soil quality.
- By extension, reduced irrigation needs may also reduce the costs and energy requirements of water pumping for irrigation.

CHAPTER 2: CURRENT CONDITION OF THE AREA

The forests of Barjora, Gangajalghati, Sonamukhi, Beliatore and Patrasayer are under the Bankura North Forest Division. In general the topography of this region is typical to the district, dry with undulating high and low land, lateritic soil with light and acidic texture, having deciduous type of vegetation cover with moderate undergrowth that becomes thick during the monsoon months while lessens gradually towards the summer months. Although the annual rainfall is low, but the distribution of rainfall across the land is quite uneven. Certain monsoon months also record over excess rainfall at certain times too. Adding to this, there are insufficient waterbodies in the area that can help storing some of this rainwater for maintaining moisture content of the soil all the year long.

The vegetation of this forest is dominated by native floral specie like Sal (*Shorea robusta*), Piyal (*Buchanania lanzan*), Kendh (*Diospyros melanoxylon*), Asan (*Terminalia elliptica*), Bel (*Aegle marmelos*), Mahua (*Madhuca longifolia*), Karanja (*Millettia pinnata*), Arjun (Terminalia arjuna), Aam (*Mangifera indica*), Bot (*Ficus benghalensis*), Ashwatha (*Ficus religiosa*), Tamarind (*Tamarindus indica*), Sirish (*Albizia lebbeck*), Hartaki (*Terminalia chebula*), Baheda (*Terminalia bellirica*), Amloki (*Phyllanthus emblica*), and a variety of shrubs and herbs. Most of this species have economic value as forest produce, medicinal qualities and also serve as fodder for the elephants residing at and/or visiting this forest cover.

During the rainy season the under growth of this forest patch is dense compared to other forest patches. So, it helps a lot of animals to sustain here.

Apart from the Asian Elephants (*Elephas maximus*) which is the mega fauna of this area, other mammalian diversity is also recorded from this forest patch like the Golden Jackal (*Canis aureus*), Bengal Fox (*Vulpes bengalensis*), Indian Wolf (*Canis lupus pallipes*), Indian Hare (*Lepus nigricollis*), Indian Crested Porcupine (*Hystrix indica*), Indian Pangolin (*Manis crassicaudata*), Wild Boar (Sus scrofa), Langur (*Semnopithecus sp.*), Mongoose (*Herpestidae sp.*), Asian Palm Civet (*Paradoxurus hermaphroditus*), Small Indian Civet (*Viverricula indica*), Bandicoot rats (Bandicoota sp.) and many others. Apart from the mammals, insect community, reptilian and avian diversity is also abundant in the area. Due to the presence of Durgapur Barrage, migratory avian species are also observed in and around this forest patch during the winter months of December to February. Apart from the mammals this forest area is a home for notable schedule 1 and schedule 2 species such as Indian Rock Python (*Python molurus*), Monocled Cobra (*Naja Kaouthia*), Braminy Worm Snake

Fig.02: Coexistence of skink and scorpion inside the Barjora North Forest Habitat

(*Ramphotyphlops braminus*), Spectacled Cobra (*Naja naja*), Russell's Viper (*Doboia russelii*), Indian Chamaeloen (*Chamaeleon zeylanicus*), Grey Francolin (*Francolinus pondicerianus*), Lesser Adjutant (*Leptoptilos javanicus*), Asian Openbill Stork (*Anastomus oscitans*), Red Naped Ibis (*Pseudibis papillosa*), Oriental Honey Buzzard (*Pernis ptilorhynchus*), Peregrine Falcon (*Falco peregrinus*)

Due to coal mining activity, a certain portion of this forest cover will be compromised, which extends up to an area of about 338.74ha. This mentioned area is one of the key patches of Barjora where wildlife, both flora and fauna, is abundant and diversified, contributing largely to the rich biodiversity of the region. More over mining activities will also cause huge sound pollution and soil erosion in the project site, thus hampering the existing vegetation at large. Soil erosion can also jeopardize the lives of the mine workers working below the ground. So SMC work will not only identify and access the vulnerable stretches in the project site which will be subjected to erosion activity, but will also help in rejuvenating the existing vegetation of the area which can retain the rich biodiversity of the place. The plans proposed in the project will also obliterate the life threats that may befall upon the mining workers due to vibration caused at the soil strata due to mining as well as erosion. Now, let us discuss the present condition of the five microhabitats viz., the forest of Barjora, Gangajalghati, Beliatore, Sonamukhi and Patrasayer.

Barjora has the most dense vegetation cover and this forest is mainly located along the highlands of the landscape of the study area. This habitat is also the one where the current mining activities are ongoing. In this habitat, the contour of the forest land varies form 90-110 m while that along the non-forested patch is around 70-80 m, thus the forest cover is along the highlands while the non-forested area is along the lowlands. As per this general elevation of the landscape, water flow is along the forest cover towards the mining area which is along the low land area. So naturally the moisture retention capacity of the soil inside the existing forest is low, as most of the water flows to the adjoining low land areas. The proposed planning can help the combating this issue by strategically placing the trenches and water bodies along the contour of this habitat, thus maintain the moisture content of the soil and facilitating a healthy vegetation cover which in turn can not only prevent soil erosion but also regulate sound pollution from the constant mining activity.

The contour of Gangajalghati is quite similar to the landscape of Barjora where the forest zone covers the highland having contour of 90-110 m while the adjoining human settlements and agricultural field is at the lowlands having a contour of 70-80 m. This elevation of the landscape thus leads the water to flow from the highland to lowland. Moreover within the forest cover there is insufficient waterbody, so there is very little scope of water to retain within this highland, resulting in water scarcity in the habitat. This results in decreasing vegetation cover, ultimately leading to soil erosion activity. The planning for SMC will help create sufficient waterbodies within this habitat that will retain maximum rainwater as well as water from the flowing streams within the habitat especially during the monsoon months, thus ensuring the moisture content of the soil, ultimately leading to healthy vegetation cover and combat erosion activity.

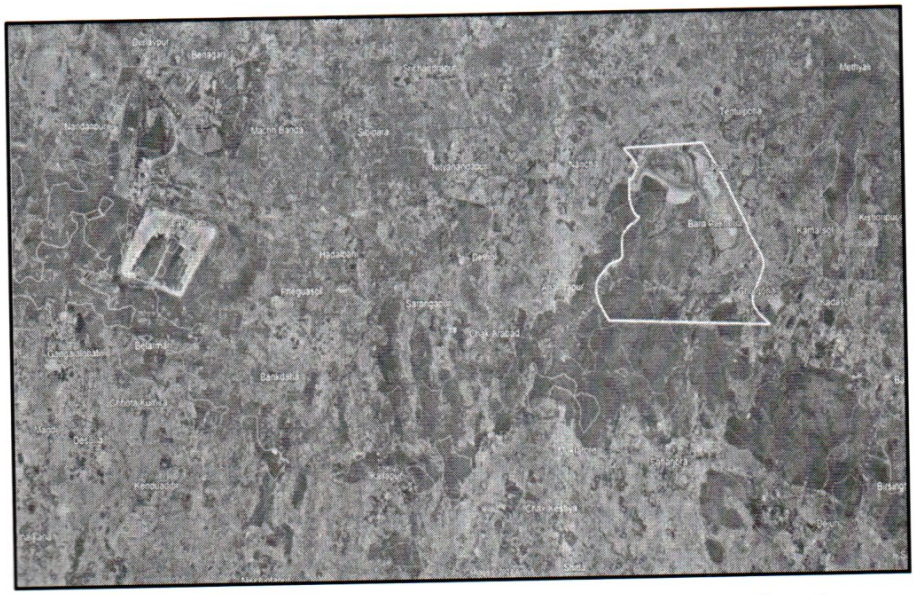

Fig.03: Area of Ghangajalghati and Barjora Forest; The Forest diversion area is denoted in the white polygon

The forest cover of Beliatore and Sonamukhi is quite fragmented and also has very limited number of waterbodies. The contour along the forest cover is up to 100 m while the contour of the adjoining agricultural field is about 80 m. So naturally, the water flow is from the forested patches towards these crop fields. Adding to the already dry landscape and forest fragmentation, these habitats are subjected to

immense soil erosion activity. So the proposed planning has provision for excavating sufficient waterbodies within the forest cover of these habitats that can conserve rainwater during the monsoon months and also sudden heavy rainfall. The water retained in these waterbodies will help in maintaining the moisture content of the soil, leading to sustainable vegetation growth and combat soil erosion eventually.

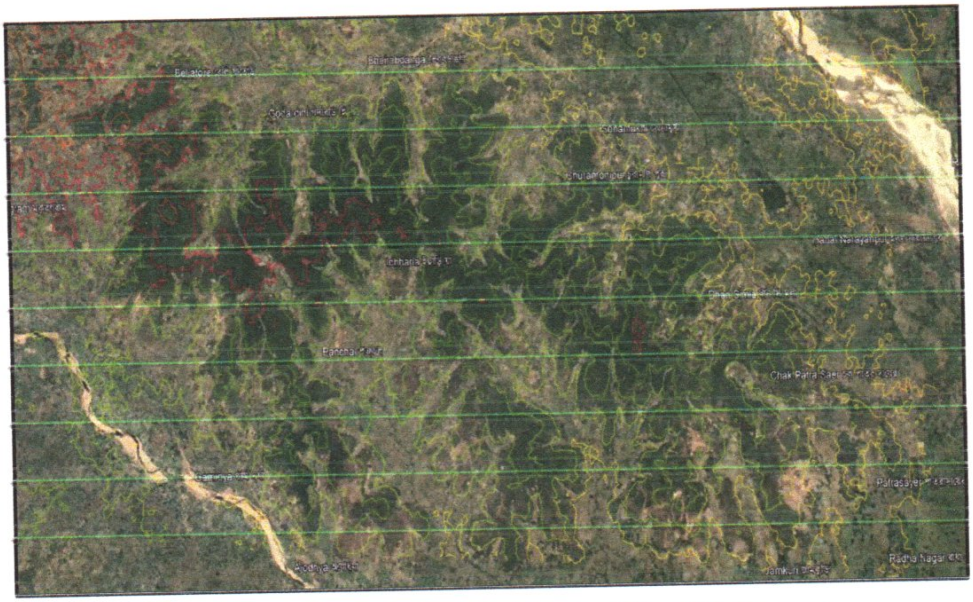

Fig.04: Forest area of Beliatore, Sonamukhi and Patrasayer

Patrasayer is the area which is dominated by the agricultural fields. The contour of the forest land and the adjoining crop field is slightly different, the prior having a contour of 80-90 m while the latter having a contour of 80 m. Since the forest is entirely surrounded by crop fields, often fertilizers and pesticides get mixed with the streams and rivulets traversing along the habitat, percolating the soil strata. This incident over time has to some extent alternated the chemical composition of the soil of the area, leading to lesser water retention capacity within its layers. This crisis in soil moisture has lead to erosion activity. The proposed planning will help in assessing the current condition of the soil quality and according the certain developmental measures will be implemented so that the habitat can rejuvenate its soil moisture level that will help grow and sustain healthy vegetation, which in turn will combat soil erosion in the region.

CHAPTER 3

PROPOSED WORK

The entire SMC work is completely based on the soil context and land sloping of the entire area. So, before proposing our plan, it is better to discuss the drainage

Fig.05: Satellite view of the area where this SMC Planning will be proposed

pattern and contour of the landscape inside the forest area.

As per the forest land situation, the forest after the diversion work, is denoted in the figure no 05. In the figure no. 06, one can find the slope all along the northern side of the forest. It is very important to hold the water from flowing towards the mines to conserve the moisture of the soil as well as to decrease soil erosion.

As per the contour and drainage pattern, it is seen that most of the forest cover is along the highlands and the water flows from these highlands to the adjoining lowlands where there are human settlements and agricultural fields. So strategic planning of certain facilities has been proposed that can not only preserve the rainwater within the forest covered highlands but also retain the moisture content of

the soil, thus facilitating healthy vegetation growth and ultimately combating the threat of soil erosion.

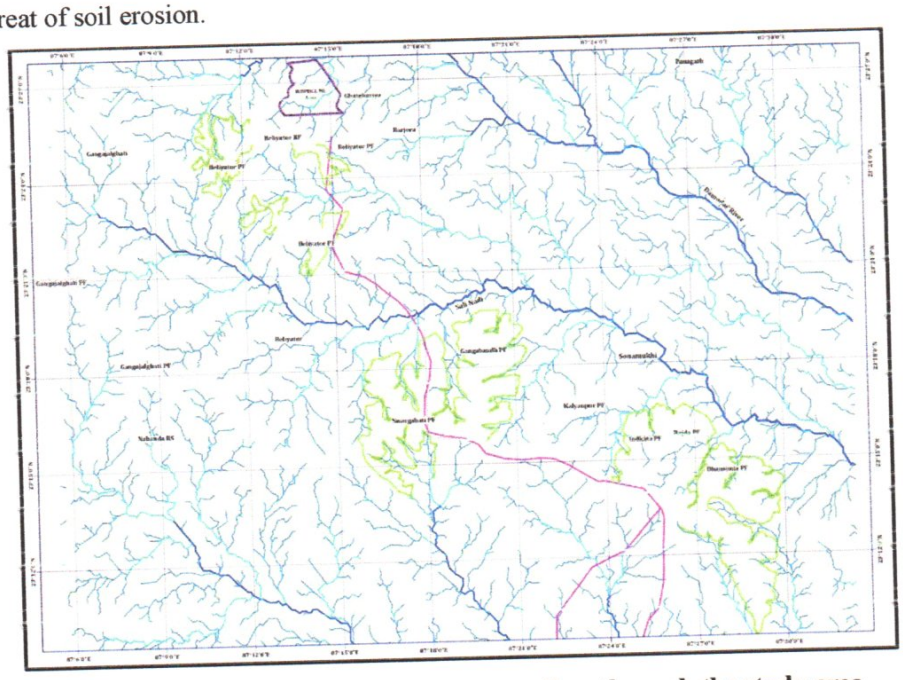

Fig.06: Drainage map showing the water flow through the study area

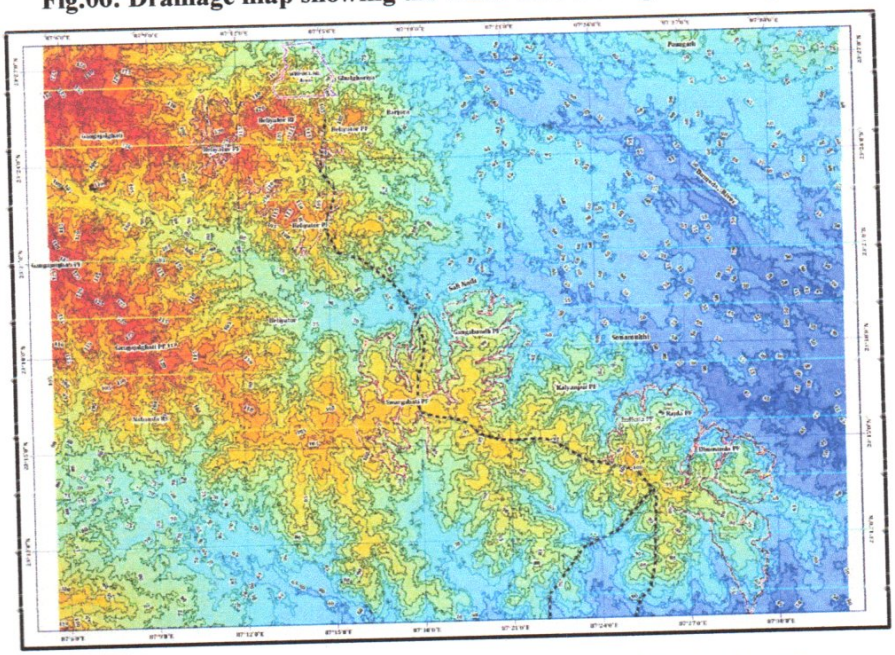

Fig.07: Contour map showing the landscape of the study area

From the figure nos. 06 & 07 we can conclude that, in the Barjora area, all the water flow will be towards the northern area of the forest and it will automatically enter the mine area which will be drained out by the mining authority, as it has no use for them. On the other hand, this water is very important for the forest department to ensure the moisture content of the soil in the dry lands of Bankura. From the same figures we can find out in all of the habitats the water flows mainly from the forest areas to the outside non forest areas, by judging the contour map. Let us discuss our proposed measures in the following.

Staggered Contour Trench:

The contour trenches are the method of constructing the trenches along the contour lines of the slope with 10 - 30%. Objectives of the trench are to reduce surface water flow velocity, retain water and sediment on the slope, promote infiltration, improve local soil moisture and as the result, to reduce the runoff discharge and sediment to the downstream watershed. There are three major types of contour trenches - (i) continuous, (ii) line and (iii) staggered. Staggered contour trenches are trenches dug in a trapezoid shape with a top width of 1 meters, a bottom width of 0.7 meters and a depth of 1 meters. The soil removed is used to create a berm just downhill from the trench. The trenches should be dug perpendicular to the slope (along the contours).

Fig.08: Sample of Stagger Contour Trench

The layout of this staggered contour trench will be as follows:

- The trench will be constructed in 3 layers - upper, middle and lower, depending depending upon the situation of the field.
- The trench will be excavated from higher elevation to lower elevation along contour of the entire landscape at the study area.
- The distance between the successive layers will be 1-3 km, depending upon the situation of the field.
- Each layer of the trench will again be divided into 3 tiers. The distance between each tier will be about 5-10 m apart.
- The dimension of each contour will be of 1m (width) X 1.0m (depth) X 2 m (length). The topline width of a contour will be 1m, while the bottomline width will be 0.7m,
- The staggered contour trench will stretch over a distance of 67 km and about 1,20,000 such trenches will be excavated.

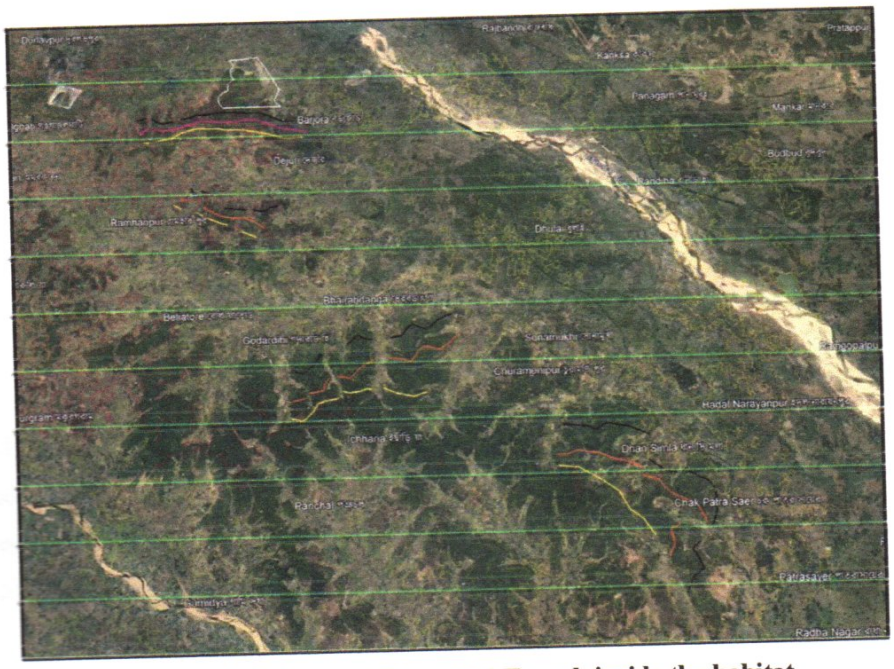

Fig.09. Triple Layered Staggered Trench inside the habitat

The main concept of this proposed structure is to restrict the water flow along the north margins of the regions and that the water to remain conserved within the forest cover only. The structure's first layer will restrict the initial water flow after which the excess water will be arrested in the second and third layers successively, thus arresting the major water flowing outside the forest cover.

Gully plugging

Earth plugs (commonly called plugs), which are small structures, are constructed across the gullies. Their main purpose is to hold water and let it percolate into the ground.

In non-humid regions, small gullies which are not deeper than 1 m, with a gully bed gradient of less than 10 percent, can be stabilized by a series of earth plugs. In humid regions, earth plugs must be combined with small diversions.

Distribution of earth plugs depends on the gully channel's gradient. Determine the earth plug's site by running a level line from the water level of the upstream earth dam to the channel bottom; fix another plug there. Compute the number of earth plugs needed by using the equation "Number of check dams (N.O.C.D.)" while taking into account the compensation gradient which is zero percent in this case. The maximum height for earth plugs is 3 meters.

Limit the use of earth plugs and diversions to areas where sufficient storage capacity can be provided above the earth plugs. These areas should be able to retain the major portion of the run-off discharged from the drainage area, less that which can be disposed of on the adjacent spreading areas. The earth plugs are raised above the ground level. The short diversion ditches lead overflow away from the ends of the plugs to prevent erosion damage and to spread the water. Finally, the water is either held and infiltrated by the gully or by the soil on the spreading areas. Because silt deposits gradually reduce the storage capacity of the small ponds, the amount of diverted overflow increases and may erode the discharge areas unless a sufficient plant cover is maintained.

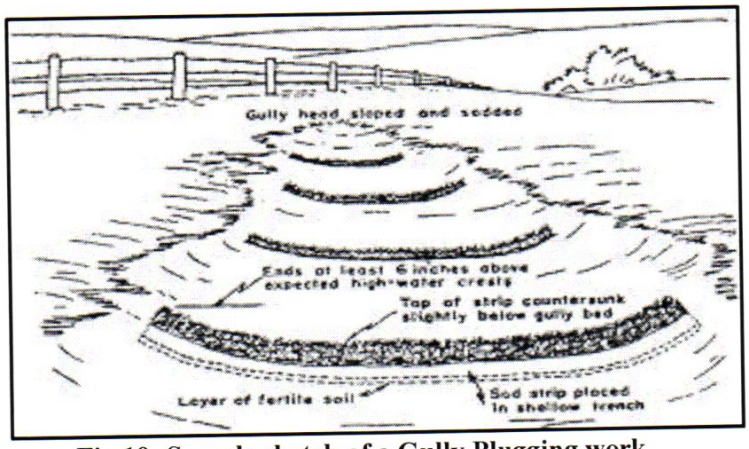

Fig.10: Sample sketch of a Gully Plugging work

This gully plugging will play a very important role in the SMC working planning as on one hand it will ensure the flow of the waters towards the contour trench and earthen dams and retain the maximum water inside the forest cover only, while on the other hand it will help to conserve the soil by reducing the soil erosion. Since Bankura has a comparatively dry climate apart from the other parts of West Bengal (excluding Purulia and Jhargram), it is very important to hold the waters and gully plugging will play the initial role in this to control the water flow thus ensuring water retention within the layers of the soil.

Earthen Dams:

An embankment dam is a massive artificial water barrier. It is typically created by the placement and compaction of a complex semi-plastic mound of various compositions of soil, sand, clay and/or rock. It has a semi-permanent waterproof natural covering for its surface, and a dense, waterproof core. This makes such a dam impervious to surface or seepage erosion. The force of the impoundment creates a downward thrust upon the mass of the dam, greatly increasing the weight of the dam on its foundation. This added force effectively seals and makes waterproof the underlying foundation of the dam, at the interface between the dam and its stream bed. Such a dam is composed of fragmented independent material particles. The friction and interaction of particles binds the particles together into a stable mass rather than by the use of a cementing substance.

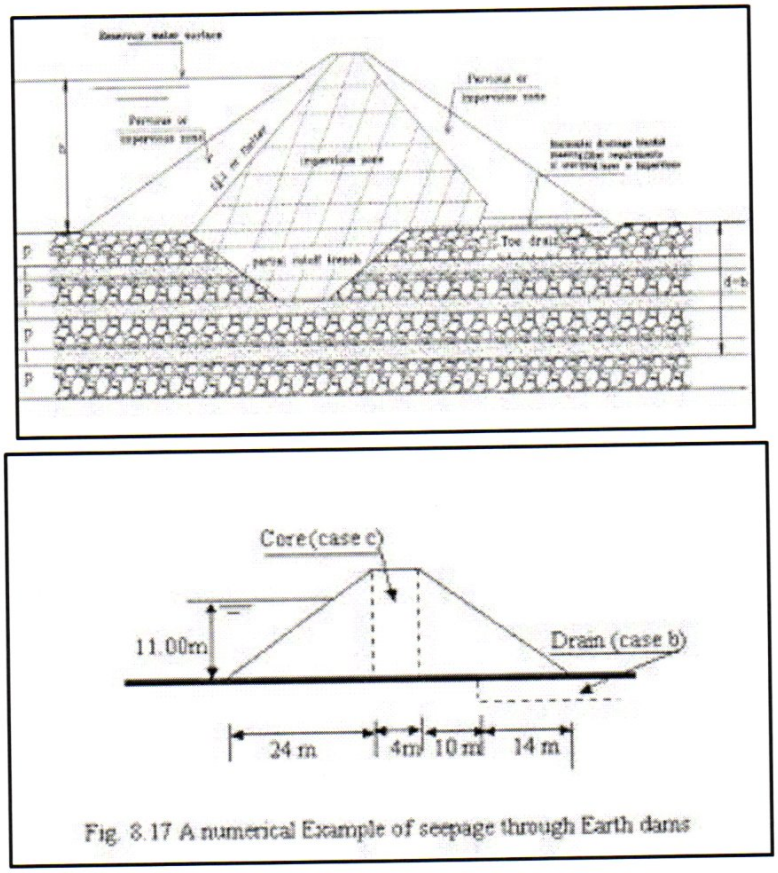

Fig. 8.17 A numerical Example of seepage through Earth dams

Fig.11: Sample sketch of Earthen Dam

This will be the most important component in this proposal at it not only holds maximum water from being drained out from the forest, but will also help to replenish the ground water level and provide drinking water to the wild animals. As per our planning we are proposing to excavate 4 earthen dam, two inside the forest cover of Barjora and two at the forest of Gangajalghati. These structures will stretch over area of 1-2 ha, each and will hold a huge amount of water that can provide sufficient water for the wildlife in the area throughout the year.

Plantation:

Here we are proposing for planting native tree, herb and shrub species to not only restrict animal movement, more specifically, wild animal movement, inside a particular zone but also to enrich soil and prevent soil erosion. The adjoining areas of waterbodies and all along the river and rivulets flowing through the project area, a provision has been allotted to plant native grass species as well as fruit bearing tree species like Ficus spp,wild banana, bael, kathbel, bamboo and similar types, which will develop

a type of bio fencing that will not only help in conserving the moisture content of the soil in the project area but also help in providing sufficient fodder to the major fauna of the region as well as other wildlife, thus enrich the ecosystem of the study area. This plantation will be done also in and around the periphery of the proposed stagger trenches and earthen dams and gully plugging also. The reason for choosing the native variety of floral is because these species are better suited for the landscape of the region and also have better water retention capacity than any other variety of trees or shrubs. For example, apart from being a very good elephant fodder, which is the major fauna in the region, bamboo can hold a water capacity of 200 to 400 mm and is able to assimilate macro and micro nutrient part from also absorbing heavy metals from the flowing water. Thus a special emphasis has been given to the only the native and wild species of trees, herbs and shrubs of the region, so that this fencing can restore the balance in the ecosystem and at the same time combat soil erosion activity at the region.

Chapter 4: DETAILED BUDGET

Sr. No.	Item	Description of Item	Unit	Quantity	Rate	Amount
1	Staggered Trench	A total 67 Km area will be covered in all the 5 micro habitats where 3 layered and 3 tier staggered trenches will be prepared	Nos	120000	₹600.00	₹7,20,00,000.00
2	Earthen Dam	4 Large waterbody of 1-2 Ha will be built with one side having proper concrete embankment	Nos	4	₹1,80,00,000.00	₹7,20,00,000.00
3	Gully Plugging	Earthwork in excavation from borrow pits includes breaking clods in embankment work and filling up the back of abutments	Nos	1600	₹1000.00	₹16,00,000.00
4	Bamboo Plantation	Bamboo plantation in a width of 30 m and length 10 km at the mine boundary, including maintenance	Ha	30	₹1,00,000.00	₹30,00,000.00
5	Boundary plantation	Plantation in a width of 50 m and length 8 km at the mine boundary with soil binding species such as Ficus spp. Etc, including maintenance	Ha	40	₹2,00,000.00	₹80,00,000.00
6	Plantation along Staggered trenches	Fodder Plantation along Staggered trenches to stabilize the trenches.	Numbers	120000	₹10	₹12,00,000.00
					Subtotal (in Rs.)	**₹15,78,00,000.00**
					Cost Escalation due to annual inflation calculation (in Rs.)	**₹45,65,280**
					Total (in Rs.)	**₹16,23,65,280.00**

Note: Annual inflation rate of 6% is taken into account to calculate revised amount due to annual inflation. Year wise break up is shown in the table.

Year wise Distribution of Work

S. No.	Item	Y1		Y2		Y3	
		Qty	Total Amount	Qty	Total Amount	Qty	Total Amount
1	Staggered Trench	40000	₹2,40,00,000	40000	₹2,54,40,000	40000	₹2,69,66,400
2	Earthen Dam	4	₹7,20,00,000				
3	Gully Plugging	600	₹6,00,000	600	₹6,36,000	400	₹4,49,440
4	Bamboo Plantation	30	₹30,00,000				
5	Boundary plantation	40	₹80,00,000				
6	Plantation along Staggered trenches	40000	₹4,00,000	40000	₹4,24,000	40000	₹4,49,440
Year Wise Total (in Rs.)		-	**10,80,00,000**	-	**2,65,00,000**	-	**2,78,65,280**
Total (in Rs.)		**16,23,65,280**					

Preparation of SMC planning for 338.74 Ha of Forest Land Diversion work in Barjora North Coal Mine area

Prepared & checked by:-

Divisional Forest Officer,
Bankura (North) Division.

Recommended & forwarded by:-

Chief Conservator of Forests,
Central Circle, West Bengal.

Approved by:-

Principal Chief Conservator of Forests
& Head of Forest Force, West Bengal.