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No. SEF/2019 Dt. 8.11.2019

Dear Dr. Sarma

Sub: Request for article/paper for Souvenir to be published in connection with the symposium on **Regional Focus on Water Conservation and Utilisation,** to be held on 20th Dec, 2019 **(changed to 20th Feb, 2020)**

Sir,
The Senior Engineers Forum- Guwahati, formed fifteen years ago, is a unique body of Senior Engineers in India and is a conglomeration of senior and retired engineers of different engineering streams of India's northeast. This body is committed to utilize their time, talent, energy, knowledge and experiences to develop the north eastern region.

You are kindly aware of the Prime Minister's remark that not even 8% of rain water are conserved in the country although north-eastern states reel under flood water and experience land slides during monsoon period. Unharnessed flood water straight way flow to the Bay of Bengal. In order to create an awareness, the forum is organizing a Seminar/Symposium on 20th Dec, 2019 at **Cotton Alumni Hall, Panbazar, Guwahati**, on the above mentioned theme. Many experts from within and outside the region will participate in the deliberation.

It has been decided to publish a **Souvenir** to commemorate the event. The Souvenir will be largely circulated among public, state and central Government. We shall be grateful if you kindly patronize our endeavors by contributing an article on the topic to **reach this officeby 5th December 2019.**
A copy of Brochure is enclosed for your reference.

With warm regards

Yours faithfully

Er. M.K.Adhikari	Er.K.G.DebKrori	Er. Babul Chakravarty
Secretary	Chairman, Technical Committee	President

Implementation of Soil and Water Conservation Measures in Hel-Longa Watershed, Dotma Block, Kokrajhar District, Assam: Case Study

ABSTRACT

Of all the natural endowments soil and water are the basic resources essential for the existence of life. Accordingly, they demand appropriate management to ensure continuity of life. Over the last few decades there has been a continuous depletion of land resources due to various factors like soil erosion, deforestation, mining, overgrazing, general mismanagement, improper utilization to name a few. It takes nature about 600-1000 years to form 1" of nutrient rich top soil but the same soil gets eroded in 2-3 rainfall events if rendered barren. The result is siltation of riverbeds and subsequent floods. The Hel-Longa watershed in Dotma block of Kokrajhar district, Assam was taken up for treatment through soil and water conservation measures with an aim to restore the ecological balance lost due to deforestation and conversion of forest land into agricultural land. The reasons for degradation are unscientific exploitation of land, reduction in forest cover leading to loss of topsoil and its fertility status, accelerated soil erosion due mainly to unabated high-velocity surface runoff due to deforestation during the last decade. The present study revealed that the Hel-Longa watershed was treated with various soil and water conservation measures so as to restore the local ecological setting and to keep the area sustainable.

1. Introduction

To involve village communities under all the area development programmes GoI promulgated Guidelines to help in the implementation of watershed projects across the country. Accordingly, suitable plans were prepared for all the arable and non-arable land, community land and private land under the Hel-Longa watershed development program in Dotma block of Kokrajhar district, Assam. The various soil and water conservation items, included in the plan are: development of small water harvesting structures (farm ponds, nalla bunds, check-dams, percolation tanks and other ground water recharging measures), renovation and augmentation of water sources, de-siltation of village tanks for drinking water/irrigation/fishery development, afforestation including block plantations, agro-forestry, horticultural development and pasture development. Additionally, activities like land development, in-situ soil and moisture conservation measures, drainage line treatment with a combination of vegetative and engineering structures were undertaken. While preparing the watershed treatment plan, emphasis has been laid on rain water-harvesting activities and massive plantation works on community as well as private lands. The study was undertaken with a view to assessing the various soil and water conservation measures undertaken in the project area to improve the overall productivity.

2. Profile of the Watershed

The Hel-Longa watershed in Dotma block of Kokrajhar district, Assam is located between $90^0$49' and $90^0$51'E. Long. &$26^0$43' and $26^0$50' N. Lat. It may be seen from Figure1 that the watershed is cut into two halves by the NH-31C. The two inherent advantages for development of the area are that the rivers Hel and Gaurang lie on two sides of the area (Figure 2). Both the rivers are perennial in nature and they contribute substantially for replenishment of the ground water in the watershed area through seepage. At the same time it is to be noted that most of the surface water gets lost by way of deep percolation, because of the fact that the area is located in the Bhavar belt with underlying non-coherent unconsolidated rock materials and fissured geological formations. The area is criss-crossed by a number of small streams and the drainage density is high meaning that overland runoff is also considerable.

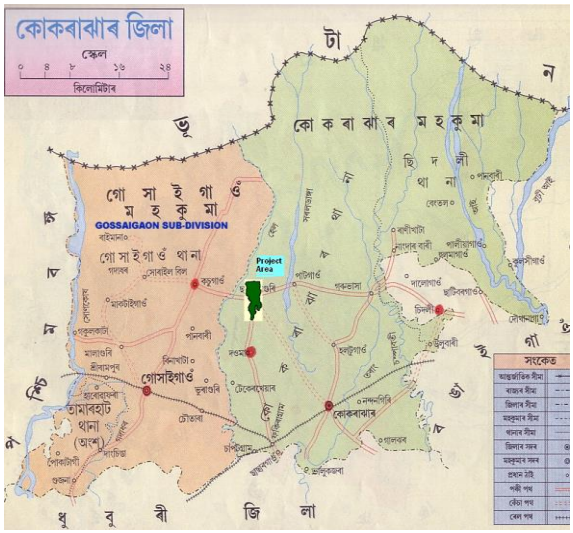


Figure 1- Location of the Hel-Longa watershed

The Average elevation of the area is about 59.50 m above MSL as per SoI. The project area is about 6,000 ha of which the treatable are is 5000 ha. The area has Build-up Land of 1789 ha, Agricultural Land (private) of 2228 ha, Fallow Land of 1683 ha and Forest Land of 300 ha. The farming system in the area is diversified. The topography is uneven, with minor undulations with average ground slope of <9%. The area falls under Lower Brahmaputra Valley (North West) Zone and has a humid, sub-tropical climate.

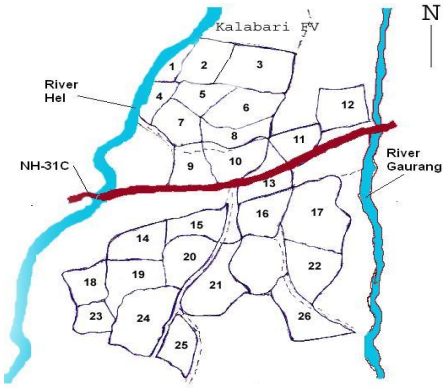


Figure 2: Project area villages

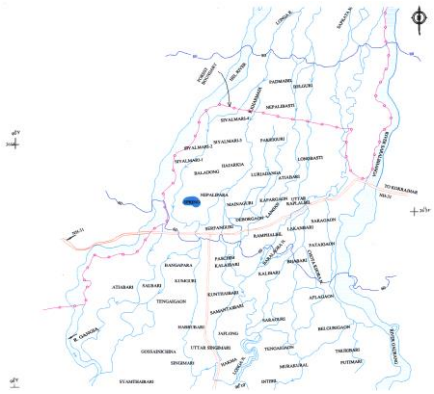


Figure 3: Drainage map of the study area

The area receives about 2,300 mm (due to SW monsoon) of rainfall and drains through rivers Hel, Longa, Gangia and a number of water bodies. The maximum temperature recorded in the area is about 37^0C against a minimum temperature of 15^0C. Relative humidity is found to be in the range of 55% to 87%. The area is formed by the alluvium deposit of rivers Hel and Longa consisting of unconsolidated pebble, sand, silt and clay. The area has two main types of soils viz. Type-1 (coarse loamy, mixed, hyperthermic, Arenic Hapludalf) and Type-2 (fine loamy, mixed, hyperthermic, Arenic Hapludalf). The soil is acidic in reaction.

The area is characterised by mixed forest coupled with backyard plantation of bamboo, betel nut, sub-tropical horticulture plants etc. The major agri-horticultural crops grown in the area are paddy, banana, ginger, maize, turmeric, chilly, oilseeds etc. Productivity of major agricultural crops varies between 0.5 MT/ha to 2.2 MT/ha. Other socio-economic activities include growing of fruit-bearing trees, weaving, rearing of Eri and silk worms, cane/bamboo crafts, carpentry, bee-keeping, livestock rearing (cattle, buffaloes, pigs, poultry, goats and ducks). The major problems identified in the area are topsoil soil erosion, deforestation in the upstream, recurrent flood due to siltation of river Longa, drainage problems during Kharif season and lack of irrigation.

3. Status of Soil and Water Conservation Measures

Prior to government intervention, there was hardly any sign of planned soil and water conservation measures in the watershed, due to which various parts of the watershed became unproductive. Lack of good vegetative in the project area was identified as an important cause of loss of fertile top soil. The areas suffered from sheet, rill and to some extent gully erosion for which suitable soil conservation measures were necessary. It was therefore, envisaged to take up proper soil and water conservation measures in the area under the proposed watershed treatment plan, by putting in place a combination of both mechanical and vegetative measures.

4. Activities Proposed

Activities undertaken for development of the project area following watershed approach were grouped under two viz. activities under arable land and activities under non-arable land. These are listed below.

Activities for arable land	Conservation measures	Bund
		Plantation on bund
	Production system	Farm forestry and agronomic practices
		Livestock, pisciculture and kitchen garden
Activities for non-arable land	Conservation measures	Water harvesting pond cum fishery
		Erosion control structure
		Drainage improvement
		Development of beel/swampy areas
	Production system	Agri-horticulture
		High value plants

5. Soil and Water Conservation Measures

One of the important steps towards soil and water conservation is to control soil erosion. The parameters responsible for topsoil loss in the watershed are light texture of the soil, high intensity of rainfall, slope of the terrain and unscientific land utilisation pattern. Of these, the problem regarding land utilisation pattern can be tackled by means of proper land use planning. The slope of the terrain can be reduced by land development measures and land use planning. Accordingly, various soil and water conservation measures were taken up, details of which are given below. The total area treated was 5000 ha out of 6000 ha of project area.

6. Measures for Arable Land

Mostly in-situ moisture conservation measures like deep ploughing, doing agricultural operation along the contour and vegetative barriers on individual holdings were carried out. In addition, nalla bunds/checks, woven wire check dams were constructed to divert water using lead earthen channels. Agronomic practices used to reduce the runoff in the arable land include **off-season tillage** (i.e. ploughing land immediately after the harvest to keep the land ready to receive rainfall and make the area available for subsequent crops on initial light shower), **deep tillage** (carried out to break the hard undisturbed pan that might have developed in the land due to prolonged ploughing at the same depth) and **ploughing along the contour** (an operations for in-situ moisture conservation). For contour ploughing, contour dead furrows were formed on the contour in each holding. Other in-situ measure taken in the area (slope <4%)is vegetative barriers(with Vetiver/Khus grass) to check runoff.

7. Measures for Non-Arable Land

Non-agricultural use (road, juri, Govt. wasteland): 650 ha	Grazing land (community land): 905 ha
Tanks and homestead land : 350 ha	Fallow land: 659 ha & Degraded Forest: 300 ha
Sub-total: 1,000 ha (non-treatable)	**Sub-total: 1,864 ha (treatable)**

It is proposed to treat these lands by the following four treatments:

7.1 Brush Wood Check Dam

Brush wood check dams were installed in the upland to keep the bed slope of streams to <0.2% to reduce the erosion. About 60 nos. were placed. These checks may not store huge quantities of water but can act as silt retention checks. At the same time the upstream water stored in these checks can meet the water requirement of grazing cattle. They keep the flow of water in the streams uniform and would help in getting water for lean season cultivation.

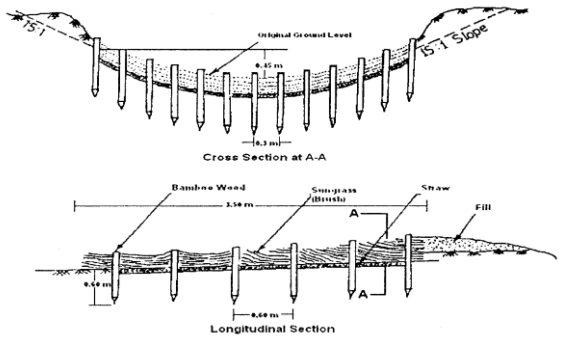


Figure 4: Design details of brush wood check dam

7.2 Development of Napier Grass (Green Fodder) in Abandoned Stream Bed

The abandoned drainage/canal networks within the project area are used for cultivation of green fodder (Napier grass). The total area used is about 18 ha. Cost of raising Napier grass is about Rs. 5,000.00 per hectare.

7.3 Drainage Line Treatment

The watershed is spread over an area of about 6000 ha, of which the treatable area is 5000 ha. The total drainage area elevation varies from 80 m at the upstream to about 58 m at the downstream end. By means of checks over a period of 3 to 5 years, it is expected that the storage volume would increase and at the same time in drought years the present discharge would be maintained.

7.4 Loose Boulder Check Dams in Valleys and Streamlets

Boulders being available, loose boulder check dams were installed @ 1 dam/10 ha of degraded forestland (30 nos. in total). In other vulnerable pockets (20 nos.) too such dams were installed. The checks are so proposed that there could be silting in upstream side and uniform seepage through the loose rock fills.

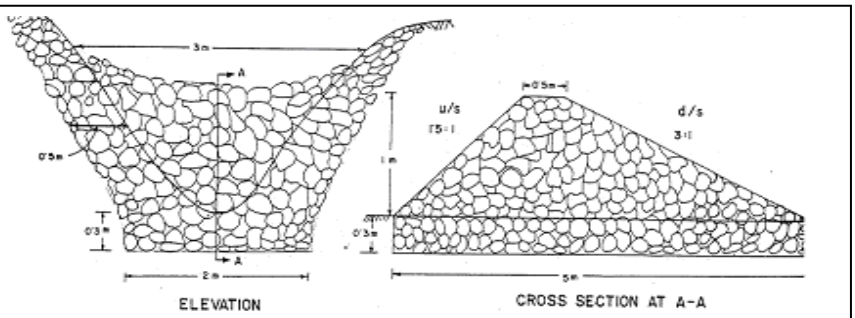


Figure 5- Design details of loose boulder check dam

7.5 Gabion Structures

Gabion structures (22 nos.) in suitable locations were constructed on small streams by means of which water for irrigation could be diverted to the cultivated land in lean season.

The Structures consist of loose rock fills with rolled in woven wire to reduce the damage during flood and to keep the structure in place, due mainly to dead load. To avoid toppling of dam, 0.50 m foundation up to rock bed/outcrop and 0.50 m inside the stream embankment was provided.

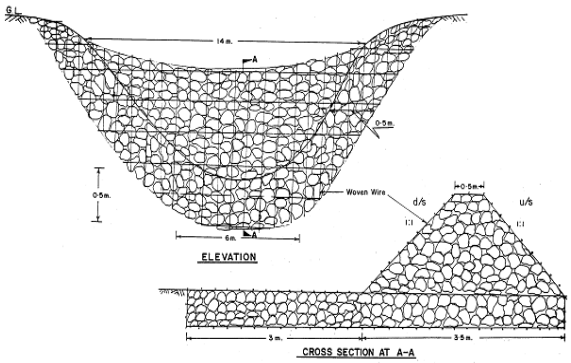
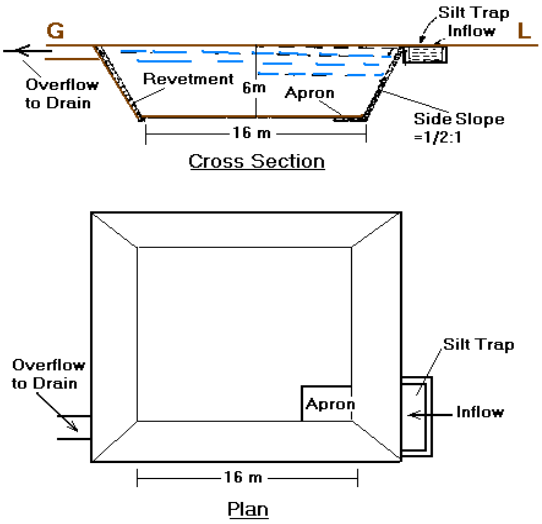


Figure 6- Design details of Gabion structure

7.6 Percolation Tank

Percolation tank is an earthen embankment to store the runoff for increasing the recharge into ground water. They are constructed in areas having fractured rocks below the ground to allow fast movement of water. It has a waste weir to dispose the surplus flow in excess of its storage capacity. The percolation tank bund is provided with stone pitching on the upstream face and turfing on the downstream slope. Drains are provided under the bund to lead water percolating into the bund safely downstream. In general the structure serves various purposes viz. stores runoff water in sloping lands, increases groundwater reserve by recharging and helps in increasing the irrigated area. Altogether, five (5) percolation tanks were reported to have been constructed in the study area.



8. Project Benefits

It has been reported that the project has met the basic development objectives of-

- Increased agri-horticultural production
- Improving income generation avenues in the project and surrounding areas
- Reducing un-employment, under-employment and rural to urban migration
- Improving land management with soil and water conservation measures
- Environmental improvement through afforestation
- Improve groundwater status

9. Conclusion

Overall, the implementation of the project has benefitted the community despite constraints like insufficient farmers' motivation, relatively low adoption rate of improved technologies and practices. It is reported that the area has also suffered due to occasional flash flood or crop damage by wild animals etc. generally speaking, the community at large, inhabiting the area has understood that watershed projects play important role in managing soil and water resources of an area. Research is needed to ensure that new projects draw upon lessons from their predecessors' experiences. Although the technical and social complexities of watershed projects make evaluation difficult, it would be useful to adopt quantitative and qualitative evaluation methods together (which traditionally have been used separately) so as to make evaluation more effective, particularly when constraints to study design exist. Accordingly, agency concerned (DRDA, Kokrajhar) may undertake such an impact evaluation study for all the projects that have been undertaken in the district.

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