

Rehabilitation of Flood Eroded Tea Land – A Field Study in North – East India

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ABSTRACT: In north east India tea industries are located in flood prone area. Tea area receives high rainfall, starting from April and continues till September, almost every year. The rivers and their tributaries of that area discharge runoff water to Brahmaputra. After originating from Kailash mountain in Tibet, Brahmaputra flows in China in the name of Sangpho river. Then it enters upper Assam, while flowing in Arunachal Pradesh. In Assam, it covers a distance of around 720 km almost equal to length of Assam. Large number of tributaries, including Ranganadi, Singra, Subansiri, Kameng, Dhansiri, Jia Bharali, Pagladia, etc join Brahmaputra, after flowing in tea area. All these tributaries are perennial source of water for tea industries. During rainy season, these tributaries overflow and due to that low lying part of tea gardens get inundated with water.

During last a few decades, both sides of bank and bed of these tributaries have undergone a lot of changes, because of their high erodibility and rainfall intensity and large quantity of sediment transported from hills to plain of tea land. Around 33 major tributaries and good enough number of subtributaries are contributing their water and sediment to tea fields. The presence of sand is main cause of instability of river bank area. Flood is a serious disaster in that area and due to that there is loss of fertile tea soil, life of human resources, their livestock, etc. Also, it makes occupational environment poor and unsafe for workers and their dependents living in colonies.

I. CHARACTERISTICS OF FLOOD

Flood was found one of the most devastating natural calamities, badly affecting tea gardens in north east India. First wave of flood was in first week of June, during previous years. After that, there were several intermittent spells of flood depending on intensity and frequency of precipitation. Two characteristics of flood were found during study. The flood water from river or stream entered plantation with a high velocity, inundating large area, within a short time and raised level of water. It was found a specific characteristic of flood. Due to that tea bushes and even good amount of fertile soil were washed off in its current. This was found severe in sloping tea land. In second type, silt was carried by flood water, which was deposited on surface of soil. Debris materials like sand, etc were also brought along with silt. Due to that there was loss of productivity of soil. The drains were found congested with silt, debris materials, etc. The severe and unmanageable problem was due to sudden increase in volume of rain water. A badly eroded drain by flood water is shown in Fig. 1.



Fig. 1. A badly eroded drain.

The soil erosion was found occurring due to removal of top soil from field and undercutting of drains. The formation of rills and then channels of increased area was such that tea land was rendered unfit for tea cultivation. After flood, that land was found full of small channels, undulations, depressions, sand patches, etc. The roots of tea bushes were found naked and clearly visible. Tea bushes were not erect, but they were found flattened on ground surface. The water stagnated in depressions created waterlog and due to that there was infestation of diseases, weeds, etc. The waterlog for 2 to 3 days around tea bushes in flood affected part of land had caused 24 to 32 per cent vacancies of tea bushes. After that tea bushes died due to attack of root rot and other diseases. Then again death of many healthy plants occurred due to pest attack. The flood affected area needed catchmentwise rehabilitation. Hence, it was found essential to replace those tea bushes with high yielding and superior quality of planting materials after rehabilitation.

II. CATCHMENT PLANNING

A tea garden was divided into different catchments, which was a self contained unit in view of ingress and outlet of water. A tea garden was found having good enough number of catchments of different sizes bounded by ridges or high land or well defined boundary. It was found having an outlet, discharging water into main drain of tea industry. Every tea industry needed a long term programme for development of each catchment. The removal of debris material, course sand, stone, uprooted trees, etc from surface of flooded land was essential prior to commencement of survey. It was found essential to know all details of topography of land for digging drains, subdrains, roads, branch roads, plucker's lane, etc. The contour survey of catchment was found an important task for carrying out field practices with tractor and implements.

The deep drains were needed to keep catchment free from waterlog as stagnation of water around tea plant was harmful. While roads, subroads and lanes were required for movement of field machineries for carrying out operations on tea plantation. The roads having width 4 to 7 metre were needed, alongwith deep drain on both sides. A master plan possessing all details of land was found an urgent requirement for flood affected land. A schedule of field practices as per requirement and to check loss of soil was essentially required for each catchment for efficient and effective utilization of inputs, including field machineries and human resources for sustainable growth of tea industries.

III. MECHANIZED FIELD PRACTICES

Atleast one higher horse power tractor (45 hp) and a scraper for removing all debris materials, including sand from flood affected area, was needed. This tractor could be utilized for carrying out all highly power intensive operations. Other matching implements such as leveler, scraper, winch, roller packer, planker, subsoiler and disc plough, one each, were required. A proper match between power of tractor and implement was found essential for efficient and effective utilization of these equipment. A medium size tractor falling in range of 35 horse power for performing all semipower intensive field practices was also required. All its matching implements such as harrow, post hole digger, planker, mounted type irrigation pump, two wheel trailer, water tanker, grass cutter, manure spreader and tea trailer, one each, were also needed. The availability of all facilities, required for repair and maintenance, including availability of genuine parts in nearby area was found essential. It was also found during study that small tea growers were not capable to own these costlier field equipment, while their tea land were also found affected by flood. Hence, an urgent need of establishing hiring centre for providing custom service to small tea growers was found essential in study area.

Digging soil for uprooting flood affected tea bushes in haphazard manner by engaging a group of labourers was found highly uneconomical, susceptible to soil erosion and time consuming. The soil erosion was more serious on slope. The stagnated water in depressions and pits, dug by labourers was found hinderance for next field practice, as soil was moist. The tractor mounted with scraper could be utilized for clearing field from all kinds of debris materials. The winch fitted on tractor was needed for uprooting tea bushes with little disturbance to soil. It was found quite capable to uproot 7 to 8 tea bushes at a time, when soil moisture content was 15 to 16 per cent. Which was found optimum for this operation. The tractor mounted with winch was found capable to pull out all the roots and rootlets at this moisture content of soil and no further digging was required, Fig. 2.



Fig. 2. Uprooting tea bushes with tractor.

It was found during study that root fragments left in subsoil were found inviting harmful insects. After uprooting tea bushes, all pits, depressions, etc were earth filled with the help of tractor mounted leveler, then land was smoothed. Also, loose soil was packed with the help of planker or packer. It was found necessary to check soil erosion as rain was uncertain. It also, facilitated to mark contour lines and then carry out subsoiling. The application of farm yard manure at the rate of 15 to 20 quintals per hectare was found beneficial. The land was harrowed after mixing farm yard manure. After soil preparation land was again operated with the help of packer to make it level. Then contour lines were marked on the level ground manually. The subsoiling was recommended along contours to check loss of soil by runoff water.

The stem cuttings of green manure crop called “Guatemala” having three eyes (nodes) were planted at spacing of 50 cm apart. This was found essential, as replanting immediately after uprooting tea bushes in flood disaster affected land without correcting deficiencies of soil was not desirable. Guatemala, the green manure crop, was allowed to grow for one year to height of 1.25 to 1.50 metre, then it was harrowed with tractor in September - October. After that contour lines were drawn on that field. The points for digging planting holes were marked and pegged, maintaining 75 cm × 75 cm spacing, which was recommended standard as spacing for superior variety of tea. The holes having 35 cm diameter and 45 cm depth were dug with the help of tractor drawn, power take off shaft driven auger. It was found during study that a tractor could make 1000 to 1100 pits per day, while a labour could dig only 50 to 60 pits in a day. It was found during study that a pit needed 4 kg of farm yard manure and 2 kg of fertile soil or clay. Before planting tea seedling or sapling of shade tree, forking of bottom of all the holes, to a depth of 15 to 20 cm, to make that soil loose for liberal root growth was essential.

For planting tea seedlings on slope, broader and deeper pits in form of trench were found useful as field practices with tractor were not beneficial on sloping land. The slope of land was kept towards main drain of catchment. This type of land was found along the bank of subtributaries on 30 per cent tea gardens. After every field operation, light packing of soil and smoothing of the same were needed as a farmer planks the land after every ploughing with country plough, while preparing soil for growing food crops in low rainfall area. Tea seedlings and saplings of shade tree were planted in pits manually after tearing off the polythene sleeves, in which plants were grown in nursery. All those used polythene sleeves were collected and destroyed. The appropriate time for planting seedlings and saplings was found December to January, when ambient temperature was low. Then water was given to each and every young plants.

The sprinkler irrigation was introduced in tea farming around three decades ago and since then there has been vast growth. Many schemes of sprinkler irrigation were financed by National Bank for Agriculture and Rural Development for tea area of north east India. It was found providing excellent control on water applied to newly planted tea seedlings as well as old tea bushes. The water was applied at a rate that soil absorbed without causing runoff. The sprinkler set could be easily controlled and therefore, its application was found suitable for water conservation. It could be efficiently used on slopes. It was found suitable for north eastern region, because of low wind velocity and presence of sandy loam soil. The use of tractor mounted centrifugal pump was found useful for lifting water from ponds, drainage wells, rivers, tributaries, etc for application through sprinkler set. Being portable, tractor

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mounted with pump could be parked near water source as per requirement. After completion of work, it could be shifted to another site for irrigation. The frequency of precipitation was found irregular during last a few years, while tea cultivation needed evenly distributed rain fall. The sprinkler set was found a boon for tea planters, though there was increase in cost of production of tea to some extent. However, drought problem could be solved to large extent by use of sprinkler set.

IV. INFRASTRUCTURE DEVELOPMENT

The drains, roads, branch roads, lanes, etc were marked on land. The main drains were dug with ditcher operated by higher horse power tractor and labour force. The dug out earth was utilized for filling depressions available over soil surface. A full network of roads, etc for the movement of tractor with implement, covering entire catchment was found essential. The provision of lanes was necessary to avoid difficulties in harvesting tea leaf and other field operations, like application of chemicals, etc by workers. The presence of lanes enabled pluckers to pass through bushes, while carrying harvested leaf to collection point.

The roads or wider lanes having width more than overall width of tractor, enabled them to utilize field crop sprayer for chemical application, including plant nutrients, pesticides, etc. It was found during study that earlier, this provision was nonexistent on tea gardens, when tea industries were established around 100 to 150 years ago. Those days tractors were not available and all the field practices were performed by engaging a group of labourers. The completion of construction of these infrastructural facilities like digging deep drains, making roads, etc prior to onset of monsoon was found essential. The deep drains did not allow water table to rise during flood. It was observed during study that entire field practices needed a fixed schedule to avoid risk of soil erosion when work was progressing.

V. INTENSIVE USE OF BIOSOURCES

It was found necessary to cover open soil surface by green grasses. Guatemala (*Tripsacum laxum*) was grown on all tea gardens of study area to cover open soil. This grass was not susceptible to root rot fungi. Another grass, known as Pusa Giant Hybrid Napier (*Pennisetum purpureum*) was also grown on 70 per cent gardens in area affected by flood. This grass was reported to be popular in north eastern region next to Guatemala. Citronella grass (*Cymbopogon winterianus*) was also found in 30 per cent tea gardens of study area. Managrass (*Cymbopogon confertiflorus*) was also found on 20 per cent of tea plantations. It was found during study that these grasses were used in tea area as mulch to cover all open soil surfaces. These grasses could be propagated by stem cuttings, having 2 to 3 nodes or by division of root stock, spaced 30 to 40 cm apart.

It was found essential to grow these grasses in bed of water ways, entrance of inlet and outlet of soil conservation structures, sloping land, places of sudden drop of water, etc to check loss of soil in flood affected land. The tea area sloping towards tributaries or subtributaries needed dense cover. The roots and rootlets of these grasses were found binding soil particles and provided a carpet cover on surface of ground. Other biosources suitable to check loss of soil as mulch were cut grasses, toppings of green manure crop, leaf litter, water hyacinth, stalk and husk of paddy, etc which were locally available in that area. These biosources could be used as mulch around tea bushes as also to suppress growth of weeds and reduce loss of moisture through evaporation.

The bamboo, a woody grass was found useful to check occurrence of flood to large extent in north east India. Around seventy per cent of geographical area of north east was found hilly, which was full of bamboos. It was found a minor produce of forest. *Arunadina maling*, *Bambusa balcooa*, *Bambusa bambos*, *Bambus nutans*, *Bambus pallida*, *Bambusa tulda*, *Bambus vulgaris*, etc were found varieties of bamboos, grown in study area. The bamboo could rapidly invade soil and takeover a habitat. It was found attaining maturity in 3 to 4 years. The seedlings and rhizomes of this grass were found suitable for planting along the boundary of flood prone area to keep soil firmly intact. While growing high, bamboos were found spreading fast and acted as cover on tea gardens. Root fibres of bamboo were found raising shear strength of soil. The matured bamboos were utilized for making temporary soil conservation structures on tributaries and spurs to divert current of water to check stream bank erosion. Their use around tea gardens and colonies

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could check entry of flood water. The bamboos were found useful raw material on cultural occasions, festivals, funeral ceremonies, religious events, etc.

In study area tea estates were established long ago. Those days depth of rivers and their tributaries was more and entire area was surrounded by thick forest. Now, due to heavy siltation of bed of rivers and their tributaries, their water carrying capacity has reduced. The deforestation was also found a cause of increased siltation. Hence, it was found essential to construct earthen dam, with bamboo side walls on both sides. The bamboo plantation around entire flood prone land, including factory, nursery, seedbari, worker's colony, etc was found essential to check effect of flood disaster. As far as possible, these infrastructures, including facilities like overhead water tank, etc should be shifted to safe site, located on high land having bamboo plantation along its boundary.

Last year in flood affected area sunshine was found scorching and precipitation was low in the month of April. Cloudiness in atmosphere was also low. Sunshine period was more during day time. The mulch spreaded over soil surface around tea bushes was found dry. Soil was also dry in absence of sufficient moisture. As compared with previous years, environment was not favourable to growth of tea bushes during last year and due to that harvest was low to extent of 40 to 45 per cent of harvest of previous years. Because of these reasons, erodibility of soil was also high in absence of shade trees. Rainfall occurred in the month of May and June with high intensity and due to that there was loss of fertile soil from top surface of tea land due to splash erosion.

Then a tea plantation of adjoining area, having shade trees planted 10 to 11 metre apart was visited. Shade trees were found beneficial for the growth of tea bushes in a variety of ways such as addition of organic matter and nutrients to soil through leaf fall, fixation of atmospheric nitrogen by nodules of roots (in case of leguminous shade trees), conservation of moisture in soil, reduction in incidence of red spider and other mites, suppression of weed growth, provision of comfortable shade to labourers and so on. Albizzia chinensis and Albizzia odoratissima shade trees were found fixing atmospheric nitrogen to soil by their nodules of roots. Their roots were found going deeper into soil to extent of 3 to 5 metre beyond root depth of tea bushes, which was 1.50 to 1.75 metre only. Due to that absorption of nutrients by shade trees was from deep soil. The maintenance of favourable and conducive environment, protection of soil from flood water, etc were found benefits derived from shade trees planted in flood prone tea area, Fig. 3.



Fig. 3. A plantation having shade trees.

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