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Water: Resources Utilization and Conservations (Outer Himalayan in Dehradun Valley UK

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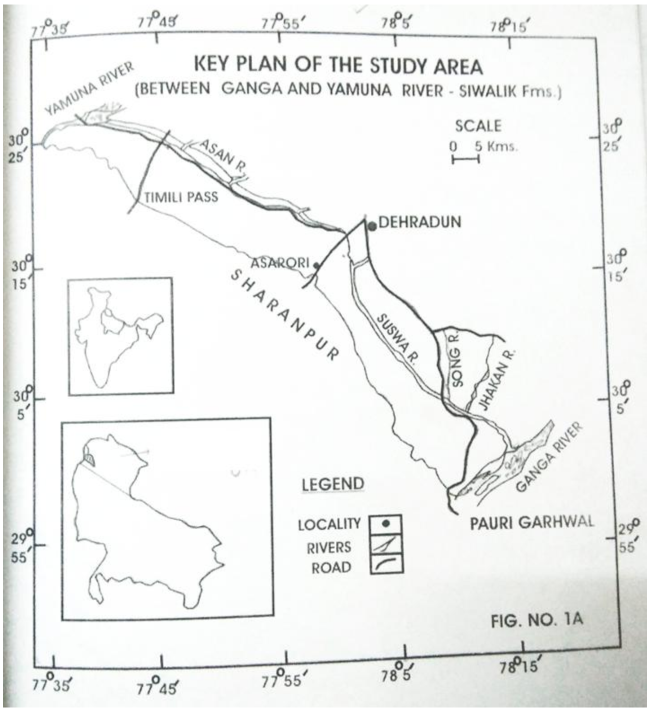
1. Introduction

The area between **Ganga** and **Yamuna** rivers (**Siwalik formations**) forms a unique geomorphic unit in the Garhwal Himalaya. Geomorphologicailly this area is drained by the spring fed perennial rivers the Suswa and the Asan which contribute to the Ganga and the Yamuna forming the Eastern and Western parts respectively.

The maximum rainfall is 210cm per annum and the fast flowing perennial streams with higher gradients in the region are not properly used for agriculture on account of misuse of gradient and excessive flow of running water The present study of the entire Siwalik formations between Ganga and Yamuna rivers aims to evaluate the geomorphological features and their inferences upon the terrain morphology as influenced by the drainage network and relate them for the rational planning, The planning and economic development is very essential because the region is the link between the underdeveloped Garhwal region and the developed plains.

The area traversely crossed by the antecedent rivers Ganga and Yamuna (Wadia, 1938) forming open gorges in the Siwaiik at, Haridwar and Pontadwar (Saxena, Anantharaman and Pandey, 1979) respectively. Thus, the area is girdled with the Doon gravel in the north and Siwalik formations in the south and traversly bordered by anticedent holy rivers the Ganga in SE and Yamuna in NW (Fig.1A & Plate 1). The drainage of the eastern and western parts of the area is determined by the Suswa and the Asan rivers respectively. The Suswa and the Asan rivers are demarcated by a low water divide namely Dehra-Asarorl water divide passing through Mohand (Saxena, Anantharaman and Pandey, 1979). Precisely, the study region is located within 29° 55' to 30°30’ N latitudes and 77° 35’ to 78°5'E longitudes ranging between 300 to 733 metres above m.s.l. in height. The shape of the area constitutes a rectangle. The area is bounded by districts, Pauri-Garhwal in the South-east, Saharanpur in the south, Chakrata in the north-west and Himachal Pradesh state in the south- west. The exact location and surroundings of the area is depicted in key plan of the area (Fig.1A).



The physical Infra-structural aspect of the area reveals that the antecedent drainage pattern develops In the region of the Ganga and the Yamuna, near the crossing of the Slwalik with "dwars" (Harldwar and Ponta Sahib). These rivers form south-east and north-west boundaries of the area respectively. The parallel water-parting lines of Siwalik ranges form a parallel network of river valley which result in rectangular drainage. Dendritic drainage is most common form, developed by the main streams, its tributaries and their effluents in the mountains above the area proper. The tract of paired terraces, fanglomerated spurs and ridges reveals that the area has undergone intermittent upheavals four times (Kaushik, 1968) and produced a complex terrain. The physique of the western part consists of three well defined tracts. The First tract comprises an upland on the Asarori water parting line up on which the Dehradun city stands. The second tract consist of the riverine patch of the Asarori and the effluents. The third is the triangular tract of the Yamuna dhang (Saxena,1974). The tract is deeply incised by the rapid flow of the local torrents forming entrenched and ingrowned meanders.

The morphometic drainage analysis made in selected third order drainage basins of the area. All the parameters of the drainage morphometry i.e. drainage frequency, texture, elongation ratio, sinuosity index and circularity index were analysed critically and pair-wise relationship among them has also been worked out through scatter diagrams. Besides these, the longitudinal and transverse profiles of major rivers of the area were also drawn to highlight their nature of gradients in gradation, aggradations and degradation for developing the relationship in between processes and their landforms. After considering the inferences of all said parameters including circulatory index, basin elongation, ruggedness number and volume of relief the pattern of the morphology of basins was determined in four types, viz., circular, triangular, parabolic and curvilinear. Further, two major drainage regions have been demarcated in the area.

2. Drainage Patterns in Area

The Ganga and Yamuna bordering the region from two district drainage systems. The Suswa and the Asan, separated by the Dehradun-Asarori water divide meet the former and later at right angles at Haridwar and Poanta Sahib (Fig. 2E).

The Ganga system with a drainage orientation in NW-SE direction is principally formed by the Ganga and its tributaries the Suswa, the Song and the Jakhan. The Ganga river enters the valley in the Eastern Dun at Tapovan and meandering south-west goes to Haridwar. 16 kms (10 miles) downstream near Raiwala the river Suswa meets the Ganga at right angle thus forming rectangular drainage pattern. The Ganga is then distributed into several streams enriching the wooded islands and forms the boundary of the area.

The Suswa, main tributary of the Ganga in the Eastern part takes its course in a clayey depression of Kangri Neemwala Ogal1 situated to the east of Dehra-Asarori water divide near Chandrabani village. The river flows in the south-east direction and meets the Ganga in Gauri-Ghat (Raiwala) at about 10 kms (6.2 miles) from Rishikesh. The total length of the river is about 26 kms (16.25 miles).

In the area under investigation the Suswa receives the waters of the seasonal raos which are parallel to each other from the Siwalik range - Sukhrao, Ramgarh rao I, Chorpani rao, Fanduwala rao, Kan rao, Beriwara rao and from Lesser Himalayan mountain streams and Motichur rao. The bulk of the water of the river Suswa fiows in various streams underneath the Motichur Forest. (Table 3).

The river Motichur, rising from Siwalik range in the south-eastern part flows through the Motichur synclinal structure with NW-SE trend. The river, which is structurally controlled contributed its waters to the Ganga directly. Thus, the Suswa as the principal river of the Eastern Dun form a rectangular drainage and its effluents form dendritic pattern towards their water parting line of Siwalik range (The effluents themselves form parallel drainage pattern).

The Yamuna system in the area is formed by Yamuna and its tributary - the river Asan and its network. The Yamuna river enters the area in the Western Dun near Deoband. The river Asan joins Yamuna at Dhalipur village. From about 2 kms (1.2 miles) of Dhalipur the Yamuna cuts the Siwalik range forming a 'Dwar' at Poanta Sahib like Ganga at Harldwar (Wadia, 1938).

The Asan river rising from a clayey depression near Gorkhanala at Chanderbani, situated to the west of Dehradun-Asarori water divide at an elevation of 606 metres (2000') above m.s.l. flows westerly to meet the Yamuna at Dhalipur (Walton, 1911). It has course of 41 kms (25.6 miles). The Asan drains the whole of western Dun and receives from either banks from the mountain torrents which rise from the Lesser Himalaya and from the Siwalik range (Dhaunwala rao, Dhoratwat rao, Kaluwala rao, Rainwala rao and Ramgarh rao II). Number of parallel torrents rising from the Siwalik range join the Asan carrying a huge load of boulders and graveis.

All the tributaries of the Asan following parallel drainage pattern collect waters in the main river Asan from both the Water parting lines of Lesser Himalayan and the Siwalik range. The spring line adjoint to the Siwalik has a number of'Ogals' through which water oozes out incessantly and this water is used for domestic purposes. Ogals and springs are denuded at Baron ka khana , Ogals Dhang. Dandipur (Table 3).

The hierarchy of the drainage system in the area is given in the following table.

3. Drainage Pattern types and their Evolution

The Asan and Suswa systems consist of various types of drainage network which depend on erosion by inequalities of slope, rock resistance, structure and geologic history of the region (Zernitz, 1932). The surface drainage pattern is probably the most reliable indicator of ground conditions (Howard, 1967). The drainage network in the area prominently consists of degradational and aggradational river profiles. The degradational profiles are formed by erosional process. The dendritic pattern is modified as sub-dendritic pattern and sub-parallel pattern is developed over the gently sloping terraces in the area. The parallel pattern dominates the area and is due to pronounced slope and structural control. The pattern is observed in the denudational slopes and lower part of river terraces. Radial drainage pattern is observed over the Nagsidth structural hill. Rectangular drainage pattern has developed over the river terraces near Pauntha, and it appears to have developed along certain fault.

In the aggradational river profiles the streams are generally braided with the result the intermittent drainage pattern has evolved. It is marked by streams being split into number of intertwined channels separated by channels like the Asan and the Suswa exhibits this nature. The fans observed have divergent channels over them.

The Asan and the Suswa systems are separated by the NNE and SSE trending Dehra-Asarori water divide, which is developed over the river terrace due to slow tectonic warping. The altitude of the Water divide in between 1900 metres and 2800 metres (6270' and 9240') above m.s.l.

The drainage network observed in the Asan and Suswa in the area under investigation are of parallel and intermittent pattern. However, the Yamuna and the Ganga form antecedent drainage pattern.

1. **Dendritic Pattern** : This pattern woven by head streams of the river exists generally in the water divides/drainage lines of the Siwalik. It is generally observed that this pattern exists in first and second river order regions. The drainage line of the Siwalik gives rise to perennial and non-perennial streams. The iso-gradient line valued at 3000' (909 metres) passes through the first order streams under dendritic pattern (Fig. 2F). In the Siwalik range, the lower limit of dendritic pattern is marked by the iso-gradient line valued at 200'(60.6 metres). Thus its is worked out that the dendritic pattern exists in the area between 3000'and 2500 (09 and 757 metres) and the streams are rainfed.

2. **Parallel Pattern** : The streams rising from the major geomorphic structure viz, the Siwalik drainage line (Fairbridge, 1968) flow almost parallel to each other to form parallel pattern in the area. The river Asan collects water from the streams rising from this drainage line giving a parallel morphology to the network (Fig. 2F). Similarly in the Suswa system the parallel drainage network originates between 2500'and 2000 (757 and 606 metres). This network indicates the structural control and pronounced slope control in the development of the parallel drainage pattern.

3. **Intermittent Pattern** : The area fed by gravelly material by seasonal raos from the drainage lines, evolves intermittent drainage network where the torrents contribute their water to their consequents. In this network the stream flow beneath the gravelly strata due to the absence of impervious rockbase. It is worked out that the impervious base generally occurs in the course of seasonal raos near the Dun-aquifer zone i.e. between 443 metres and 777 metres (1465' & 2565') where the intermittent flow of the seasonal raos appears to continue their flow to their respective consequents.

4. **Antecedent Pattern** : The area is traversely confined by the antecedent drainage pattern of the river Ganga and Yamuna. The voluminous flow of the Ganga and the Yamuna continue their course by cutting the Siwalik range in the form of gorges at Haridwar and Poanta Sahib respectively. Both these river courses follow the faults i.e. the Ganga fault and Yamuna fault (Fig. 2F).

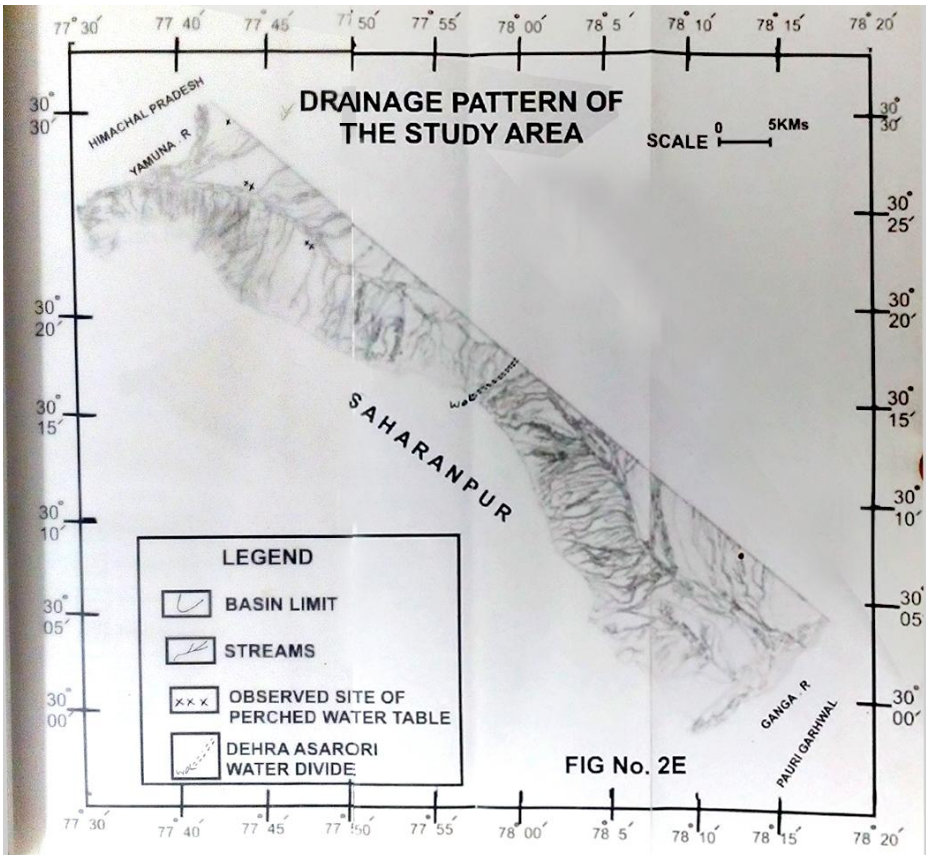
Stream Classification

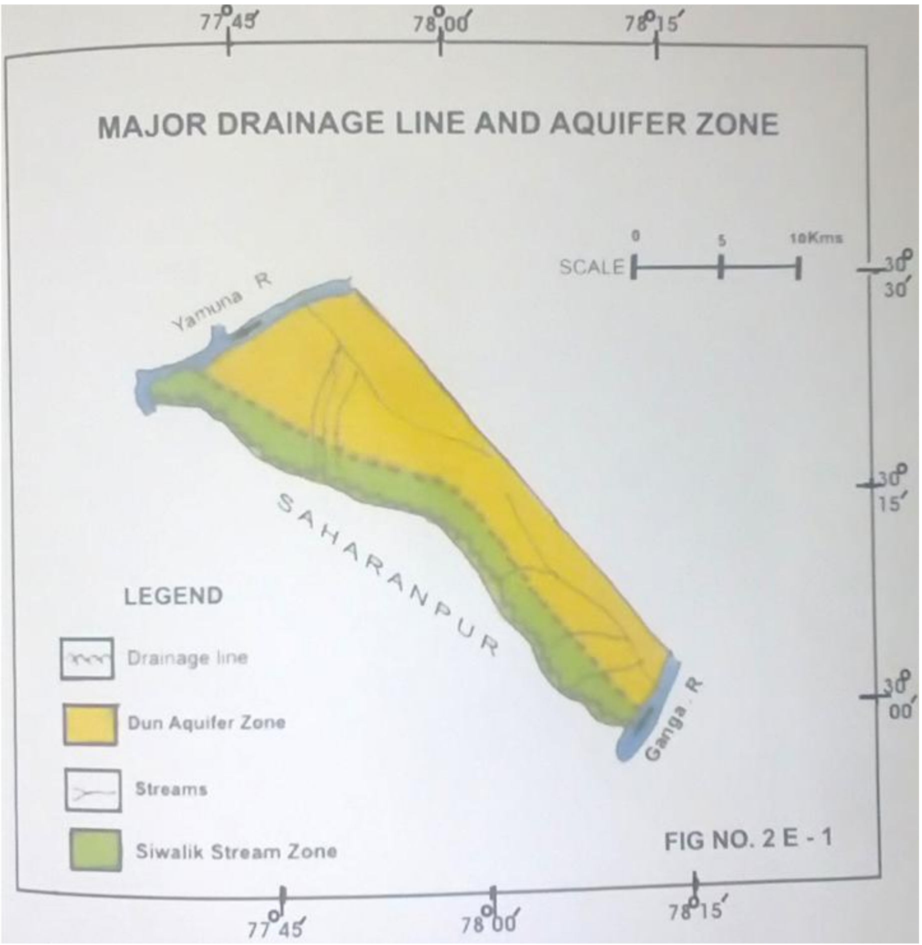
According to Johnson (1932) the streams can be classified on the basis of stage of development in cycle, mode of origin, relation to associated to past changes of level and pattern of drainage lines. The streams of the Asan and the Suswa have wide and mature valleys. Braided channels are observed on the flood plains. The terraced nature and channels entrenched in the present day flood plains indicate change in base level for most of the streams and they can be classified as rejuvenated. The classification of the streams in the area is given in the table 4.

Table No. 4 : Classification of Streams in the Study Area

Stream	Stage of Development in cycle	Origin	Relation to Structure	Relation to post changes of levels	Drainage Pattern
1. Asan	Mature	Consequent	Synclinal valley	Rejuvenated	Parallel with braided stream
The river Asan contributes its water to the Yamuna at right angle as a subsequent stream					
2. All streams of Siwalik	Youth to mature	Subsequent	Transverse valley	Rejuvenated	Parallel with braided streams.
3. Suswa	Mature	Consequent	Synclinal valley	Rejuvenated	Parallel with braided streams
4. Song	Youth to mature	Subsequent of Suswa	Transverse and synclinal	Rejuvenated	Parallel

The river Suswa finally contributes its water to the Ganga at right angle as a subsequent stream.


DRAINAGE PATTERN OF
THE STUDY AREA
SCALE 0 5KMs
HIMACHAL PRADESH
YAMUNA R
SAHARANPUR
GANGA R
PAURI GARHWAL
LEGEND
BASIN LIMIT
STREAMS
OBSERVED SITE OF
PERCHED WATER TABLE
DEHRA ASARORI
WATER DIVIDE
FIG No. 2E


MAJOR DRAINAGE LINE AND AQUIFER ZONE
SCALE 0 5 10Kms
Yamuna R
SAHARANPUR
Ganga R
LEGEND
Drainage line
Dun Aquifer Zone
Streams
Siwalik Stream Zone
FIG NO. 2 E - 1

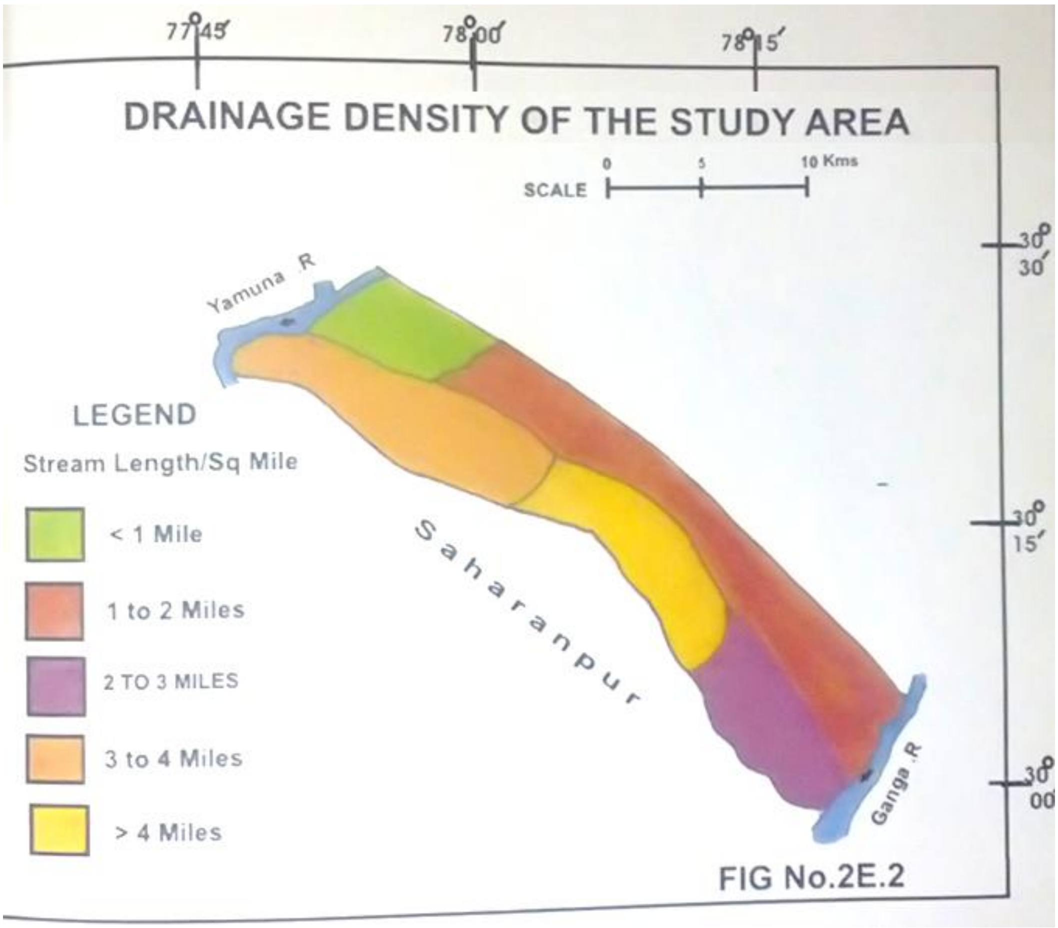


FIG No.2E.2

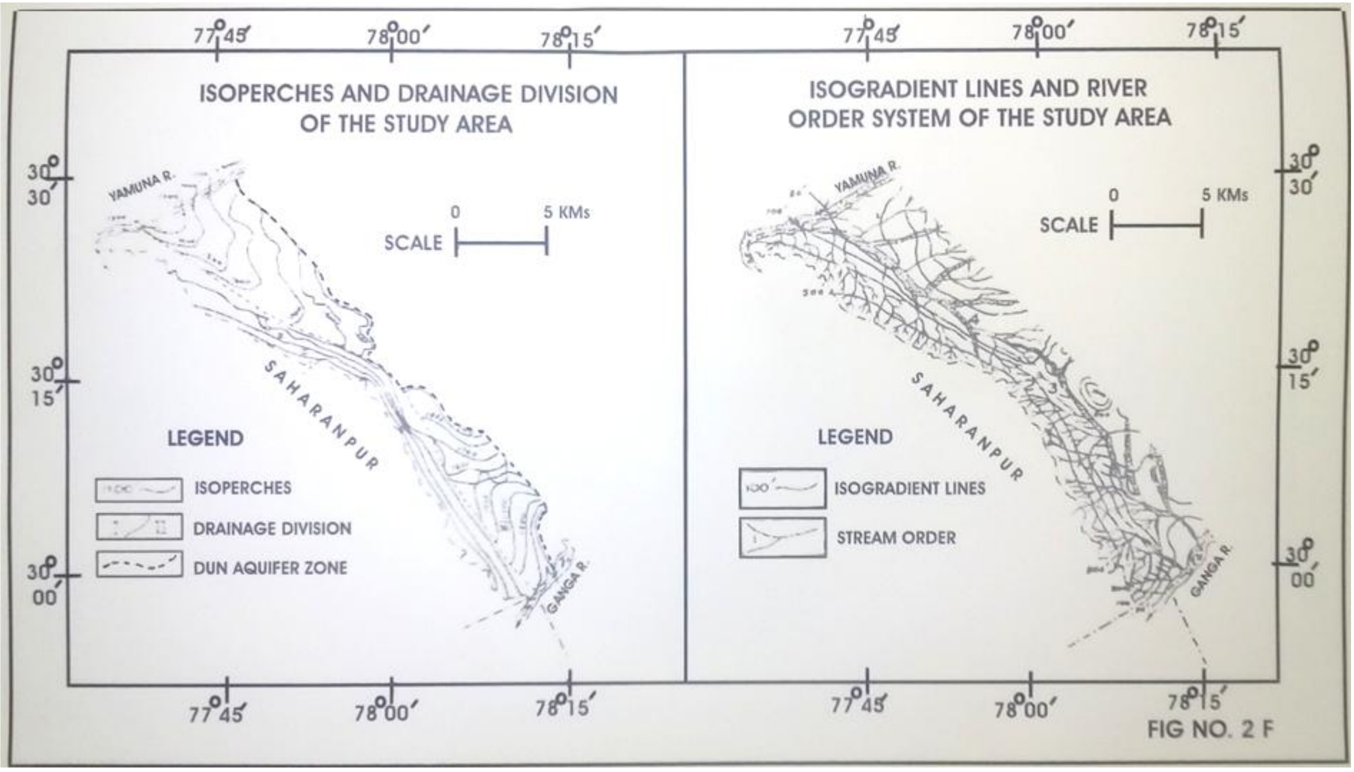


FIG NO. 2 F

Table No. 6 : Measurements Involving Heights

Name of the drainage basin	Basin area in sq. miles	Maximum height in feet	Minimum height in feet	Relative relief in feet	Relief Ratio	Ruggedness number	Dissection Index	Drainage line
Dhaunrala rao	1.8	2500	1400	1100	107.8	0.48	89.16	SW Siwalik drainage line
Dharawat rao	2.7	2500	1450	1050	84.6	0.39	96.37	
Raniwala rao	1.8	2500	1700	800	160	0.93	99.91	
Kaluwala rao	1.7	2500	1700	800	200	0.73	99.62	
Ramgarh rao II	2.1	2500	1700	800	200	0.84	99.91	
Sukh rao	1.4	2500	2000	500	147	0.58	99.86	SE Siwalik drainage line
Ramgarh rao I	2.25	2500	1750	750	178.5	0.75	99.88	
Chorpani rao	1.8	2500	1700	800	235.2	1.1	99.92	
Fonduwala rao	2.7	2250	1500	700	166.6	0.79	99.87	
Beriwala rao	2.25	2250	1400	850	193.1	1.01	99.91	
Motichur rao	9.96	2250	1050	1250	127.6	1.2	99.93	

* Relief ratio = $Rh = \frac{H}{Lb} = \frac{\text{Total Basin Relief}}{\text{Length of the Basin}}$

** Ruggedness number $Rn = Du^{2} \times H / 5280$

[£] Du = Drainage Density = $\frac{\text{Mean length of streams}}{\text{Area of Basin}}$

Dissection Index = $DI = \frac{(\text{Projected area} - \text{Area of Basin})}{\text{Projected Area}^{**}} \times 100$

Projected area = $1/3\ (\pi r^{2} H)$

r = radius of index of same perimeter as basin (Doornkamp & King, 1971)

Table No. 7 : Drainage Net Work

Drainage line	Total 3rd order basins	Range of total number of streams (Nu)	Range of total length of streams in miles (L)	Range of mean length of streams in miles Lu=L/Nu	Number of order			Range of bifurcation ratio Rb=Nu/Nu+1	Range of stream length ratio Rl = Lu/Lu–1
					1st	2nd	3rd		
Siwalik									
(i) SW Siwalik	5	31-7	11.6 – 4.2	1.45 – 0.23	7-2	3-1	2	3 – 1	0.104 – 0.100
(ii) SE Siwalik	7	75-10	54.2 – 8.8	1.2 – 0.66	17-3	3-1	1	3 – 1	0.109 – 0.011

Table No. 8 : Basin Geometry

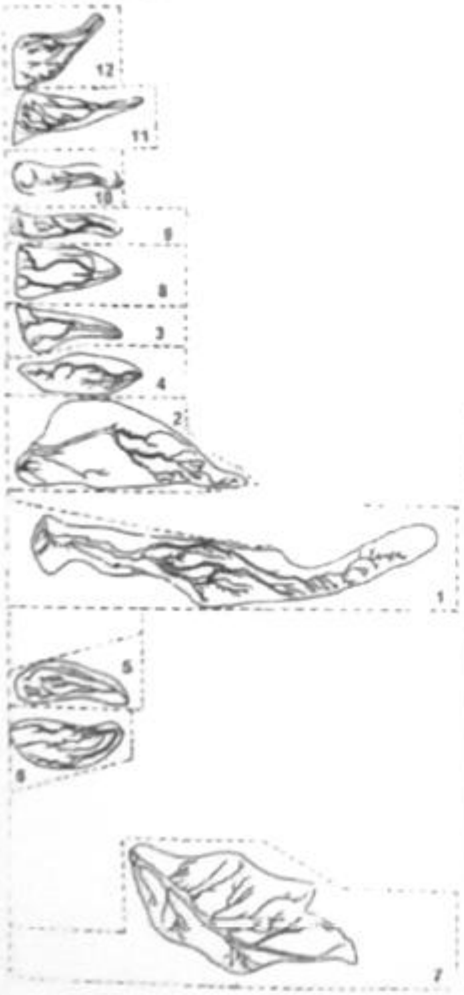
Drainage line	Range of basin length in miles (Lb)	Range of basin width in miles	Range of basin perimeter in miles (Pu)	Range of basin area in sq.miles (Au)	Area of circle in miles (Ac)	Circularity index, CI = Au/Ac
Siwalik						
(i) SW Siwalik	12.4 – 4	1.8 – 0.8	25.8 – 10.2	2.7 – 1.7	9.6 – 3.1	0.54 – 0.21
(ii) SE Siwalik	9.4 – 3.4	4.4 – 1	22 – 9	9.6 – 1.4	38.5 – 6.4	0.26 – 0.21

Table No. 9 : Measurements of Intensity of Dissection

Drainage line	Sinuosity index SI = CL / VL*	Drainage density Du = L / Au	Constancy of channel maintenance C = 1 / Du	Stream frequency Fu = Nu / Au	Texture ratio Tu = Nu / Pu	Basin elongation $Re = \frac{\text{diameter of circle}}{Lb}$
Siwalik						
(i) SW Siwalik	1.03 – 0.30	5.5 – 2	0.5 – 0.1	17.2 – 3.8	1.3 – 0.06	0.87 – 0.13
(ii) SE Siwalik	1.1 – 1.04	9.4 – 5.2	0.18 – 0.10	8.4 – 5.5	3.4 – 1.1	0.94 – 0.74

* CL = Channel length; VL = Valley length

MORPHOLOGY OF THE DRAINAGE BETWEEN GANGA AND YAMUNA RIVERS-SIWALIK Fms.



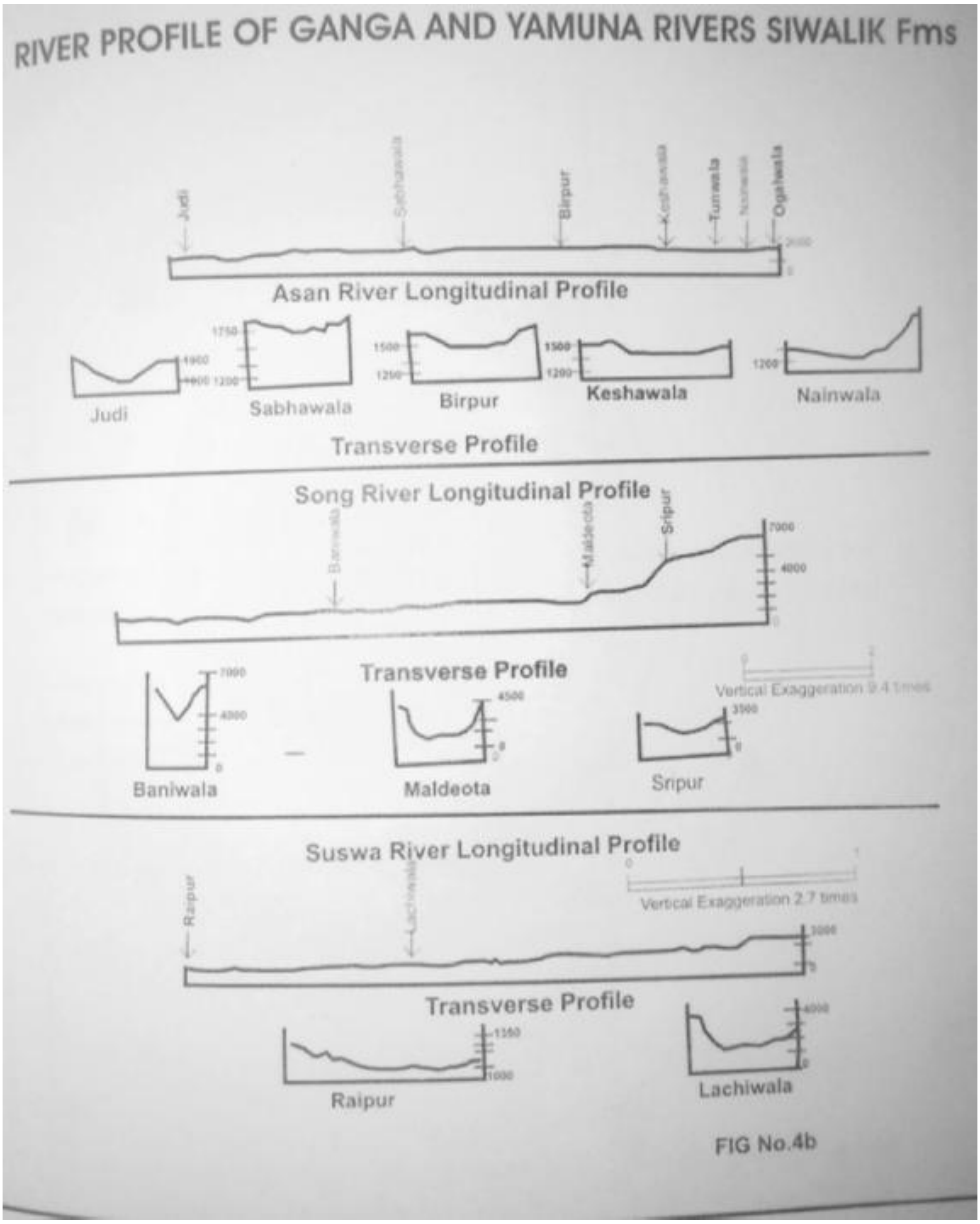
SCALE
0 5 Kms

LEGEND

No.	NAME OF THE BASIN	C.I.	R.R.	E.R.
1.	RISPANA NADI	0.23	287.5	0.68
2.	BINDAL NADI	0.23	187.5	0.83
3.	SUKH RAO	0.21	147.0	0.82
4.	RAMGARH RAO	0.26	178.5	0.78
5.	FANDUWALA RAO	0.29	166.6	0.8
6.	KANS RAO	0.21	268.5	0.87
7.	MOTICHUR RAO	0.24	127.6	0.74
8.	RAMGARH RAO-II	0.21	200.0	0.87
9.	RANIWALA RAO	0.21	160.0	0.64
10.	KULUWALA RAO	0.54	200.0	0.37
11.	DARAWAT RAO	0.43	84.5	0.37
12.	DHUNWALA RAO	0.21	107.8	0.13

C.I. CIRCULARITY INDEX
R.R. RELATIVE RELIEF
E.R. ELONGATION RATIO

FIG No. 4 A


RIVER PROFILE OF GANGA AND YAMUNA RIVERS SIWALIK Fms
Judi
Birpur
Ogalwala
Asan River Longitudinal Profile
Judi
Sabhawala
Birpur
Keshawala
Nainwala
Transverse Profile
Song River Longitudinal Profile
Sripur
Transverse Profile
Baniwala
Maldeota
Sripur
Suswa River Longitudinal Profile
Raipur
Transverse Profile
Raipur
Lachiwala
FIG No.4b

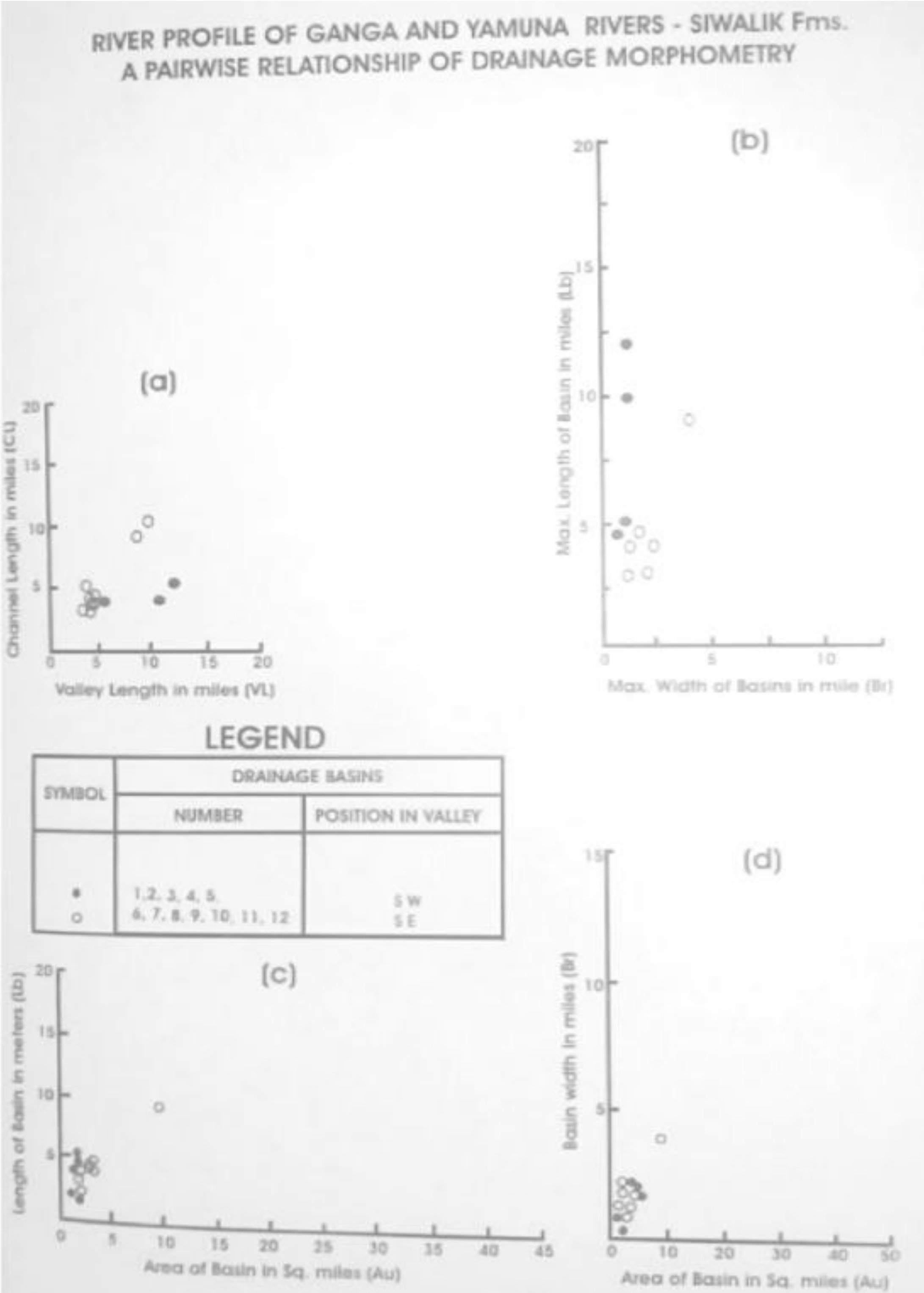


FIG NO. 4 C (a-d)

4. Water Resource Depletion

In the region the rainfall is very heavy but most of it is wasted by the way of surface runoff (Anantharaman, 1983). The hill tracts are deficient in agricultural water, the alluvial terraces possess hardly sufficient agricultural water and Dun aquifer zone has sufficient agricultural water. The available water is wasted by high gradient, heavy surface runoff, infiltration through structurally weak planes and misuse and closure of springs by human beings.

The Relationship between resource catastrophic structure and geomorphic regions (Fig. 8A) is as follows

Dun gravels The Asan-Suswa Alluvial terraces :In the eastern parts of the Suswa-Pleistocene terraces water logging during floods over large area under humid conditions is prominent. Depletion of soil-water and minerals by the above mentioned agents and processes are also prominent.

5. Conservational Geostructure

Soil Resource Conservation

The devices against erosion should be mainly directed to the removal of its causes and not to its consequences. The measures against the soil erosion should be based on a harmonious complex comprising forest reclamation, agrotechnical and hydrotechnical measures within the framework of the scientific management of the land (Bahukhandi and Anantharaman, 2003b). This complex and systems of measures should be on the fight against stream erosion, involving the immediate protection of the soils of the whole catchment basins through the creation of belts and grazing strips and the control of cultural microrelief as well as through the undertaking of engineering works i.e. ditches, embarkments, terraces, dikes, dams, drainage and water absorbing installations so as to redistribute the surface runoff and eliminate the ablation of the soil. The soil conservation measures are classified into two parts viz., biotic measures and mechanical measures. The biotic measures check the soil Erosion indirectly and the mechanical measures check the soil erosion.

Afforestation

Protective forestation in the region constitutes one of the most important measures for guarding soils against the harmful effects of droughts, ablation and scouring. Therefore, one should resort to afforestation wherever the soil is in need of such protection (Allen, 1957). On the hill slopes the ploughing should be restricted to slopes with gradients 10°-15° for saving the soil from erosion. Forest belts combined with grass and soft fruit strips on terraces (Fig. 8 B) and other water retaining measures should be adopted.

Water Resource Conservation

The present haphazard utilisation of supply of water accentuated by the development of forest, and agro-based industries as also by power generation, demands maximum rational utilisation of available hydraulic resources. A thorough investigation of the area reveals that out of the total rainfall, about 50% is spent in the evapo-transpiration and infiltration processes about 25% flows as surface runoff every year which is used in agriculture and domestic purposes, but 25% rain water flows unused. This 25% of water of the region can be channelised through the minor canals to fulfill the need of irrigation. It is proposed that suitable minor canals, wheel shifters and pumping sets are set up as per the plan shown in figure 8 B. Besides these, there is one more resource like the spring line which runs parallel to the Dun aquifer zone along the Siwalik drainage lines (Fig. 2E, 2E-1). The spring line is associated with oozing water incessantly. This feature is locally called as ogals. The ogals are formed in great number along the junction of Dun aquifer zone and the Siwalik. They can be converted into small reservoir and form ponds to store the water for irrigation purposes. This proposal can be successfully tried as Bhupalpani[1] , Chorpani and Ranipokhri[2]. From these reservoirs the water can be lifted by pumping sets to irrigate the upper level terraces of the region. Small clams can be constructed in the upper reach of the Song/Suswa river. It has been worked out that the gradient of the Song/Suswa valley ranges from 20' to 300'/ mile {6 metres to 90 metres / 1.6 kms). The suitability of the above gradient accompanied with the discharge of water available small power generators to Operate pumping sets can be set up.

1. Pant -Springs in local dialect which is suffixed to a word .
2. Pokhari -Pondllake in iocai dialect .

On the basis of the above study of the available resources and their conservation measures the following conservational geo-structure measures of the geomorphic regions are suggested (Fig. 8 B).

1) **Piedmont colluvial tracts**: The colluvial terraces with high gradient and fair supply of water can well be utilised and conserved by adopting the above measures, besides the plantation and crop rotation of commercial crops like Soyabean and sunflower. Channel and terrace cultivation is also proposed in these tracts.
2) **Dun gravels**: The Suswa-Asan Alluvial Terraces : In this region construction of canals at Rudarpur, Dohri, Harawala, Dhumnagar and Dunganagar is proposed. Further reservoirs can be set up at various places as sited in the Fig. 8 B. Cultivation of sugarcane and rice along Suswa riverine tract, crop rotation of commercial crop like Soyabean, sunflower and legume plants, afforestation in lines of contour and channel cultivation methods are suggested.
3) **Siwalik structural and denudational hills** : To check and conserve the forest and soil of this region forest plantation, cultivation of Anava sislana and giant fodder grass are proposed. To control the fast flowing runoffs, watersheds and torrent control projects should be implemented immediately

Economic Planning of the Geomorphic regions

The most urgent problem of the region is the severe soil erosion which bring out in its wake the decline in cultivated area. In the region afforestation and fruit groves belts should the encouraged on the scarp ridges of the ingrown and entrenched meanders of the rivers.

In the piedmont colluvial tract, the cultivated areas of the spur villages should be protected by bending and contour terracing. Grassy water courses for checking soil erosion be introduced in the settlements along the spring lines where the flow of water is not very swift like Chanderbani, Banjarawala and Bhupalpani. This spring line lies in the flat to gently sloping run gravels.

In the Siwalik structural and derudational hills, the forest ranges of Kansrao and Asarori in the Eastern part and Jhajra, Malhan and Timli in the Western part of the region are badly exposed to lopping and grazing by cattles. Suitable administrative measures are required to check the lopping and grazing which cause soil erosion in these areas.

A vast majority of villages are located on gravelly soil and repeated ploughing leads to soil loosening and soil erosion. This leads to gully erosion. Villages like Selakui, Haripur, Dhoolkot in the western part and Joligrant, Benuwala, Listrabad and Dhogpur in the Eastern part suffer by gully erosion. Minimum ploughing of soil, coupled with farm water ways to divert the runoff are necessary in such cases.

Soil erosion in villages like Bhogpur, Asthal, Sanalauprela and Chiroli located in the interfluves, hillocks, terraces and spurs is caused by torrential flow of seasonal raos and channels causing gully formation. Mulching and wattling measures should be introduced in these cases.

The heavy rainfall is the cause of torrential runoff at the maximum rate over the Suswa in the Eastern part and the Asan in the western river bed (Saxena, 1975). This results in huge loss of soil. To control the landslides and runoff which mainly occur in the courses of seasonal raos like Sukhrao, the Watershed and torrent contmi projects should be implemented on the water parting lines of Siwalik uplands. These projects wili check the expansion of guiiies and ravines. The denuded areas of the Siwaiik and Suswa valley should be afforested with Eucalyptus spp., Cedrus, Sal and Acava sislana.

The most geocatastrophlc features of the water resources of the region are runoff, soil erosion, gully formation, flooding and water logging in the Asan-Suswa riverine tracts. The water which goes as waste causes havoc. The most suitable method of impounding water is construction of Village tanks and small reservoirs. The suitable location for small reservoirs are on spring line and ogais like Chandrabani, Ogaiwala and Bhogpur, wheel shifters can be introduced at Sripur, Beniwaia along Song river, Kashowala, Nehrugram, Mohkampur, Ramgarh, Lachhiwala, Raiwala, Shyampur along Suswa river, Nainiwala, Tunwala, Burronwala, Garhi-Dakra, Kaonli, Dhurpur, Sabhawaia along the Asan river. Pumping sets can be installed in the villages situated at the spring line.

Further the region is endowed with scenic beauty of various landscapes thickly clad with overgreen vegetation under mountain valley breezes. The region is enriched with scenic spots like Mansa devi hill, Chandi devi hill, Dat Mandir, Sakumbari devi mandir, Laxmansidh, etc. Besides the rivers Ganga and Yamuna are very sacred for the Hindus.

Thus the region fulfills the concrete basis for tourist industry which is not fully developed. There are few tourist spots which are maintained and they are visited by people.

The Ganga Lahri, Suswa-Ganga confluences can be developed as a tourist attraction. By constructing the Ganga canal at Chula and by developing a bird sanctuary at Lachhiwala a tourist complex can be created enirciing these spots.

At present the region, with its vast land resources like forest, water and rocks and beautiful scenic landscapes remains, to a very large extent untapped. It is therefore, urged that serious consideration be given to the measures suggested in this study for the economic growth of the region.

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