THE IMPACT OF SOIL QUARRYING AT MANAKKAMALA, MULANTHURUTHI, ERNAKULAM

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THE IMPACT OF SOIL QUARRYING AT MANAKKAMALA, MULANTHURUTHI, ERNAKULAM

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The team visited the site on 18-10-2016 and examined the geomorphology of the hill from where the Soil quarrying is done and the hydrological character of the area including the farm lands surrounding the hill. The team also visited a nearby hill which was mined for the soil earlier and examined the water availability in the area.

The Report

Introduction

Soil quarrying and levelling of hillocks have been reported from all over Kerala. These activities have reached critical levels in the peripheral areas of the major developmental centres in the state. Although Environmental Impact Assessment studies are made to identify and evaluate the environmental effects of developmental projects, its ripple effects in the mining and quarrying sectors are often ignored and/or underestimated. This, in many of the occasions, has led to serious problems in the socio-environmental setting of the regions located close to the core developmental centres.

The Ernakulam district is perhaps the region where intense land modifications are taking place. The industrial activities, the changes in land utilisation, increasing port activities, the urbanisation and all other developmental activities lead to very high stress on the physiography of this District. The over exploitation of natural resources have very seriously affected the environment. The depletion of river sand has made people to think about other alternatives such as M-sand which will definitely will lead to another crisis which will be on the rock resource of the district. Already there are more than 150 granite quaries, including both licensed and not, in the district. The soil categories in a region are influenced by factors like climate, geology, relief and various biotic components. A major part of Ernakulam is covered by lateritic soil, which is a product of tropical weathering of iron rich parent rocks in which several courses of transformation takes place. In recent years, excessive quantities of lateritic soils are being quarried from the residual hillocks in the lowlands and midlands of the District. These land part is the flood plain of the rivers during monsoon and source of ground water recharging. The extension of the urbanisation of the district in terms of population and developmental activities have lead to reclamation and development of farm lands to residential or commercial purposes. In the case of soil quarrying, loosening, loading and transporting takes place in varying combinations, depending on the shape, size and depth of the pit, the local topography and the output required.

Physiographically the district is divisible into three zones as (i) the coastal plains in the west, (ii)the midland region in the east and (iii) the steep to very steep hills in the easternmost part. The coastal plain comprises of land less than 10m elevation and is characterized by backwater bodies, marshy lands, sandy flats and alluvial plains, which are the flooding zone during monsoon. The midland region which generally lies between 10 to 100m elevation and have a topography with low hills and narrow valleys. The hills are generally covered with laterite or lateritic soils and the valleys are alleviated. The region has a very gentle to moderate slope from east to west. The easternmost part is the foothills of the Western Ghats with an elevation more that 300m above mean sea level. The area has forest soil.

Based on the morphological features and physico-chemical properties, the soils of the district are classified as Lateritic, Hydromorphic saline, Brown hydromorphic, Riverine alluvium and Coastal alluvium. The major crops are coconut, tapioca, rubber, areacanut, pepper, cashew and spices. Small patches of hydromorphic saline soil are seen in the coastal tracts of the district. Brown hydromorphic soil is the second most prevalent soil type of the district seen in valley bottoms. Groundwater generally occurs under phreatic line in weathered and fractured crystalline rocks, laterites and unconsolidated coastal sediments. It occurs under semi-confined to confined conditions in the deep seated fractured aquifer of the crystallines rocks and Tertiary sediments. The weathered zone in the crystallines below acts as good storage for groundwater but groundwater development for the district is observed to be only about 43 %. The entry and storage of rain water in soil depend upon soil characteristics.

According to Dr. H.H. Bennet, "Soil without water is desert and water without soil is useless". The problem of conserving moisture is of paramount importance in the extensive regions of low and uncertain rainfall. The key to water conservation is the utilization and treatment of land according to its water retention capabilities. Study of soil and its water holding capacity is essential for the efficient utilization of irrigation water

The better utilization of rain fall, irrigation facilities and effective control of soil erosion and run off depend largely on the water retention characteristics and erodibility indices of the soil. Soil texture, organic matter and cation exchange capacity to a large extent determine the water retention/ release and infiltration rate in soil. The water movements in the unsaturated zone, together with the water holding capacity of this zone, are very important for the water demand of the vegetation, as well as for the recharge of the ground water storage. The water that falls on the land or added to a soil by irrigation moves in a number of directions. In vegetated areas, 5 - 40% is usually intercepted by plant foliage and returns to the atmosphere by evaporation without ever reaching the soil. In some evergreen forest areas, one third to one half the precipitations is intercepted and does not reach the soil. In level areas with friable soils, most of the added water penetrates the soil. But in rolling to hilly areas, especially if the soil is not loose and open, considerable run off and erosion take place, thereby reducing the proportion of water that can percolate into the soil. Once the water penetrates the soil, part of it is subjected to downward percolation and eventual loss from the root zone as drainage occurs. In humid areas, up to 50% of the precipitation may be lost as drainage water. However, during periods of low rainfall, some of this downward percolating water may later move up into the plant root zone by capillary aeration, and thereby become available for plant absorption.

Water is the major input for the growth and development of all types of plants. The availability of water, its movement and its retention are governed by the properties of soil. The properties like bulk density, mechanical composition, hydraulic conductivity etc. depend on the nature and formation of soil and land use characteristics in addition to the weathering processes and the geological formations.

The valleys of the hill are regions of intensive agriculture. It is essential to maintain readily available water in the soil if crops are to make satisfactory growth. The plant growth may be retarded if the soil-moisture is either deficient or excessive. If the soil moisture is only slightly more than the wilting coefficient, the plant must expend extra energy to obtain it and will not grow healthy. Similarly, excessive flooding fills the soil pores with water, thus driving out air. Since air is essential for satisfactory plant growth, excessive water supply retards the plant growth. When watering is done, the amount of water supplied should be such that the water content is equal to the field capacity. 'Field Capacity' (FC) is the amount of water remaining in the soil after all gravitational water has drained.

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Water Retention Capacity of Soil

Soils can process and contain considerable amounts of water. They can take in water, and will keep doing so until they are full, or the rate at which they can transmit water into, and through, the pores is exceeded. Some of this water will steadily drain through the soil (via gravity) and end up in the waterways and streams. But much of it will be retained, away from the influence of gravity, for use of plants and other organisms to contribute to land productivity and soil health. The spaces that exist between soil particles, called pores, provide for the passage and/or retention of gases and moisture within the soil profile. The ability of soil to retain water is strongly related to particle size. Water molecules hold more tightly to the fine particles of a clay soil than to coarser particles of a sandy soil, so clays generally retain more water. Conversely, sands provide easier passage or transmission of water through the profile. Clay type, organic content and soil structure also influence soil water retention

Bedrock in tropical zones is often granite, gneiss, schist or sandstone; the thick laterite layer is porous and slightly permeable so the layer can function as an aquifer in rural areas. One example is the Southwestern Laterite (Cabook) Aquifer in Sri Lanka.

This aquifer is on the southwest border of Sri Lanka, with the narrow Shallow Aquifers on Coastal Sands between it and the ocean. It has considerable water-holding capacity, depending on the depth of the formation. The aquifer in this laterite recharges rapidly with the rains of April–May which follow the dry season of February–March, and continues to fill with the monsoon rains. The water table recedes slowly and is recharged several times during the rest of the year. In some high-density suburban areas the water table could recede to 15 m (50 ft) below ground level during a prolonged dry period of more than 65 days. The Cabook Aquifer laterites support relatively shallow aquifers that are accessible to dug wells.

Soil water holding capacity is controlled primarily by the soil texture and the soil organic matter content. Soil texture is a reflection of the particle size distribution of a soil. An example is a silt loam soil that has 30% sand, 60% silt and 10% clay sized particles. In general, the higher the percentage of silt and clay sized particles, the higher the water holding capacity. The small particles (clay and silt) have a much larger surface area than the larger sand particles. This large surface area allows the soil to hold a greater quantity of water. The amount of organic material in a soil also influences the water holding capacity. As the level of organic matter increases in a soil, the water holding capacity also increases, due to the affini y of organic matter for water.

1. It was observed that at one side of the hill top mining was done partly but at a depth of about 8-9 meters. In another part the mining has been done more deep and in slope. In both the parts the sand profile can be seen very clearly. To the depth upto which structure of the soil is open the soil is found to be rusty-red in colour indicating the specific character of laterite soils. of high iron oxide content. They develop by intensive and long-lasting weathering of the underlying parent rock.
2. The hill top and sides clearly gave the garden character with bushes, rubber and other trees
3. Though the visit to the site was during the dry summer period, water was seen in the well at top of the hill.
4. At the ground level all the houses have well and the source of water for the people are the well water.
5. Strong water scarcity was reported from the valley and areas surrounding the hill where soil mining was done earlier.

Comments

1. The soil in the Manakkamala is typical of the midlands of Kerala comprising of laterite as the major component. The physical weathering of gneissic and granitic rocks under humid tropical conditions leads to the formation of laterite in these areas. The heavy rainfall and high temperature are the contributing factors to the laterisation. The texture of the surface soil will be granular and reddish to yellowish red in colour indicating the presence of high iron oxide content. The sub surface soil also shows mixed iron oxide and aluminum oxide gravels and below that iron-rich, humus-poor mixture of clay with quartz and other minerals were the observation. Though in many areas the soil below the sub surface contains quarriable type that breaks into blocks in this area it was non-quarriable type which breaks into irregular lumps.

2. Land is a valuable asset that needs to be preserved for maintaining the social, cultural, spiritual, political and economic life of the people of a region. A landscape comprises visual features of an area including the physical elements such as landforms, biotic components of flora and fauna, the abstract elements such as lighting and weather conditions and the human elements otherwise referred as the built-in environment. The worst impact of soil quarrying is hill degradation and leveling, especially in the midlands. Degradation of connected ecosystems of hills like the valleys and the nearby wetlands is an inevitable outcome of hill leveling in the study area. The mechanical quarrying and vehicular movements would aggravate the issue further. The mechanical quarrying of soil from hills may markedly change the landform features of the basin area, resulting in instability of the adjacent land, buildings/ houses, loss of biodiversity and vegetation, accelerated erosion and caving of soil masses, etc. Lack of sufficient benches in the quarry faces could adversely affect the stability of the neighboring areas in the long run. In addition to stability problems, uncontrolled soil quarrying operations could result in extensive modification of the landscape and/or aesthetics of the region.

3. The rural landscape development possibilities which is integral to strengthen the tourism potential of the region is detrimentally affected by the visual scars created

as a result of haphazard extraction of soil from the hills and hillocks. Through massive removal of soil and/or leveling of hillocks, the medium for holding rain water (i.e., aquifer) will be lost forever. This will result in the lowering of water table to significant levels causing drinking water problems in the affected area. Soil quarrying from hill ecosystems will disturb the course of the water flow which may tend to change direction. Soil quarrying also causes significant negative impact on air quality. The exposed quarry grounds due to removal of vegetation and disintegration of soil masses cause wind borne particulates which are liable to remain in the atmosphere for long and cause atmospheric pollution. Mechanical quarrying processes enhance manifold the particulate load in the atmosphere which cause respiratory ailments or other health effects when absorbed through the skin. The removal of soil, its loading, movement of the loaded vehicles, etc., could reduce substantially the ambient air quality through increased emission of particulate matter. Further, the fugitive dust emission during mining would deteriorate the air quality of the surrounding areas. Rise in noise level due to mechanical mining and loading is another form of atmospheric pollution. The small landholders adjoining the mining hot spots are the ultimate victims of the adverse impacts of the activity

4. Though the laterite soil is generally poor in available nitrogen, phosphorus and potassium, in this site intense vegetation is observed. Hill ecosystems are unique in several respects and offers habitat for a variety of plants and animals. Resource extraction cause significant negative impacts on flora and fauna of the affected area. The land use change due to quarrying causes loss of native/ agricultural vegetations in the area. Biotic and abiotic components of hill ecosystems operate in a balanced relationship. The top soil is the abode of many soil microorganisms which maintain the fertility of soil for plant growth. Therefore, obliteration of top soil in due course could reduce the net bio-productivity of the area. The activity inevitably leads to changes in soil profile, quality and processes detrimentally affecting the functioning of the entire ecosystem. Further, quarrying disturbs the natural habitats of certain animals inhabiting in the affected area and can even lead to habitat destruction. Levelling of hill ecosystems would result in significant negative impact on the biological diversity due to habitat fragmentation. Degradation of some midland laterite hills in the study area has affected the

sacred groves which are unique to these hills. Stripping of these hillocks along with its biological wealth is a huge loss to mankind.

5. The spongy vesicular nature of the sub soil and the soil below it may be significantly contributing water and moisture content of the soils. Generally the laterites with its porous character are considered to be potential aquifers for groundwater and depth to water level ranges from less than a metre to 3 metres in rainy season. But the water retention capacity of the soil is poor and the groundwater drains off immediately after the rainy season. The high percolation of water through the laterite and the water holding and the aquifer character during the rainy season supplements considerably to the ground water.Soil water holding capacity is controlled primarily by the soil texture and the soil organic matter content. Soil texture is a reflection of the particle size distribution of a soil. An example is a silt loam soil that has 30% sand, 60% silt and 10% clay sized particles. In general, the higher the percentage of silt and clay sized particles, the higher the water holding capacity. The small particles (clay and silt) have a much larger surface area than the larger sand particles. This large surface area allows the soil to hold a greater quantity of water. The amount of organic material in a soil also influences the water holding capacity. As the level of organic matter increases in a soil, the water holding capacity also increases, due to the affinity of organic matter for water.

Conclusion

1. It is evident that indi criminate soil quarrying over the years has imposed irreparable damages to the hill ecosystems in the southwest coast of India. The hill/hillocks as well as its soil apron have many beneficial natural functions. Soil, the end product of crustal weathering which has evolved through a process that took thousands of years, is the abode for many micro-organisms that are essential for maintaining fertility of the ecosystem. In most cases the surface and subsurface flow of water is sustained by the soil profile in a hill ecosystem. Therefore, obliteration of hills/hillocks and its sub-surface aquifers through indiscriminate quarrying will lead to irreparable damages to the living environment.

2. The soil quarrying at manakkamala will very seriously affect the ground water recharge and thereby will lead to water scarcity in the valley around the area.

ചിത്രം 6 ജലവ്യതിയാനത്തിന്റെ ഏറ്റകുറച്ചിൽ രേഖപ്പെടുത്തിരിക്കുന്നു

	WELL NO	1	2	3	4	5	6	7	8	9	10
Depth to water level below ground level	19.05.2013	8.70	9.16	11.04	8.63	4.46	8.79	3.90	3.05	1.80	4.10
	18.11.2013	7.79	7.29	8.68	6.98	2.09	5.82	2.54	2.10	1.25	3.30
	16.02.2014	8.08	7.15	10.79	7.00	3.55	7.60	3.90	2.80	1.55	3.70
	25.05.2014	5.87	6.21	11.29	6.33	3.15	8.46	2.90	2.10	1.25	3.36
	14.09.2014	7.10	6.76	7.39	6.60	1.65	5.12	2.50	2.05	1.20	3.20
	30.11.2014	8.85	7.52	9.17	7.56	2.60	6.46	2.95	2.19	1.23	3.34
	08.03.2015	8.95	7.24	11.02	8.13	3.76	8.04	4.10	2.93	1.67	5.10
	31.05.2015	10.51	8.59	12.24	8.85	3.40	8.51	3.38	2.40	1.38	3.65
	04.10.2015	5.60	5.49	7.10	5.93	0.76	5.42	1.20	2.40	0.85	3.28
	13.12.2015	7.29	7.05	8.64	7.00	1.90	6.06	2.90	3.03	1.45	3.50
	14.02.2016	7.60	6.96	10.39	7.40	3.20	7.33	3.50	2.40	1.55	3.70
	16.05.2016	11.35	10.41	12.10	9.35	5.30	9.01	4.02	2.87	1.80	5.00
	25.09.2016	8.35	7.11	9.86	7.40	2.75	6.53	3.07	2.42	1.47	3.52
	10.12.2016	10.28	9.60	10.77	8.25	3.39	7.81	3.31	2.66	1.44	3.55
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]