Chapter 3

Spatial Distribution of Settlements in the Rammam Basin

3.1. Introduction

Rammam Basin occupies an area of 403.16 km^2 and is divided into North Rammam Basin and South Rammam Basin (as said in chapter 1). The North Rammam Basin lying in the north of the river Rammam is inhabited by 24 settlement units consisting of 95 hamlets, including one Notified Bazar Area and four Forest Blocks. On the other hand, South Rammam Basin lying in the south of the river Rammam is inhabited by 14 village units consisting of 93 hamlets. In this chapter distribution of villages and hamlets on the ridges, spurs and terraces has been discussed to understand the general distributional pattern of settlements in the basin as well as the relation between topography and distribution of settlements.

Size, spacing and pattern of dispersion of settlements are interrelated topics and collective study of these gives a clear idea about the spatial distribution of settlements in any region. Study of spacing and dispersion of settlements not only helps to understand the manner in which the settlements are distributed over the region but also helps to understand the regional socio-economic attributes and the manner of organization of space (Mukerji, 1970). Study of spatial distribution of settlements has been attempted by various geographers since the early 20th century. Barns and Robinson (1940), Mather (1944), A.B. Mukerji (1970) invented various methods to study spacing of settlements. A.B. Mukerji (1970) studied spacing of settlements in Rajasthan with respect to the size of the settlements in terms of population. He also identified the regional pattern of spacing between the rural settlements in Rajasthan, explained the pattern and evaluated the manner in and the extent to which the spatial pattern of spacing contributes to the character of areas (Mukerji, 1970).

The spacing of settlements in the study area depends on the terrain characteristics of the study area. As the study area is rugged in nature, the settlements are located in the suitable areas where the tract is less rugged and less dissected. Therefore, in this chapter the spacing and dispersion of settlements have been discussed along with influence of the terrain characteristics on the spacing and dispersion of settlements on the tract.

The settlements are located in various altitudes; the altitudinal variation of the settlements in the tract ranging from 320m near Kerabari at Goke to 2750m at Hilley Forest Block. Apart from these two extreme locations, other settlements are lying at altitudes in between these two extreme values and the study of distribution of settlements in various altitudinal zones helps to identify the most inhabited altitudinal zone for establishing settlements in the tract.

To understand the terrain characteristics, the morphometric indices have been discussed as well as the relation between morphometric indices and distribution of settlements on the tract have been found out. To understand the spatial pattern of the settlements nearest neighbour analysis has been practiced. Thus this chapter throws light not only on the distribution, spacing and spatial pattern of settlements in the study area but also the relationship between distribution, spacing of settlements with the terrain characteristics in the study area.

3.2. Spatial Distribution of Settlements

Under this heading, distribution, Spacing and Dispaersion of Settlements have been discussed.

3.2.1. Distribution of settlements on the ridges, spurs and terraces

The villages and hamlets distributed on ridges, spurs and terraces are as follows:

Settlements on Deorali danra

Various settlements are located on both the flanks of the danra at various elevations. Four villages such as Lamagaon, Jhepi, Kankibong and Hatta are located on this ridge. The village Hatta is located on the northern flank, Kankibong at the terminal point (NE-N), Jhepi and Lamagaon on the south-eastern flank of the danra.

Settlements on Samalbong danra

Various settlements have been developed on both the flanks of this ridge. As said earlier that ridge starts from Kaijalia, so Kaijalia is settlement located at the south end of the ridge. The settlements Samalbong, Kolbong, Murmidong, Karmi and Goke are located on the northern flank of the ridge whereas Part of Samalbong, Pulbazar (outside of the study area) and Bijanbari (outside of the study area) are located on the southern flank.

Settlements on Rimbick danra

Three settlements are located on Rimbick danra- Lodhama and Namla on the southern flank of the danra and the village Rimbick starting from southern flank to east to north of the danra.

Settlements on Sandakphu danra

Only one habitation named Gurdum Forest Village, a hamlet of Singalila Forest is located on this danra.

Settlements on Sabarkum danra

The hamlets located on this danra belong to two villages namely Rimbick (Part) and Singalila Forest (Part). The settlements located at the end of the danra facing the east towards the river Rammam are Sirikhola, Bichgaon, Daragaon, Rammam and Samanden (2300m-2400m). Samanden is located at the end of Hemlock danra, one bifurcated spur of the ridge Sabarkum danra, stretching from south-west to north-east direction. River Rato khola and its tributary separates Samanden from Kingsa danra located on the north.

Settlements on Kingsa danra

Only one habitation named Gorkhey Forest Village, a hamlet of Singalila Forest, is located on this danra

Settlement on Bhareng spur

The settlement Bhareng is located at the end of this spur at an elevation of 2100m – 2600m.

Settlements on Ribdi spur

The settlement Ribdi is located at the end of this spur at an elevation of 2100m – 2600m. Hilley Forest Block is located on this spur.

Settlement on Okhery spur and Terrace of Daramden

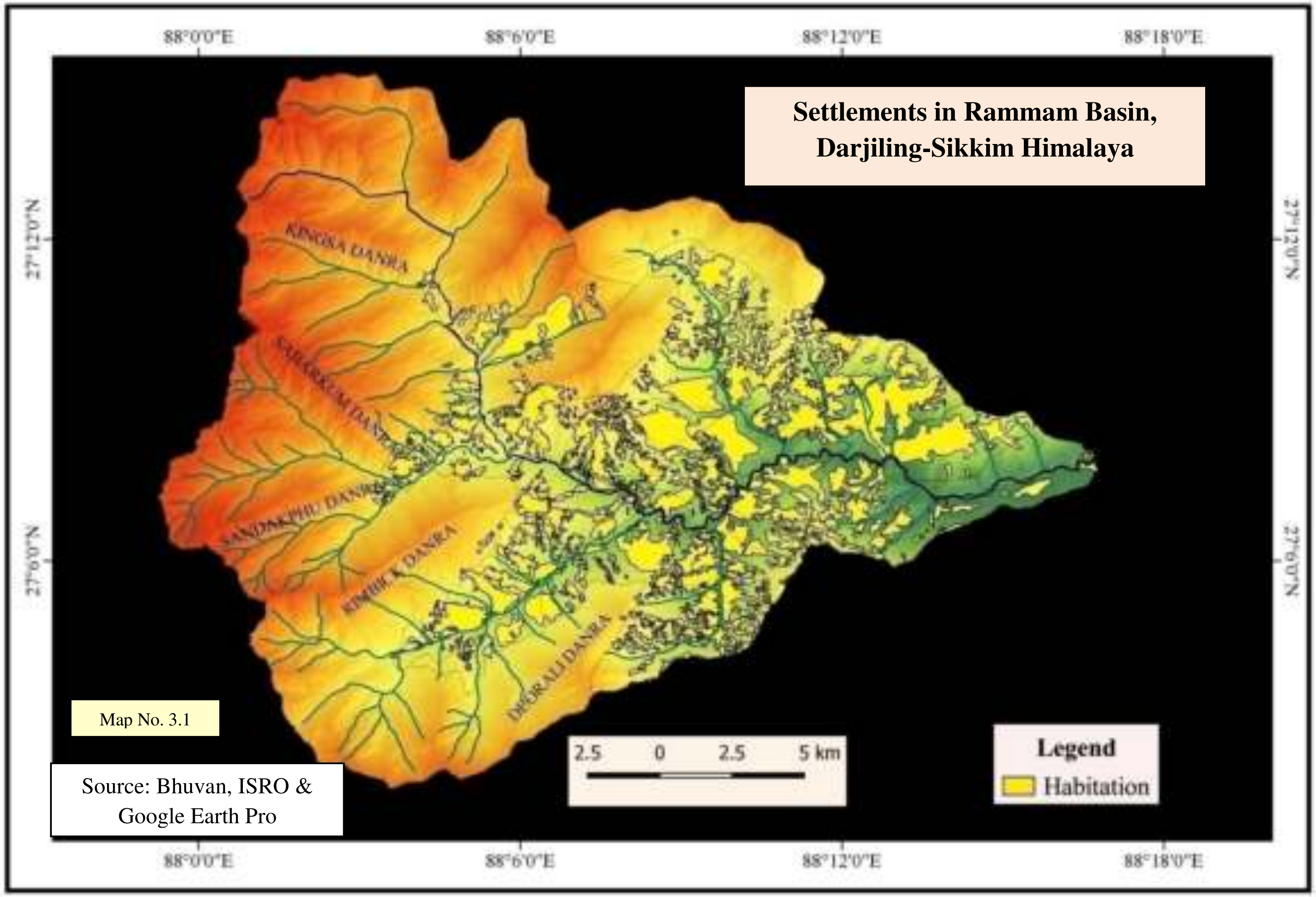
The eastern flank of this spur is most densely inhabited part as many villages are located here. The villages located on the eastern flank are Burikhop Rumbuk, Rumbuk, Upper Fambong,

Table No. 3.1: Distribution of Settlements on the ridges and spurs of Rammam Basin

Sl. No.	Settlement	Hamlets	Altitude (m)	Ridge/ spur
1.	Lamagaon	Upper Lamagaon, Middle Lamagaon I, Md., Lamagaon II	1200-1800	**Deorali danra**
2.	Jhepi	Gurdum, Ramitey, Rowligaon, Bhujelgaon, Jhepi	1200-2000	
3.	Kankibong	Batasey, Tumfuwa, Kankaybong-I, Kankaybong-II, Rai Gaon, Sanman Gaon, UpperSumbuk, MiddleSumbuk, Lower Sumbuk, Bahungaon	1100-1700	
4.	Hatta	Chhotahatta, Barahatta, Palmazuwa, Phedikhola, Dilpabusty, Gairigaon, Syangbogaon-Piplidanra	1600-2000	
5.	Lodhama	Lodhama Bazar	1300	
6.	Singalila Forest (Partly)	Dhotrey FV, Salaybong FV, Ritu Foktey FV	1900-2600	
1.	Kaijalia	Kaijalia, Bhanjyang, Sirisey, Upper Bararey, Lower Bararey, Upper Lingten, Lower Lingten	1100-1600	**Samalbong danra**
2.	Samalbong	Upper Samalbong, Middle Samalbong	1400-1600	
3.	Kolbong	Upper Kolbong and Lower Kolbong	1000-1500	
4.	Murmidong	Padeng, Malatang, Sajbotay, Kohm Busty, Murmidong	800-1600	
5.	Karmi	Upper Nezi, Lower Nezi	800-1500	
6	Goke	Upper Rangdu, Lower Rangdu, Lower Takbia, Upper Goke, Lower Goke, Kamjer Busty, Garbetar, Upper Karmatar, Lower Karmatar, Kerabari	400-1200	
1.	Lodhama	Upper Bansbottay, Lower Bansbottay, Upper Lingsaybong, Lower Lingsaybong	1600-2200	**Rimbick danra**
2.	Namla	Fatingtar, Namla Busty	1300-1600	
3.	Rimbick	Sepi, Rajavir, Upper Jawleygaon, Lower Jawleygaon, Maneydara, Upper Rimbick, Middle Rimbick, Lower Rimbick I, Lower Rimbick II, Tubun, Toksar, Gumbadara, Yakreybong, Dilpali, Lampati	1300-2300	
4.	Singalila Forest (Partly)	Namla FV, Lingsaybong FV	2200-2400	
1.	Singalila Forest (Partly)	Gurdum FV	2200	**Sandakphu danra**
1.	Rimbick (Partly)	Baisakhey-Lekhkharka, Daragaon-Musapakha, Daragaon Bhanjyang, Beechgaon, Sirikhola, Lower Sirikhola, Timburey	2000-2300	**Sabarkum danra**
2.	Singalila Forest (Partly)	Sirikhola FV, Beechgaon FV, Daragaon FV, Rammam FV, Samanden FV	2300-2500	

Sl. No.	Settlement	Hamlets	Altitude (m)	Ridge/ spur
1.	Singalila FV (Part)	Gorkhey FV	2400	**Kingsa danra**
1.	Bhareng	Upper Bhareng, Lower Bhareng	2100-2600	**Bhareng Spur**
1.	Ribdi	Khopey Ramatey, Upper Ribdi, Lower Ribdi, Ribdi Meggi	2100-2700	**Ribdi Spur**
2	Hilley Forest Block	Hilley Forest Block	2500-3000	
1.	Burikhop-Rumbuk	Buriakhop Tarevir, Buriakhop Nasa, Buriakhop Monewgaon	1500-2200	**Okhery Spur and Terrace of Daramden**
2	Rumbuk	Upper Rumbuk, Middle Rumbuk, Lower Rumbuk	1200-2100	
3	Upper Fambong	Fambong Mathilo Tar, Sombarey, Chokteygaon, Rnglyang, Anden Park, Hattavan	1200-2300	
4	Dhalam	Upper Daramden, Middle Daramden, Lower Dhalam	800-1200	
5	Lower Fambong	Lower Fambong, Ambotay, Ringyang	800-1200	
6	Longchok	Upper Longchok, Middle Longchok, Nalbogaon	800-1300	
7	Salyangdang	Upper Salyangdang, Lower Salyangdang, Lungyam	800-1300	
8	Siktam	Upper Siktam, Lower Siktam	1400-1800	
9	Tikpur	Orange Village, Middle Tikpur, Lower Tikpur, Upper Supreynagi, Lower Supreynagi	1400-2200	
10	Okhery	Upper Okhery, Middle Okhery, Lower Okhery, Puretar, Lattetar, Chyangbagaon	1800-2400	
11	Sombaria Forest Block	Sombaria Forest Block	2200-2400	
1.	Burikhop-Dodok	Upper Buriakhop, Buriakhop Beechgaon, Lower Buriakhop, Buriakhop Rengeng, Buriakhop Ghattey, Gairigaon, Middle Dodok, Sipaigaon, Ahley, Thongling	1400-1800	**Karthok Spur**
2	Karthok	Upper Yangthang, Lower Yangthang, Karthok	1200-1500	
3	Bojek	Upper Bojek, Lower Bojek	800-1100	
4	Timberbong	Bahungaon, Gairigaon, Daragaon-Teendhurey, Arubootay, Tarbari, Chisopani, Ridang	1000-1600	
5	Tharpu	Raigaon, Tharpu School, Ratimatay, Kolbotay, Gairigaon	700-1000	
6.	Soreng Forest Block	Soreng Forest Block	2000-2400	
1	Soreng	Soreng Lungthung, Soreng Danragaon A and B, Nesorgaon , Khopi Kherga, Mangarjung, Mangsari	1300-1800	**Soreng Spur**
1.	Malbasey	Upper Samthang, Lower Samthang, Malbasey, Thulogaon, Upper Pekkigaon	600-1400	**Malbasey spur**
1	Chumbong	Asyang Sajbotey, Sigrep, Torkigaon, Chumbong, Sigret Sadhugaon, Budang, Malthek, Sipsu	600-1400	**Chumbong spur**
1	Nayabazar	Nayabazar FB, Nayabazar (NBA)	450-800	**Nayabazar spur**

Source: Topographical Map (SoI), published in 1963, Google Earth and Field Survey during the period of 2018 to 2020.


Settlements in Rammam Basin,
Darjiling-Sikkim Himalaya
88°0'0"E
88°6'0"E
88°12'0"E
88°18'0"E
27°12'0"N
27°6'0"N
KINGSA DANRA
SABARKUM DANRA
SANDAKPHU DANRA
KIMBICK DANRA
DEORALI DANRA
Map No. 3.1
Source: Bhuvan, ISRO &
Google Earth Pro
2.5 0 2.5 5 km
Legend
Habitation

Settlements in Rammam Basin

1. Soreng; 2. Mangarjung; 3. Daramden; 4. Tharpu; 5. Timberbong; 6. Longchok; 7 Murmidong; 8. Kolbong

Photo Plate 3.1

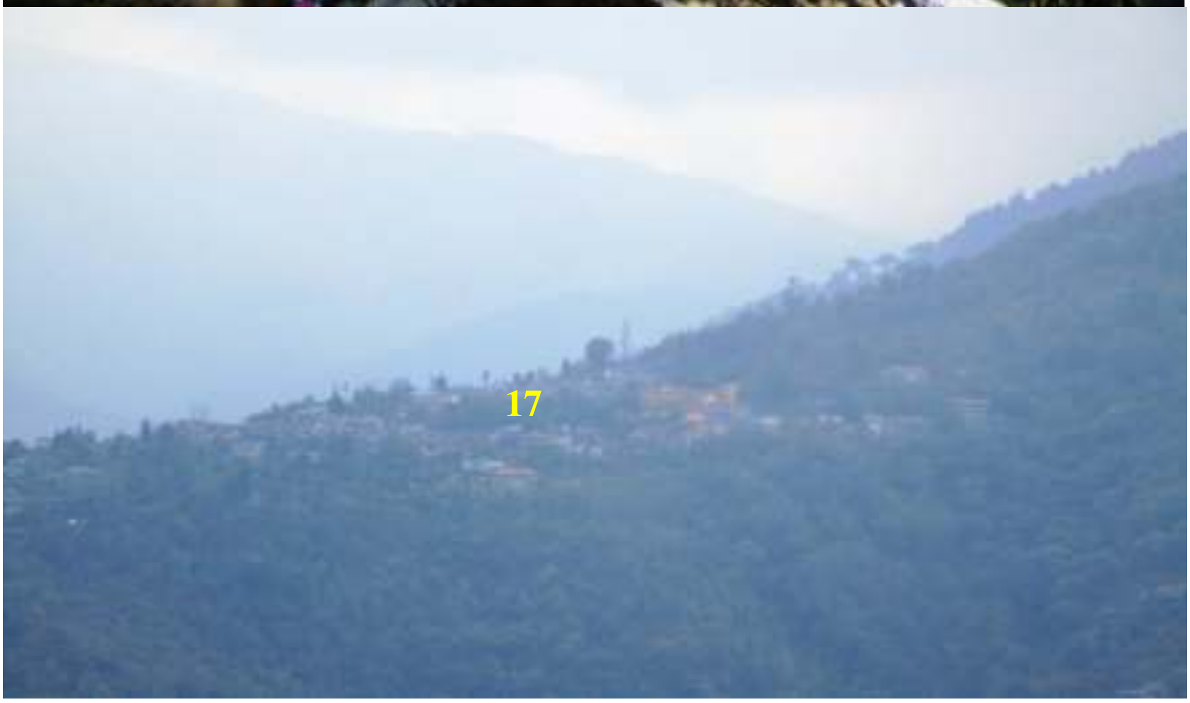
Source: Researcher

Settlements in Rammam Basin

9. Salyangdang; 10. Malbassey; 11. Chumbong Photo Plate 3.2

Source: Researcher

Settlements in Rammam Basin



12.Sirikhola;13.Beechgaon;14.Sepi;15.Daragaon;16.Okhery;17.Rimbick

Photo Plate 3.3

Source: Researcher

Settlements in Rammam Basin

18. Jawleygaon; 19. Daragaon; 20. Okhery

Photo Plate 3.4

Source: Researcher

Dhalam, Lower Fambong, Longchok; on the southern flank are Salyangdang, Siktam, Tikpur and on the south-western flank is Okhery.

Settlement on Karthok spur

In the western flank are Burikhop Dodok, Karthok and Bojek from north to south direction. On the eastern flank are important villages like Timberbong and Tharpu.

Settlement on Soreng Spur

The hamlets of Soreng GPU are located on this spur. Soreng is located over the water divide the river Rammam and Roatak khola. Soreng is the most important settlement of this tract as all the sub-divisional offices are located at Soreng. Soreng Forest Block is located on this spur.

Settlement on Malbasey-Chumbong-Nayabazar spur

Malbasey, Chumbong, Nayabazar and Nayabazar Forest block are located on this part.

3.2.2. Size of Settlements

The average size for 38 settlements of the basin is 10.61 sq. km, while standard deviation is 26.88 sq. km. The mean size of the settlements in the North Rammam Basin is 6.38 sq. km. and in the South Rammam Basin is 17.86 sq. km. These large average sizes are the result of large forest blocks located in the basin. When 32 revenue villages and one Notified Bazar Area are considered then the mean size of settlements excluding five forest blocks of the basin is 4.82 sq. km. The same figure for the northern part is 3.85 sq. km (for 19 villages and one Notified Bazar area), and for the southern part is 6.33 sq. km. (for 13 villages). Lower Fambong (1.05 sq. km.) and Burikhop Dodok (7.80 sq. km.) are the smallest and largest revenue villages in the North Rammam Basin respectively while Namla (with only 2.31 sq. km. area under the basin) and Rimbick (14.78 sq. km.) are the smallest and largest revenue villages in the South Rammam Basin respectively. If the forest blocks are only considered then Hilley Forest block (33.08 sq. km.) and Singalila Forest (167.69 sq. km.) are the largest settlements in the northern and southern parts respectively. The settlements under study have been divided into four groups on the basis of mean and standard deviation values of area:

1. Small settlements (less than mean value of 10.61 sq. km.)

20 villages, one Notified Bazar Area in the north Rammam basin and 11 villages in the South Rammam Basin belong to this group. This group consisting of 32 settlement units covers 35.833% area of the basin. These settlements can further be sub-divided on the basis of variation of areal extent into the followings:

a. Area less than 2.00 sq. km.

Bhareng, Longchok, Lower Fambong, Tharpu and Nayabazar Notified Bazar Area fall under this group. All these settlements are located in the North Rammam Basin and collectively cover 1.645% (6.631 sq. km.) area of the basin under study.

b. Area between 2.00 -5.00 sq.km.

Ribdi, Siktam, Salyangdang, Dhalam, Upper Fambong, Rumbuk, Timberbong and Karthok in the northern part; and Namla, Hatta, Jhepi, Kaijalia, Kolbong and Murmidong in the southern part belong to this group. These 14 settlements collectively cover 11.670% (47.05 sq. km.) area of the basin under study.

c. Area between 5.00 -10.61 sq.km.

Okhery, Tikpur, Soreng, Malbasey, Chumbong, Burikhop Rumbuk, Burikhop Dodok, and Nayabazar Forest Block in the Norhtern part; and Lodhama, Lamagaon, Samalbong, Karmi and Goke in the southern part are under this group. These 13 settlements collectively cover 22.518% (90.785 sq. km.) area of the basin.

2. Medium Settlements (10.61 – 37.49 sq.km.)

Soreng Forest Block, Sombaria Forest Block and Hilley Forest Block in the northern part; Rimbick and Kankibong located in the South Rammam Basin, fall under this group. These three forest blocks and two villages collectively cover 22.572% (91.003 sq. km.) area of the basin.

3. Large Settlements (above 37.49 sq.km. area)

Only Singalila Forest (167.691 sq. km.) belongs to this group. This one forest block covers 41.594% area of the basin.

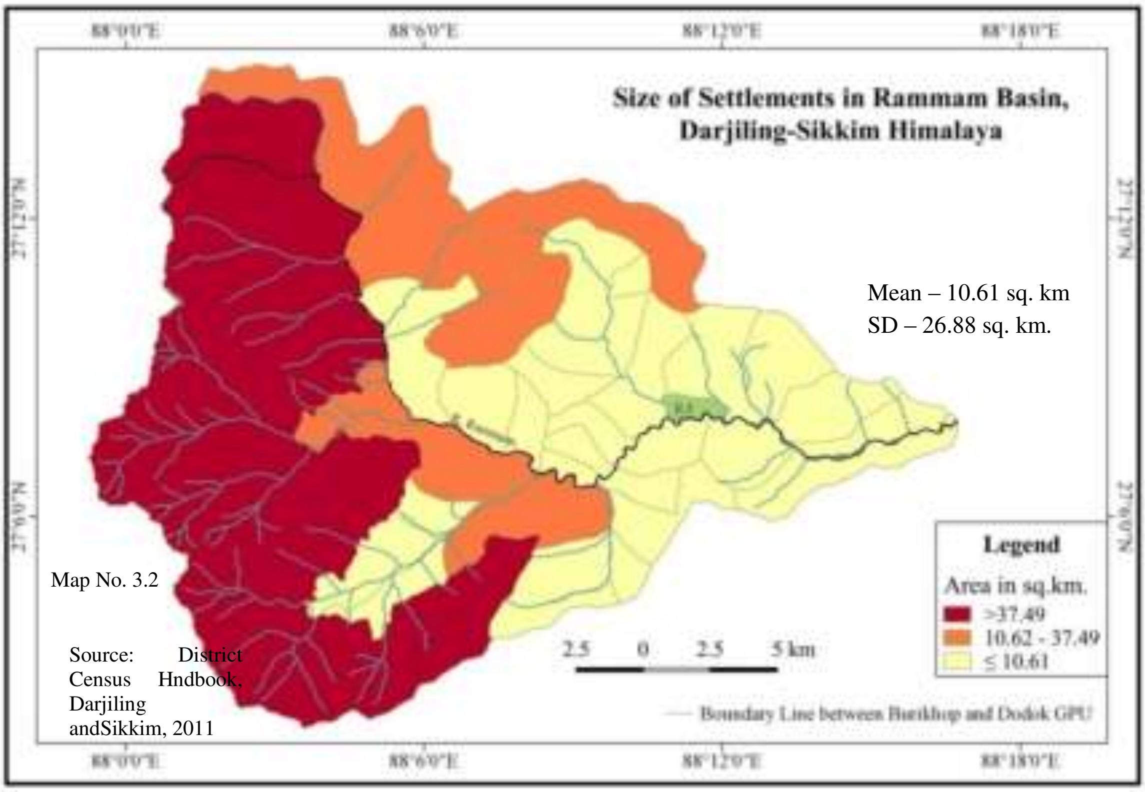


Table 3.2: Areal Distribution of the Settlements in the Rammam Basin

Area (sq.km.)	**No. of settlement**	**Number of settlement in North Rammam Basin**	**Number of settlement in South Rammam Basin**	**Area occupied in sq.km.**
<2.00	5 (13.16%)	5	0	6.631 (1.645%)
2.00-5.00	14 (36.84%)	8	6	47.05 (11.670%)
5.00-10.61	13 (34.21%)	8	5	90.785 (22.518%)
10.61-37.49	5 (13.16%)	3	2	91.003(22.572%)
>37.49	1 (2.63%)	0	1	167.691 (41.594%)
Total	**38 (100%)**	**24**	**14**	**403.16 (100%)**

Source: Computed by the Researcher

3.2.3. Spacing of Settlements

Spacing of settlements can be defined as the hypothetical distance between the settlements located in an areal unit. Thus, the spacing of settlements depends on the size of the areal unit and the number of settlements within it. If the number of settlements remains same, the larger the size of the areal unit, the higher will be the spacing of settlements or vice versa.Therefore large rural settlements would be widely spaced, whereas smaller settlements would be closely spaced (Hagget, 1966). Since the early days of quantitative analyses, there were several methods for calculation of the spacing of settlements. Walenty Winid, Barnes and Robinson (1940), Mather (1944), and A.B. Mukerji (1970) have devised several methods to study spacing of settlements. In the present study, Mather's (1944) method of spacing has been adopted for computation of spacing of settlements. Mather's formula for studying spacing of settlements is as follows:

$$D=1.0746\sqrt{A/N}$$

Where,

D is average distance of a settlement to its six nearest neighbours,

A is the total area of study; and N is the number of settlements

The Rammam basin with 14 settlements in the southern part and 24 settlements in the northern part is an example of such a basin where hamlets are very closely spaced. It is because of many parts of the basin being devoid of any habitation due to either for location of reserved forests and national parks or due to rugged terrain. If the whole area of the basin is taken into consideration then the spacing between the 38 settlement units of the basin should be 3.5 km and the intra-hamlet spacing for 188 hamlets of the basin should be 1.58 km; whereas the spacing between the hamlets in the 38 settlements vary from 0.37 km in Nayabazar Notified Bazaar Area to 6.2 km in the Hilley Forest Block. The mean and standard deviation values of spacing of hamlets in settlement units of Rammam basin are 1.50 km. and 1.26 km. On the basis of spacing values the villages have been categorized into the following groups:

1. Very Low spacing (< 1.0 km)

Soreng (0.99 km), Salyangdng (0.92 km), Longchok (0.81 km), Upper Fambong (0.90 km), Dhalam (0.91 km), Lower Fambong (0.64 km), Burikhop Dodok (0.95 km), Timberbong (0.87 km), Tharpu (0.64 km) Karthok (0.77 km) and Nayabazar (0.37 km) in the northern part of the basin; and Rimbick (0.88 km), Hatta (0.96 km), Kaijalia (0.66 km) and Murmidang (0.99 km) in the southern part of the basin are the settlements where intra-hamlet spacing is less than 1.00 km. Low intra-hamlet spacing of these settlements can be attributed to favourable terrain and other physical conditions as well as good connectivity of these settlements to the nearest Sadar town.

2. Low Spacing (1.00 -2.00 km)

Bhareng (1.06 km), Ribdi (1.01 km), Okhery (1.11 km), Tikpur (1.29 km), Siktam (1.08 km), Rumbuk (1.27 km), Malbasey (1.2 km), Chumbong (1.07 km) and Burikho-Rumbuk (1.39 km) in the northern part; while Namla (1.15 km), Lodhama (1.14 km), Kankibong (1.11 km), Jhepi (1.05 km), Lamagaon (1.43 km), Kolbong (1.30 km) and Goke (1.00 km) in the southern part of the basin belong to this group.

3. Moderate Spacing (2.00 – 3.00 km.)

Samalbong (2.02 km) and Karmi (2.22 km) are the settlements in this group.

4. Moderately High Spacing (3.00 – 4.00 km.)

Sombaria (3.75 km) Forest Block and Nayabazar Forest Block (3.48 km) in the northern part of the basin belong to this group.

5. High Spacing (4.00 – 5.00 km)

This group consists of Soreng Forest Block (5.05 km) in the northern part and Singalila Forest (4.14 km) in the southern part of the basin. The reason behind such high spacing of hamlets lies in the fact that Singalila Forest is a national park and most part of it is uninhabited except the 12 hamlets located outside of the core area (78.6 sq.km.) of the national park.

6. Very High Spacing (>5.00 km.)

Hilley Forest Block (6.01) is the only settlement in this group.

Table 3.3: Spacing of hamlets in the settlements of Rammam Basin

Spacing in km.	No. of Settlements		Total
	North Rammam Basin	South Rammam Basin	
Very Low (<1.00)	11	04	15
Low (1.00- 2.00)	09	07	16
Moderate Spacing (2.00 -3.00)	00	02	02
High (3.00 -4.00)	02	00	02
Moderately High (4.00 – 5.00)	01	01	02
Very High (5.00 -6.00)	01	00	01
Total	24	14	38

Source: Computed by the Researcher

3.2.4. Nearest Neighbour Analysis

From study of spacing, it is clear that Daramden and its surrounding areas located at the central part of the basin, is characterised by low spacing of hamlets and the outer margins are characterised by high to very high spacing of hamlets. Still now it has been assumed that the hamlets are uniformly distributed over their respective village areas and through spacing the average distance of a hamlet to its six nearest neighbours has been computed. But in reality the nature of distribution of hamlets may not be uniform. The hamlets may be clustered to one place or may be randomly distributed or may be uniformly distributed over the area of their respective villages. To know the manner in which the hamlets are distributed in the village areas, the method of Nearest Neighbour Analysis have been applied taking the village as unit of study. In this study, Nearest Neighbour Analysis of Clark and Evans (1954) has been applied in which 'Rn' values of all settlements have been computed. The formula for computing 'Rn' is as follows:

Rn= rA/rE

Where, rA is actual mean distance between the hamlets in a settlement

rE is expected mean distance between the hamlets in a settlement

rA may be calculated as follows:

rA = $\sum d$/n,

where, d is distance between nearest hamlets; n is number of hamlets

rE= $1/2\sqrt{n/a}$ where 'n' is number of hamlets and 'a' is area of the village

The 'Rn' value should range from '0' meaning complete cluster through '1' meaning randomly distributed to '2.1491' meaning uniformly distributed. The 'Rn' values obtained in the basin, ranges from zero for four forest blocks and Nayabazar to 0.805 for Okhery to 2.140 for Bhareng in the northern part and 0.812 for Singalila Forest to 2.056 for Murmidong in the southern part of the basin. Thus there is wide variation of 'Rn' values indicating pattern ranging from complete cluster to near random to even or uniform distribution. Thus, the villages in the Rammam Basin have been categorised into four groups on the basis of pattern of distribution, which are as follows:

1. Completely clustered distribution ('Rn' value zero)

Hilley Forest Block, Sombaria Forest Block, Soreng Forest Block, Nayabazar Forest Block and Nayabazar Notified Bazar Area of North Rammam basin are included in this group. These settlements have only one hamlet as four out of five are forest blocks. The 'Rn' values of these settlements are 'zero' meaning complete clustered pattern can be found in these settlements.

2. Random distribution with tendency towards clustering ('Rn' value 1.0 and less)

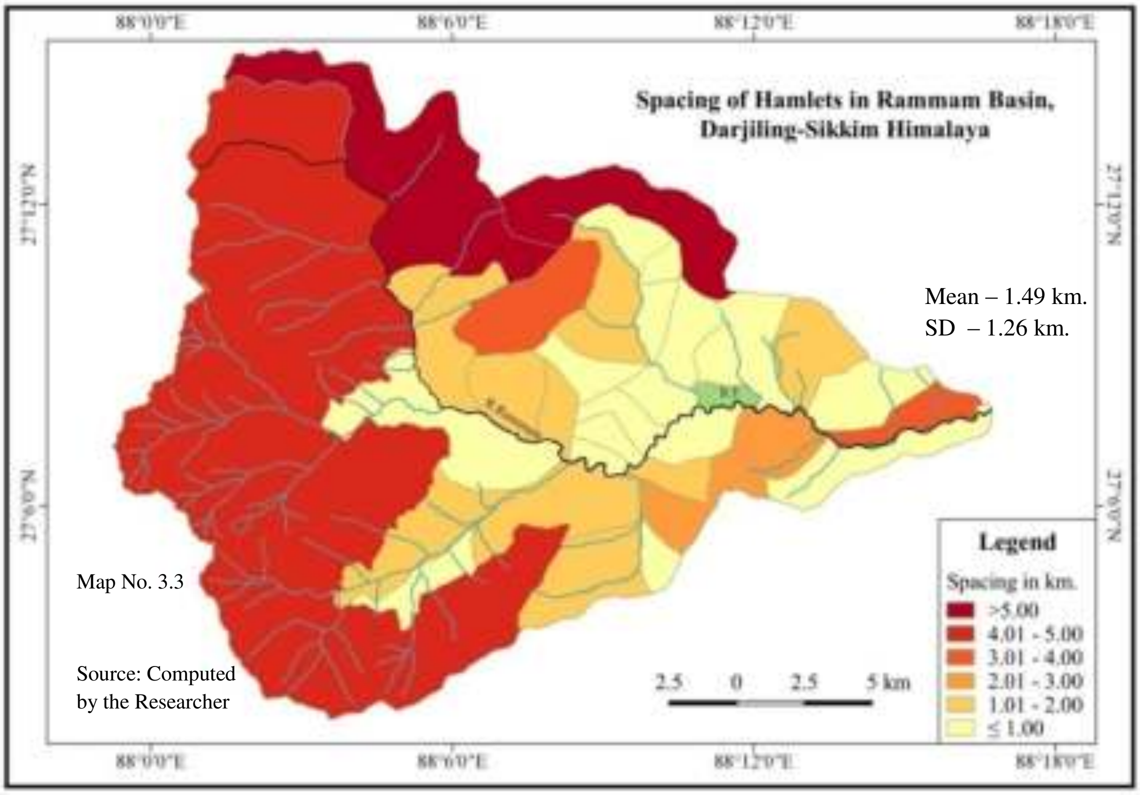
Okhery (0.81) in the northern part; and Singlila Forest (0.812), Samalbong (0.699) and Karmi (0.982) in the southern part, are the settlements belonging to this group. The existence of protected area in the western part of Singalila Forest resulted in location of hamlets mainly towards the eastern part of the forest. This resulted in lower dispersion value in case of Singalila Forest.

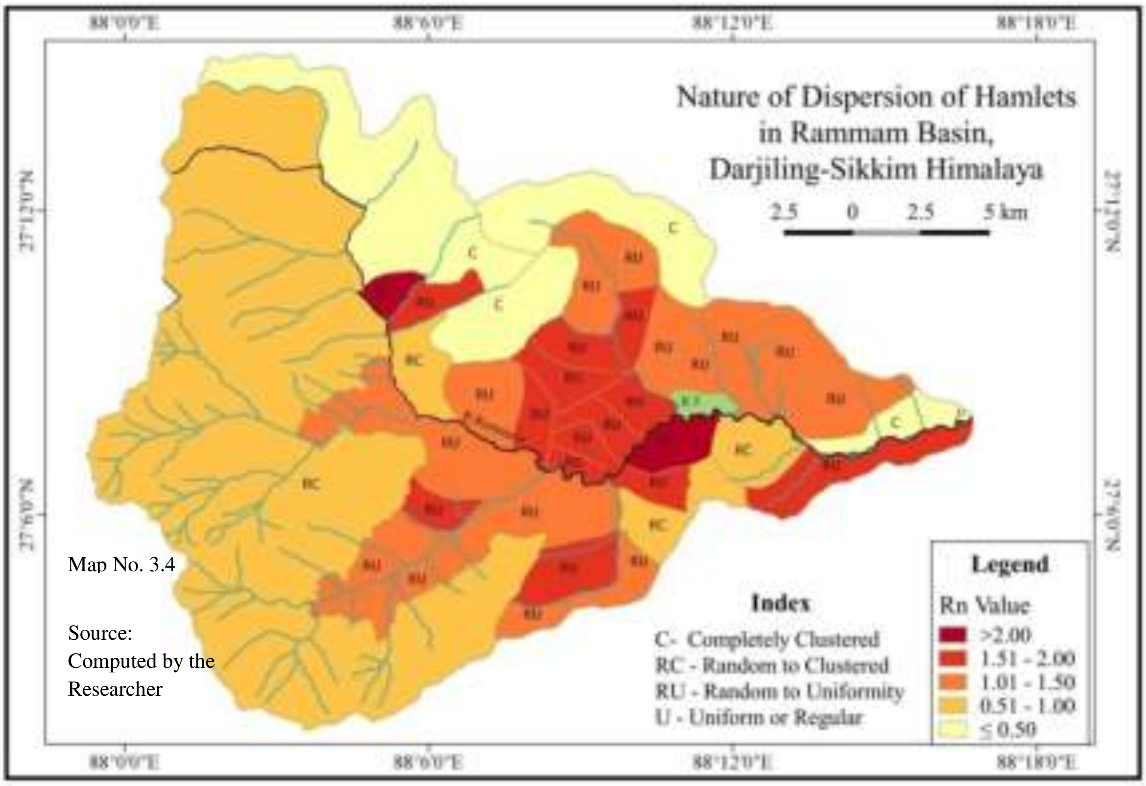
3. Random distribution with tendency towards uniformity ('Rn' Value ranging between 1.0 - 2.0)

This group has further been divided into two groups:

3.a. Settlements with low regularity ('Rn' Value 1.0 - 1.5)

Tikpur (1.10), Burikhop Rumbuk (1.28), Burikhop Dodok (1.07), Timberbong (1.069), Soreng (1.15), Tharpu (1.495), Malbasey (1.19) and Chumbong (1.218) in the northern part; and Rimbick (1.345), Lodhama (1.08), Hatta (1.45), Kankibong (1.33), Lamagaon (1.316) and Kaijalia (1.3) are the settlements in the southern part belonging to this group. The random distributions of hamlets in the villages are result of existence of some centrifugal force such as existence of market centre, administrative centre (as the case for Soreng as it is Sub-divisional head quarters) or may be for other villages the random pattern may be result of rugged terrain, non-fertile land, existence of dense forest, etc.


88°0'0"E
88°6'0"E
88°12'0"E
88°18'0"E
27°12'0"N
27°6'0"N
Spacing of Hamlets in Rammam Basin, Darjiling-Sikkim Himalaya
Mean – 1.49 km.
SD – 1.26 km.
Legend
Spacing in km.
>5.00
4.01 - 5.00
3.01 - 4.00
2.01 - 3.00
1.01 - 2.00
≤ 1.00
2.5 0 2.5 5 km
Map No. 3.3
Source: Computed by the Researcher


88°0'0"E
88°6'0"E
88°12'0"E
88°18'0"E
27°12'0"N
27°6'0"N
Nature of Dispersion of Hamlets in Rammam Basin, Darjiling-Sikkim Himalaya
2.5 0 2.5 5 km
Index
C- Completely Clustered
RC - Random to Clustered
RU - Random to Uniformity
U - Uniform or Regular
Legend
Rn Value
>2.00
1.51 - 2.00
1.01 - 1.50
0.51 - 1.00
≤ 0.50
Map No. 3.4
Source: Computed by the Researcher

3.b. Settlements with high regularity ('Rn' Value 1.5- 2.0)

Ribdi (1.6), Siktam (1.83), Salyangdang (1.64), Longchok (1.85), Lower Fambong (1.63), Dhalam (1.65), Upper Fambong (1.58), Rumbuk (1.63) and Karthok (1.62) in the northern part; and Namla (1.83), Jhepi (1.6), Kolbong (1.74) and Goke (1.690) in the southern part are the settlements in this group.

4. Completely even or uniform distribution ('Rn' Value 2.0 - 2.14)

Bhareng (2.14) in the northern part and Murmidang (2.1) in the southern part, are in this group.

The villages with dispersion value ranging between 1.5 to 2.14, enjoy even distribution of hamlets due to favourable conditions for living and similar developmental status everywhere in the settlements. Besides, all these settlements are smaller in size with low spacing of hamlets. So population pressure might have lead to even distribution of hamlets in these settlements. There may be several other reasons behind such distribution.

Generally it can be said that in the rugged terrain of these mountainous settlements, the diversification force works, as all the lands are required to be tilled to produce more crops for sustenance of local people which results in such even distribution of hamlets in the villages.

Table 3.4: Pattern of Dispersion of hamlets in the Settlements of Rammam Basin

Pattern of Dispersion	No. of Settlements		Total
	North Rammam Basin	South Rammam Basin	
Cluster ('Rn' Value '0')	05	0	05
Random with tendency towrds clustering ('Rn' Value 1.0 and less)	01	03	04
Random with tendency towrds uniformity ('Rn' Value 1.0-2.0)	17	10	27
Uniform/Even ('Rn' Value more than 2.0)	01	01	02
Total	24	14	38

Source: Computed by the Researcher

Table 3.5: Spacing and Pattern of Dispersion of Hamlets in the Rammam Basin

SL.NO	Settlement	Area (Sq.km)	No. of Hamlets	Spacing (km)	Rn
1	Bhareng	1.9439	2	1.06	2.14
2	Ribdi	3.5591	4	1.01	1.6
3	Okhery	6.4176	6	1.11	0.805
4	Tikpur	7.2126	5	1.29	1.095
5	Siktam	2.0125	2	1.08	1.833
6	Salyangdang	2.1913	3	0.92	1.639
7	Longchok	1.7196	3	0.81	1.852
8	Dhalam	2.1726	3	0.91	1.648
9	Timberbong	4.5658	7	0.868	1.069
10	Upper Fambong	4.1795	6	0.90	1.578
11	Lower Fambong	1.0497	3	0.64	1.632
12	BurikhopRumbuk	5.0767	3	1.39	1.275
13	BurikhopDodok	7.7962	10	0.95	1.070
14	Tharpu	1.7986	5	0.64	1.495
15	Soreng	5.9041	7	0.99	1.146
16	Malbasey	6.5624	5	1.23	1.194
17	Chumgbong	6.0017	8	0.931	1.218
18	Rumbuk	4.2046	3	1.27	1.63
19	Karthok	2.5580	5	0.77	1.617
20	Nayabazar NBA	0.1200	1	0.37	0
21	Nayabazar Forest Block	10.5100	1	3.38	0
22	Soreng Forest Block	22.4800	1	5.09	0
23	Sombaria Forest Block	10.0400	1	3.40	0
24	Hilley Forest Block	33.0800	1	6.20	0
25	Singlila forest	167.6907	12	4.14	0.812
26	Rimbick	14.7800	22	0.88	1.345
27	Namla	2.3067	2	1.15	1.825
28	Lodhama	5.5968	5	1.14	1.075
29	Hatta	4.7591	6	0.96	1.454
30	Kankibong	10.623	10	1.11	1.333
31	Jhepi	4.7753	5	1.05	1.560
32	Lamagaon	5.3300	3	1.43	1.316
33	Kaijalia	2.5900	7	0.65	1.299
34	Samalbong	7.0937	2	2.02	0.699
35	Kolbong	2.9178	2	1.30	1.74
36	Murmidong	4.2572	5	0.99	2.056
37	Karmi	8.5632	2	2.22	0.982
38	Goke	8.7200	10	1.00	1.690

Source: Computed by the Researcher on the basis of data collected from Darjiling Pulbazar C.D.Block Development Office, Gram Panchayat Offices and field survey

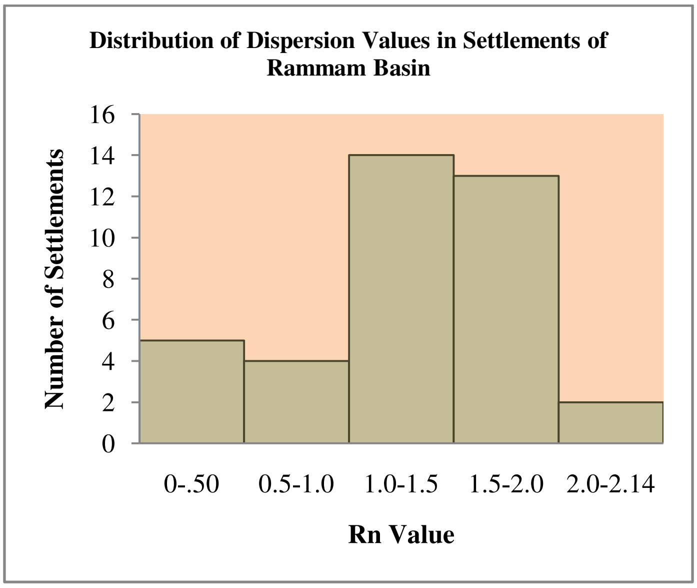


Figure 3.1

Mean=1.2295

Standard Deviation =0.58796

Kurtosis=0.314594

Range = 2.14

Maximum Value = 2.14

Minimum Value = 0

The figure indicates that the distribution is Platykurtic. The highest column exhibits the range from 1.0 to 1.5 followed by 1.5-2.0 which signifies that maximum distribution is towards random to uniformity or regularity (Table 3.5).

3.3. Morphometric Indices

3.3.1. Altitudinal Zones

It is apparent from the contour map (in chapter 2) that altitude in the Rammam Basin varies from 320m near the confluence point of the river Rammam and river Bari Rangit to 3685m at Singalila peak. The altitude of the tract gradually increased from the confluence point located at the eastern end of the tract to west and ultimately it reaches highest at the Singalila Range. As mentioned earlier that the Southern Singalila Range lying on the west of the tract is standing like a boundary wall between the Rammam Basin located in India in the east and Tamur basin located in Nepal in the west. The whole tract has been divided into six altitudinal zones at an interval of 700m. It has been observed that the terraces are located at the altitudes of 400m, 800m, 1500m and 2200m where most of the hamlets are located. Therefore, altitudinal zones have been taken at 700m intervals. The zones are as follows:

A.The **first or lowest altitudinal zone** is lying between the lowest point of the basin near the confluence point of river Rammam and Bari Rangit at an altitude of 320m to 700m altitude. This zone covers an area of 16.48 sq.km (4.08%) and is mainly located on the eastern part of the tract mainly on both sides of the river Rammam. On the western end this zone extends up to the confluence point of river Jhepi and river Rammam.

Spatial Distribution of Settlements in the Rammam Basin

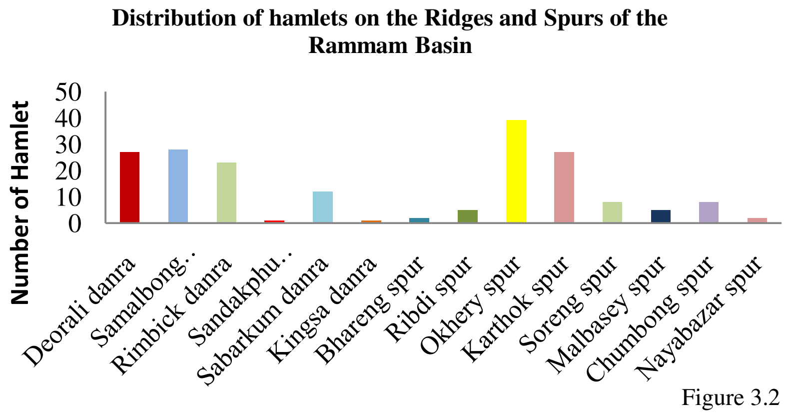


Figure 3.2

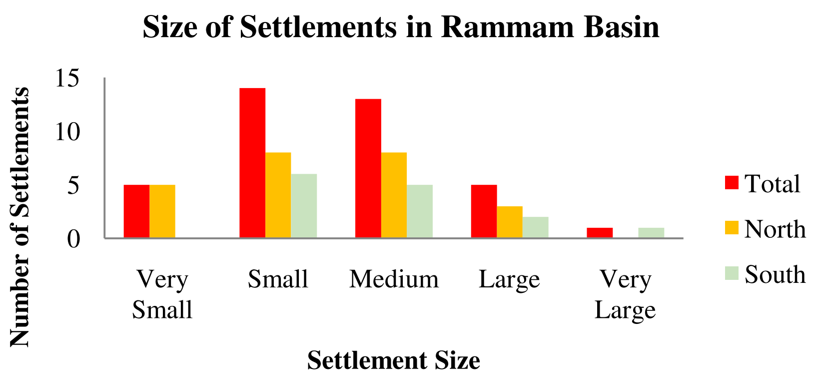


Figure 3.3

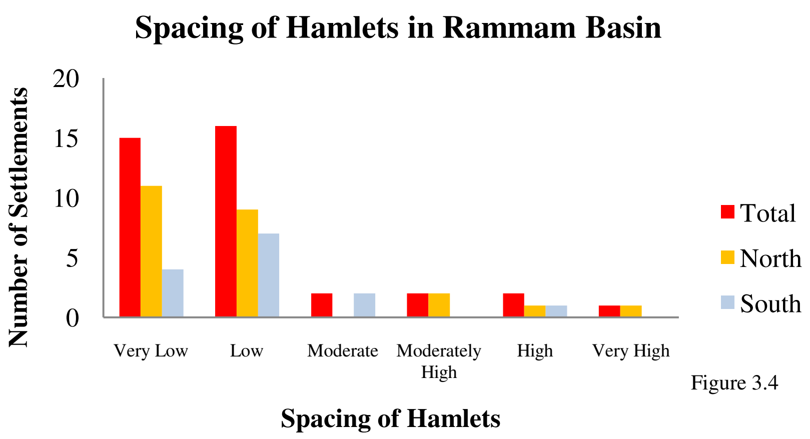


Figure 3.4

Source: Computed by the Researcher

B. The **second altitudinal zone** lies between 700m altitude to 1400m altitude and covers 69.36 sq.km. (17.21%). This zone covers most part of the lower Rammam Basin including parts of the basin of the river Jhepi khola located on the southern part of the Rammam Basin and parts of basins of river Riyong khola and Rani khola located on the northern part of the Rammam Basin. The entire Chumbong hill, lower part of Karthok spur, entire Daramden terrace located on the northern part of Rammam Basin and most part of Samalbong danra and lower part of Deorali danra located on the southern part of the Rammam basin fall under this zone.

C. The **third altitudinal zone,** lying between 1400m to 2100m, covers 82.62sq.km. (20.49%) area of the basin and is spread over the middle part of the basin. This zone covers upper part of Samalbong danra, middle part of Deorali danra and lower to middle part of Rimbick Danra in the southern part of the basin and middle part of Karthok spur, lower middle part and lower part of Okhery spur near Longchok.

D. The **fourth altitudinal zone,** lying between 2100m and 2800m, covers 147.22 sq.km. (36.52%) area of the basin and is spread over the western part of the basin. Most part of Okhery spur, Ribdi spur, Bhareng spur, parts of Hilley Forest Block, Sombaria Forest Block in the northern part of the basin and upper part of Deorali danra, Middle part of Rimbick danra, Sandakphu danra, Sabarkum danra and lower part of Kingsa danra in the southern part of the basin fall under this zone. This is the most widespread zone in the Basin.

E. The **fifth altitudinal zone** is lying between 2800m and 3500m altitude and covers 86.68sq.km (21.50% area) area of the basin. The highest parts of the water divide which is known as Singalila-Sungri ridge lying in between Rammam Basin in the south and the basin of the river Kalej Khola in the north, fall in this zone. In the southern part of the basin this zone covers highest parts of Deorali danra, Rimbick danra, Sandakphu danra, Sabarkum danra and Kingsa danra. This zone is entirely covered with natural vegetation and fall under the jurisdiction of Singalila National Park in the southern part of the basin. This zone is completely uninhabited; only some seasonal Goths (temporary huts of Sherpas used while pasturing their herds of dzoes in the forests) are located in this altitudinal zone.

F. The **sixth altitudinal zone** is lying above 3500m altitude and covers only 0.80 sq.km area which is only 0.2% area of the basin. Small patches of land near Sandakphu, Phalut and Singalila peak belong to this zone. Here lie two famous Mountain View points - Sandakphu and Phalut. In the northern part of the basin, no area falls under this zone (this zone is only confined to the southern part of the basin).

In the first altitudinal zone nine hamlets (4.79%) are located. The second altitudinal zone has highest number of hamlets which is 74 (39.36%). In the third and fourth zone, 72 (38.30%) and 33 (17.55%) hamlets are located respectively. Fifth and sixth altitudinal zones are devoid of any settlement. Distribution of hamlets in the various altitudinal zones has been shown in details in table 3.6.

3.3.2. Clinographic Curve

The Clinographic curve is used to represent the changing gradient directly for the topography of a particular area. Following the computation method as proposed by R. De Smet **(1954)** the gradients of different altitudinal zones in the Rammam Basin have been derived here. As the contour interval of any altitudinal zone has been plotted as 700m, so the gradient of any altitudinal zone can be calculated by the formula $a = \tan^{-1}(i/w)$, where, a = gradient in degrees, i = contour interval and w = average width of the altitudinal zone.

Average width of an altitudinal zone has been determined here after dividing the area of the altitudinal zone by average length of the pair of contours bounding the same zone. Then the direct value of gradient for each altitudinal zone is computed through the formula mentioned above. At last the Clinographic curve is drawn on a graph. The abscissa of the graph is now denoted by cumulative value of average widths, while the ordinate expresses the altitudinal zones.

The graphical construction of Clinographic curve got by above mentioned method has now completed. The graph shows maximum gradient of 56.365° for the highest altitudinal zone of the basin area under study, i.e. the zone above 3500m. This is because of the vertical uprising of the peaks like Sandakphu, Phalut and Singalila (the highest one in the Rammam Basin). On the other hand, the minimum gradient value of 18.806° is represented for the altitudinal zone of 2100-2800m. This is due to the existence of the planation surface around 2600m.The break of slopes of the whole basin area are clearly be understood from the Clinographic curve - at the altitudes of 3500m, 2200m and 700m.

Table 3.6: Distribution of Hamlets in various altitudinal zones

Sl. No.	Part of the Basin	Settlement	Zone I	Zone II	Zone III	Zone IV	Zone V	Zone VI	Total
1	North	Bhareng	0	0	0	2	0	0	02
2		Ribdi	0	0	0	4	0	0	04
3		Okhery	0	0	2	4	0	0	06
4		Tikpur	0	0	4	1	0	0	05
5		Siktam	0	1	1	0	0	0	02
6		Salyangdang	0	3	0	0	0	0	03
7		Longchok	0	2	1	0	0	0	03
8		Lower Fambong	0	3	0	0	0	0	03
9		Dhalam	0	3	0	0	0	0	03
10		Upper Fambong	0	1	4	1	0	0	06
11		Rumbuk	0	1	2	0	0	0	03
12		BurikhopRumbuk	0	0	3	0	0	0	03
13		BurikhopDodaak	0	0	10	0	0	0	10
14		Karthok	0	4	1	0	0	0	05
15		Timberbong	0	4	3	0	0	0	07
16		Tharpu	0	5	0	0	0	0	05
17		Soreng	0	4	3	0	0	0	07
18		Malbasey	0	4	1	0	0	0	05
19		Chumbong	1	7	0	0	0	0	08
20		Nayabazar	1	0	0	0	0	0	01
21		Nayabazar Forest Block	1	0	0	0	0	0	01
22		Soreng Forest Block	0	0	0	1	0	0	01
23		Sombaria Forest Block	0	0	0	1	0	0	01
24		Hilley Forest Block	0	0	0	1	0	0	01
25	South	Singalila Forest	0	0	0	12	0	0	12
26		Rimbick	0	2	15	5	0	0	22
27		Namla	0	1	1	0	0	0	02
28		Lodhama	0	2	3	0	0	0	05
29		Hatta	0	0	6	0	0	0	06
30		Kankibong	0	5	5	0	0	0	10
31		Jhepi	0	2	3	0	0	0	05
32		Lamagaon*	0	0	2	1	0	0	03
33		Kaijalia*	0	7	0	0	0	0	07
34		Samalbong*	0	0	2	0	0	0	02
35		Kolbong	0	2	0	0	0	0	02
36		Murmidong	0	5	0	0	0	0	05
37		Karmi	0	2	0	0	0	0	02
38		Goke*	6	4	0	0	0	0	10
Rammam Basin			**09**	**74**	**72**	**33**	**00**	**00**	**188**
North Rammam Basin			**03**	**42**	**35**	**15**	**00**	**00**	**95**
South Rammam Basin			**06**	**32**	**37**	**18**	**00**	**00**	**93**

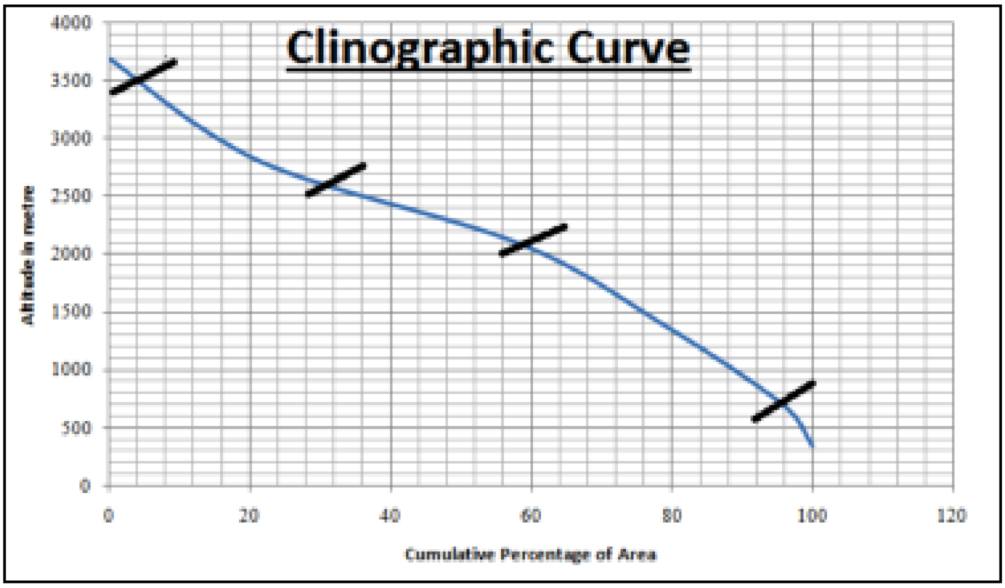
Source: Computed by Researcher

(* Settlements partly under the Basin)

Table No. 3.7: Computation of Clinographic Curve

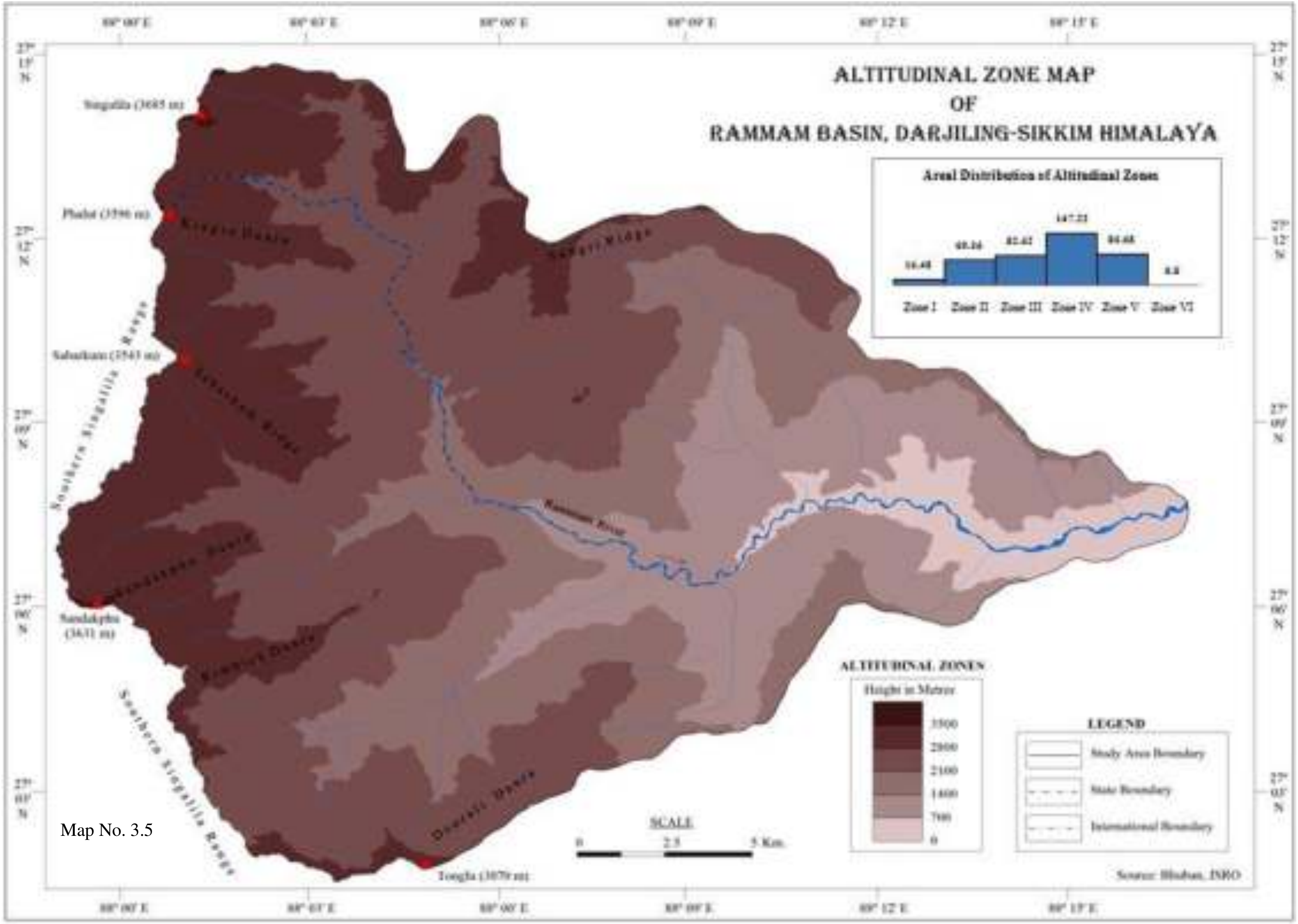
Altitudinal Zone (m): i	Area (sq.m.):A	Area (%)	Cumulative Area (%)	Mean length (m): L	Average width (m) : w = A/L	Gradient in degree $\alpha=\tan^{1}(i/w)$
3500-3685	800000	0.20	0.2	6500	123.077	56.365°
2800-3500	86680000	21.50	21.70	48000	1805.833	21.188°
2100-2800	147220000	36.52	58.22	76000	1937.105	19.868°
1400-2100	82620000	20.49	78.71	62500	1321.920	27.903°
700-1400	69360000	17.21	95.92	45000	1541.333	24.425°
350-700	16480000	4.08	100	32000	515.000	34.200°

Source: Computed by the Researcher



Source: Researcher

Figure 3.5


ALTITUDINAL ZONE MAP
OF
RAMMAM BASIN, DARJILING-SIKKIM HIMALAYA
Areal Distribution of Altitudinal Zones
Zone I
Zone II
Zone III
Zone IV
Zone V
Zone VI
ALTITUDINAL ZONES
Height in Metres
3500
2800
2100
1400
700
0
LEGEND
Study Area Boundary
State Boundary
International Boundary
SCALE
0
2.5
5 Km.
Southern Singalila Range
Map No. 3.5

3.3.3. Relative Relief

Relative relief is the difference between maximum altitude and minimum altitude in a unit of area. This method has been devised by Smith (1930) and is used to show the undulation of the topography. Higher the relative relief means higher the undulation of topography and lower relative relief means lower the undulation of the topography. The formula for calculation Relative relief is as follows:

$RR = H_1 - H_2$

Where, RR is Relative Relief, H_1 is Highest Elevation and H_2 is lowest elevation.

The values of relative relief of this basin vary from 8.65m to 720.91m. Thus lower value of relative relief is favourable for establishment of settlements. The basin under study has been divided into six relative relief zones which are as follows:

A. **Zone I** is the **very low relative relief zone**, showing the values of less than 125m. Two dotted patches of land are under this zone, both located in the northern part of the basin. One is located near the confluence point of Rani khola with river Rammam and another is located near the upper part of Ribdi spur in the northern part of Rammam Basin. This zone covers only 2.61sq.km area (0.647 percent) of the basin.

B. **Zone II** is the **low relative relief zone** the values of which vary between 125m and 250m. This zone covers most portions of the upper Rammam basin as well as lower part of the basin mainly near the valley of the river Rammam. The confluence points of Rani khola and Riyong khola with river Rammam and the confluence point of river Jhepi and Rammam in the lower part of the basin, most part of the Ribdi khola, lower part of Bhareng khola, Kali khola (headstream of river Rammam), the valleys of Rato khola, Siri khola and upper part of Lodhama khola, upper part of Kingsa, Sabarkum, Sandakphu and Deorali danra, the crest line of Southern Singalila Range belong to this zone. This zone covers an area of 114.21sq.km which is 28.33% area of the entire basin area. The settlements Ribdi, Bhareng, in the northern part and Gorkhey, Samanden, Rammam, Lower Daragaon, Dhotrey, some parts of Kaijalia and Karmi in the southern part of the basin are under this zone.

C. **Zone III** is the **moderate relative relief zone**; the values lying in between 250m and 375m. This is the most widespread zone of this basin covering an area of 160.01

sq.km (39.69%) and can be found everywhere. Kathok spur, eastern flank of Bhareng spur, southern flank of Kingsa danra, northern flank of sabarkum danra, Lower part of Sandakphu danra, northern flank of Rimbick danra, northern flank of Deorali danra, lower part of Samalbong ridge fall under this zone. The important settlements located in this zone are Soreng, Daramden and Salyangdang in the northern part and Gurdum, Sepi and Jhepi in the southern part of the basin.

D. **Zone IV** is the **high relative relief zone**. The values of relative relief vary in between 375m and 500m which means at places the difference between maximum and minimum altitude reaches up to 500m in this zone. This zone covers an area of 87.81 sq.km which is 21.78% area of the basin. The zone is spread over the middle and lower part of the Rammam Basin. Part of Chumbong hill, major part of Okhery spur in the northern part and lower part of Sabarkum danra near the settlement Sirikhola, southern flank of Rimbick danra, middle part of Deorali danra and most part of Samalbong ridge except Goke belong to this zone. Important settlements located in this zone are Sombaria, Rumbuk, Buriakhop Dodok, in the northern part of the basin and Sirikhola, Beechgaon, Rajavir, Jawleygaon, Sumbuk, parts of Kaijalia and Samalbong in the southern part of the basin.

E. **Zone V** is the **very high relative relief zone**. The values of relative relief of this zone lie between 500m and 625m. This zone covers 35.45sq.km area which is 8.79% area of the tract. The zone can be found within the zone IV of high relative relief.

F. **Zone VI** is the **extremely high relative relief zone** covering only 3.07 sq.km. area which is only 0.76% area of the tract. The values of relative relief in this zone vary from 625m to 750m. This zone is only concentrated near the settlement Nayabazar (NBA) and upper part of Okhery spur in the northern part of the basin.

3.3.4. Dissection Index

Dissection index of a region is an essential tool by which the evolutionary stage of terrain can be traced. De Smet (1951) gave a formula for computation of dissection index value which is as follows:

Dissection Index = [A- (A′ X Average Slope)]/ Volume of Relief, Where,

A= Real Area between any two contours;

A′ = Projected Area between the same pair of contours,

In 1957, Dov Nir derived a relatively easier formula for computation of dissection index:

Dissection Index = Relative Relief/ Absolute Relief. Thus, the method of Dov Nir became more popular than that of De Smet. The process of computation of index value following the latter formula is quicker too.

The present researcher has used the formula of Dov Nir for determination of Dissection index for the terrain of the Rammam Basin. Computation of the index value has been done for each grid covering one sq km area and then a zonation map has been drawn by plotting isopleths. Thus six Dissection Index zones have been identified all across the basin area with gradual increase or decrease of index value of 0.1.

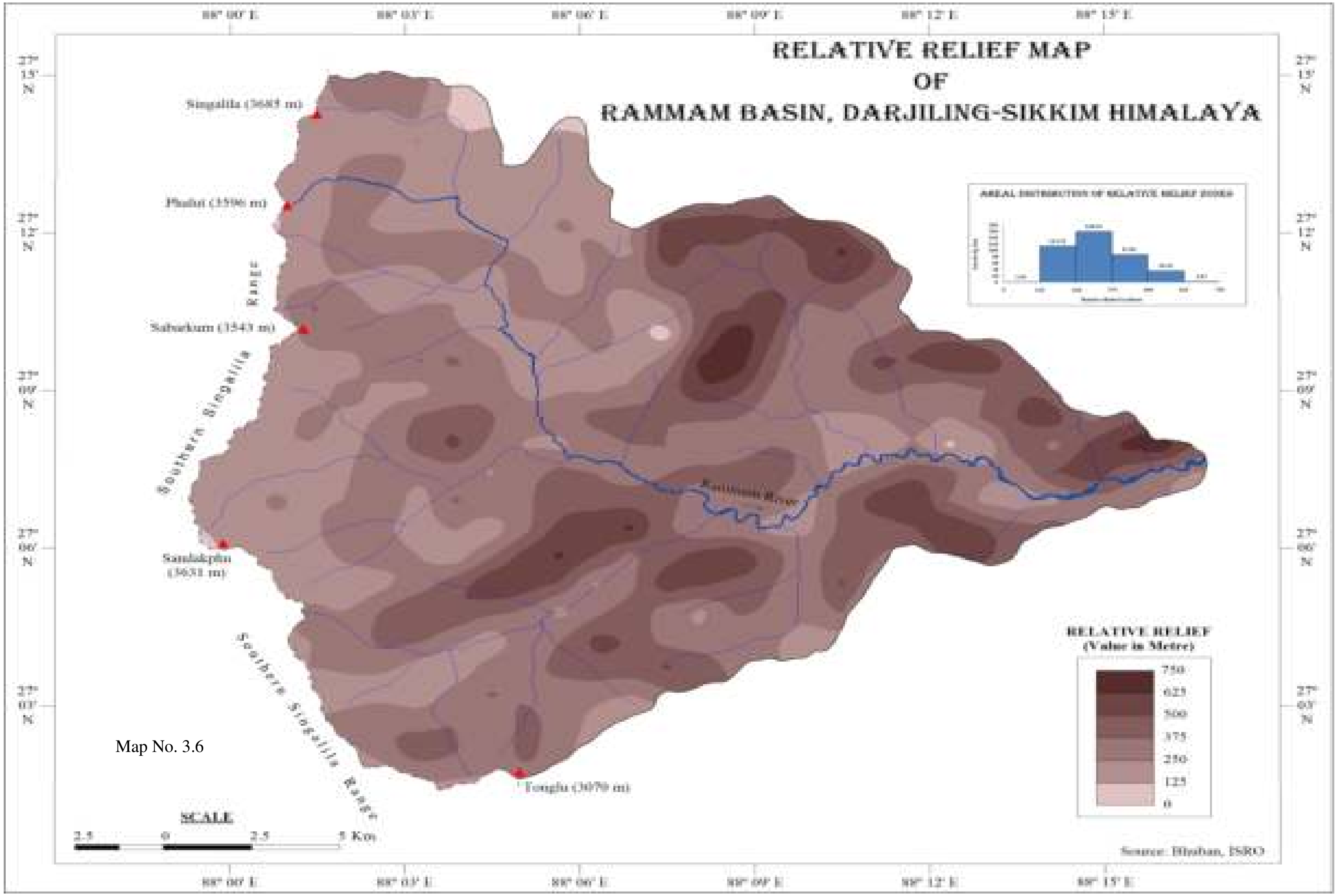
After following Mukhopadhyay’s scheme **(1982)** the significance of the zones regarding the evolutionary stages to be identified is as follows:

Table No. 3.8: Dissection Index Zones

Zone/Zones	Dissection Index value	Stage of Evolution
Zone I	0 to 0.1	Initial
Zone II & III	0.1 to 0.3	Early Youthful
Zone IV & V	0.3 to 0.5	Late Youthful/ Late Mature
Zone VI	Above 0.5	Early Mature

Source: S.C. Mukhopadhyay, “The Tista basin: A Study of Fluvial Geomorphology”, pp. 41-42

Since the basin area under study lies high above the mean sea level and characterised by such a topography which has formed in late Tertiary Period and modified by Quaternary erosional processes, any part of the tract does not exhibit the stage later than Late Maturity.


RELATIVE RELIEF MAP
OF
RAMMAM BASIN, DARJILING-SIKKIM HIMALAYA
Singalila (3685 m)
Phalut (3596 m)
Sabarkum (3543 m)
Sandakphu (3631 m)
Tonglu (3070 m)
Southern Singalila Range
RELATIVE RELIEF
(Value in Metre)
750
625
500
375
250
125
0
SCALE
2.5
0
2.5
5 Km
Source: Bhuban, ISRO
Map No. 3.6

A. Zone I (Initial Stage): The Dissection index value of this zone is less than 0.1.Most part of Upper Rammam Basin, Upper part of Siri khola, Upper part of Lodhama khola, Singalila Range fall in this zone.This zone covers 132.11 sq.km area which is 32.77% area of the basin. The settlements of Singalila Forest, Rammam, Samanden, Gorkhey in the southern part of the basin and lower part of Ribdi and Bhareng are located in this zone.

B. Zone II & III (Early Youthful Stage): With Dissection Index values ranging between 0.1 to 0.3, this zone covers most part of the Middle Rammam Basin. The areal coverage of this zone is 139.31+ 84.67= 223.98 sq. km. which is 55.56% area of the basin. The villages of Rimbick, Namla, Lodhama, Hatta, Kankibong, Jhepi, Lamagaon, Kaijalia, Samalbong in the southern part and Okhery, Tikpur, Siktam, Salyangdang, Upper Fambong, Lower Fambong, Dhalam, Rumbuk, Buriakhop Rumbuk, Buriakhop Dodok, Karthok, Bojek, Tharpu, Timberbong and Soreng in the northern part of the basin are located in this zone.

C. Zone IV & V (Late Youthful): This zone is confined in the lower part of the basin with Dissection Index values ranging between 0.3 to 0.5.The areal coverage of this zone is 31.56 +10.37=41.93 sq.km. which is 10.40% area of the basin. The villages of Kolbong, Karmi and Goke in the southern part of the basin and Malbasey, Chumbong in the northern part of the basin are located in this zone.

D. Zone VI (Early Mature Stage): With dissection index value of more than 0.5, this zone is located in the easternmost part of the basin covering 5.14 sq. km (1.27%) area of the basin. Some parts of Chumbong village and Nayabazar Notified Bazar Area in the northern part and some parts of Goke village in the southern part are located in this zone.

In the first and second dissection index zones have 13 (6.91%) and 54 (28.72%) hamlets respectively. In the third altitudinal zone has highest number of hamlets which is 78 (41.49%). In fourth, fifth and sixth zones 28 (14.89%), 13 (6.91%) and 02 (1.06%) hamlets are located respectively. Distribution of hamlets in the various dissection index zones has been shown in details in table 3.9.

3.3.5. Average Slope

Slopes, defined as angular inclinations of terrain between hill tops and valley bottoms, resulting from the combination of many causative factors like geological structure, absolute and relative reliefs, climate, vegetation cover, drainage texture and frequency, dissection index etc. are significant morphometric attributes in the study of landforms of a drainage basin **(Singh & Srivastava, 1975)**.

The Average slope of Rammam Basin ranges between 0 degree to 88 degree and the entire basin has been divided into six zones at 15 degree intervals. The zones of average slopes are as follows:

A. Zone I – (0°- 15°): This zone is mainly confined to the valley bottoms of the rivers Rammam, Riyong khola, Jhepi khola, lodhama khola, Siri khola and at the tops of the Rimbick danra and Deorali danra. This zone covers 8.02 sq.km. area (1.99%) of the Basin.

B. Zone II – (15°- 30°): This zone encircles the first zone and covers 34.85 sq.km. area (8.64%).

C. Zone III – (30°- 45°): This zone is found on the upper portion of Ribdi and Bhareng spur, along Kingsa danra, Rato khola, Sandakphu danra, Rimbick danra, upper part of Lodhama khola, Upper part of Deorali danra, and along the river beds of Rammam, Riyong khola, Siri khola, Lodhama khola and Jhepi khola. This zone covers 101.45 sq.km. (25.16%) area of the Basin.

D. Zone IV – (45°- 60°): This zone covers most part of the Basin. Part of Soreng-Malbassey-Chumbong hill, western and southern part of Karthok spur, eastern and southern part of Okhery spur, middle part of Ribdi and Bhareng spur, Southern part of Kingsa danra, most part of Sabarkum danra, western part of Rimbick danra, western part of Deorali danra fall in this zone. The area of this zone is 172.87 sq. km. (42.88%).

E. Zone V – (60°- 75°): This zone extends over Nayabazar and Chumbong hill, Malbassey hill, northern part of Okhery spur, the eastern part of Rimbick danra, frontal part of Deorali danra and Samalbong ridge. The area covered by this zone is 85.81 sq. km. (21.28%).

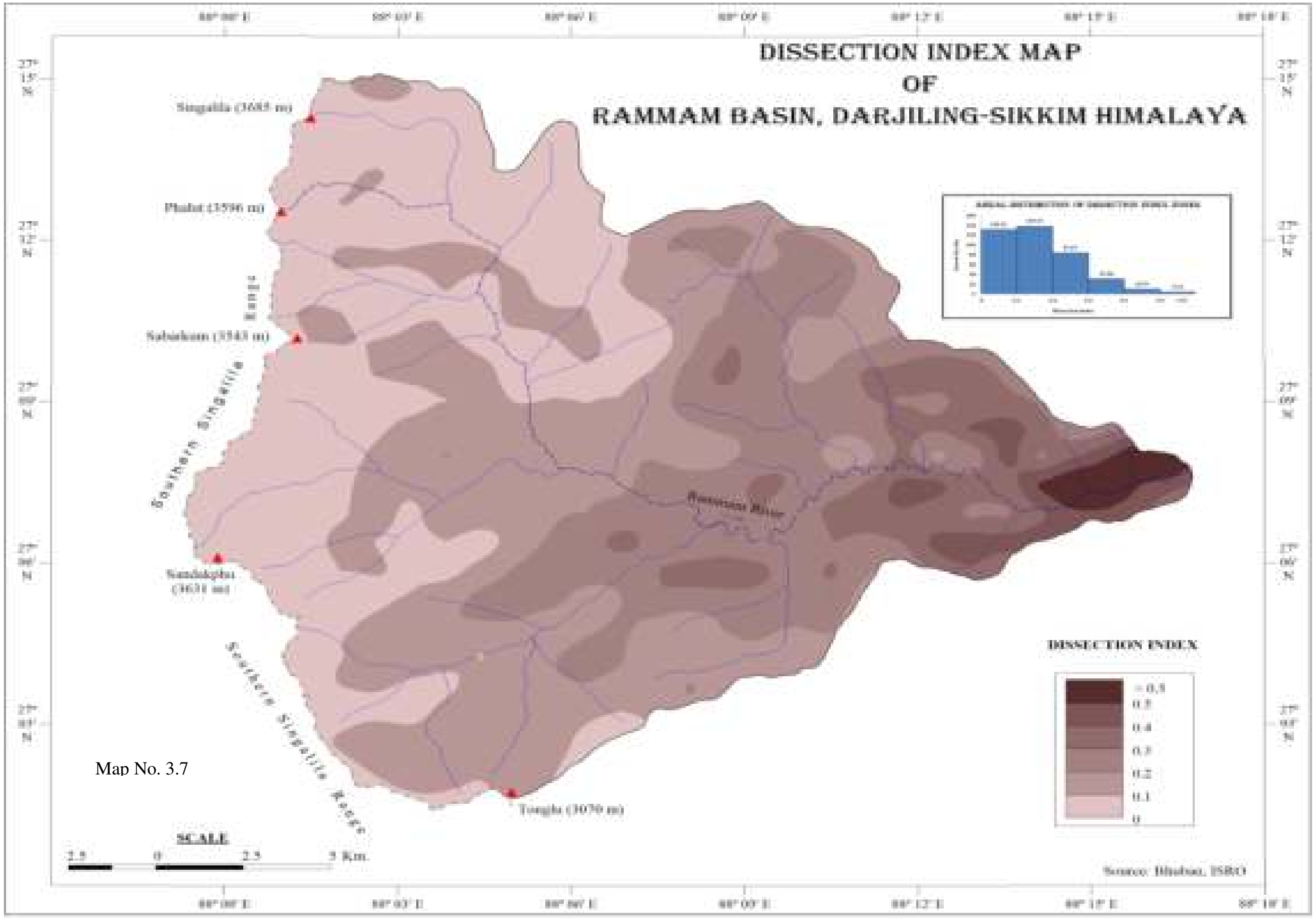
F. Zone VI – (60°- 75°): This zone covers only 0.16 sq.km. area (0.04%) and exists as dots over Nayabazar hill and Okhery spur.

Table 3.9: Distribution of Hamlets in various Dissection Index Zones

Sl. No.	Part of the Basin	Settlements	Zone I	Zone II	Zone III	Zone IV	Zone V	Zone VI	Total
1	North	Bhareng	1	1	0	0	0	0	02
2		Ribdi	4	0	0	0	0	0	04
3		Okhery	3	3	0	0	0	0	06
4		Tikpur	0	3	2	0	0	0	05
5		Siktam	0	1	1	0	0	0	02
6		Salyangdang	0	0	3	0	0	0	03
7		Longchok	0	0	1	2	0	0	03
8		Lower Fambong	0	0	3	0	0	0	03
9		Dhalam	0	0	3	0	0	0	03
10		Upper Fambong	0	1	5	0	0	0	06
11		Rumbuk	0	0	3	0	0	0	03
12		BurikhopRumbuk	0	0	3	0	0	0	03
13		BurikhopDodaak	0	2	8	0	0	0	10
14		Karthok	0	3	2	0	0	0	05
15		Timberbong	0	0	5	2	0	0	07
16		Tharpu	0	0	2	3	0	0	05
17		Soreng	0	0	4	3	0	0	07
18		Malbasey	0	0	0	4	1	0	05
19		Chumbong	0	0	1	2	5	0	08
20		Nayabazar	0	0	0	0	0	1	01
21		Nayabazar Forest Block	0	0	0	0	0	1	01
22		Soreng Forest Block	0	1	0	0	0	0	01
23		Sombaria Forest Block	0	1	0	0	0	0	01
24		Hilley Forest Block	1	0	0	0	0	0	01
25	South	Singalila Forest	4	6	2	0	0	0	12
26		Rimbick	0	9	13	0	0	0	22
27		Namla	0	0	2	0	0	0	02
28		Lodhama	0	4	1	0	0	0	05
29		Hatta	0	6	0	0	0	0	06
30		Kankibong	0	0	7	3	0	0	10
31		Jhepi	0	3	2	0	0	0	05
32		Lamagaon*	0	3	0	0	0	0	03
33		Kaijalia*	0	5	2	0	0	0	07
34		Samalbong*	0	2	0	0	0	0	02
35		Kolbong	0	0	2	0	0	0	02
36		Murmidong	0	0	1	4	0	0	05
37		Karmi	0	0	0	2	0	0	02
38		Goke*	0	0	0	3	7	0	10
Rammam Basin			**13**	**54**	**78**	**28**	**13**	**02**	**188**
North Rammam Basin			**09**	**16**	**46**	**16**	**06**	**02**	**95**
South Rammam Basin			**04**	**38**	**32**	**12**	**07**	**00**	**93**

Source: Computed by Researcher

(* Settlements partly under the Basin)


DISSECTION INDEX MAP
OF
RAMMAM BASIN, DARJILING-SIKKIM HIMALAYA
Phalut (3596 m)
Sandakphu
(3631 m)
Tonglu (3070 m)
Southern Singalila Range
Rammam River
DISSECTION INDEX
> 0.5
0.5
0.4
0.3
0.2
0.1
0
SCALE
2.5
0
2.5
5 Km.
Source: Bhuban, ISRO

Map No. 3.7

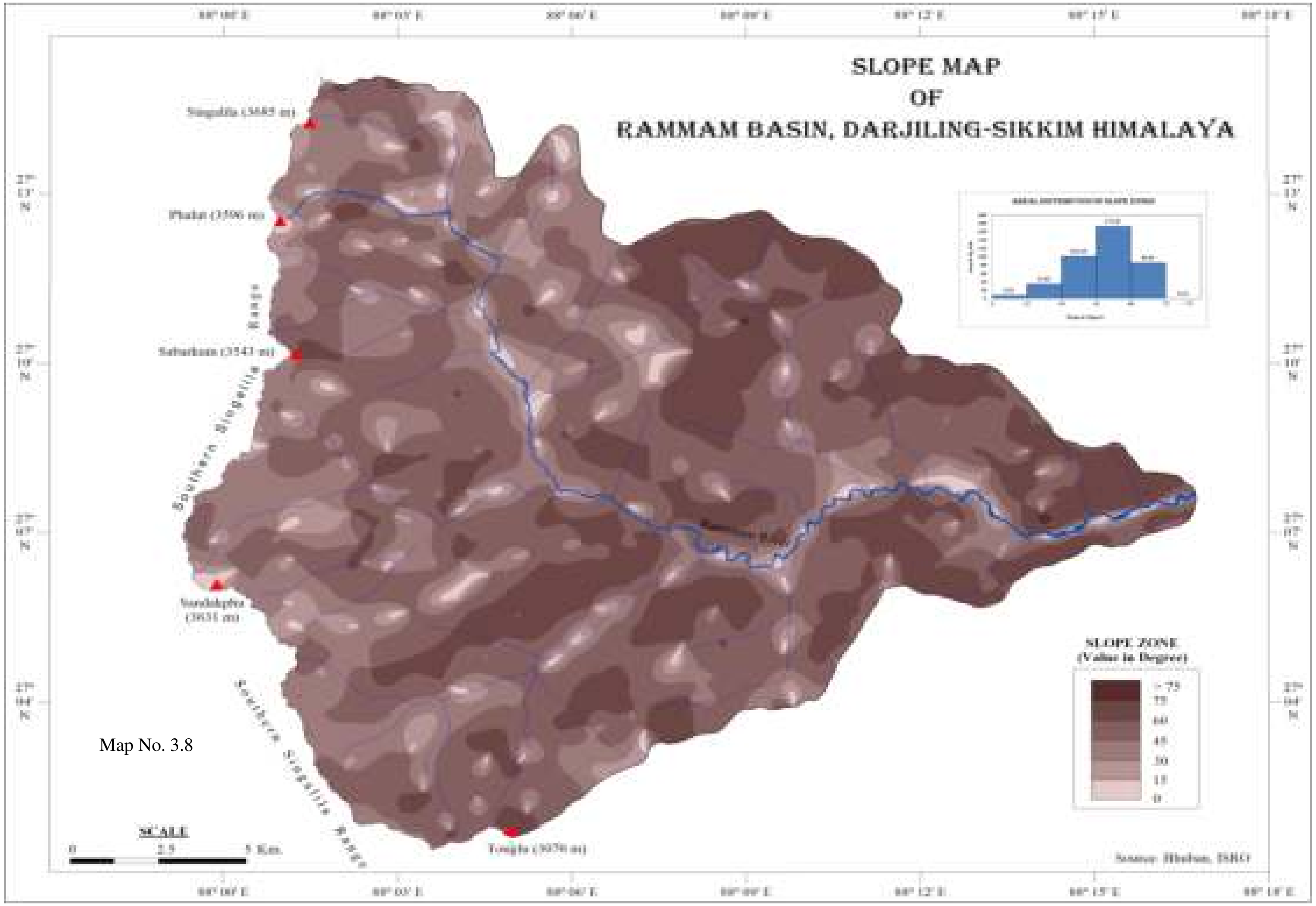

SLOPE MAP
OF
RAMMAM BASIN, DARJILING-SIKKIM HIMALAYA
Southern Singalila Range
SLOPE ZONE
(Value in Degree)
SCALE
Map No. 3.8

Table-3.10: Per Cent of Areas under Different Morphometric Parameters

Zone	Area of Altitudinal Zone in sq.km.	%	Area of Relative Relief Zone in sq.km.	%	Area of Dissection Index Zone in sq.km.	%	Area of Average Slope Zone in sq.km.	%
I	16.48	4.08	2.61	0.65	132.11	32.77	8.02	1.99
II	69.36	17.21	114.21	28.33	139.31	34.55	34.85	8.65
III	82.62	20.49	160.01	39.69	84.67	21.00	101.45	25.16
IV	147.22	36.52	87.81	21.78	31.56	7.83	172.87	42.88
V	86.68	21.50	35.45	8.79	10.37	2.57	85.81	21.28
VI	0.8	0.2	3.07	0.76	5.14	1.27	0.16	0.04
Total	403.16	100.00	403.16	100.00	403.16	100.00	403.16	100.00

Source: Computed by the Researcher

3.3.6. Drainage Density

Drainage density is the ratio between the length of a stream and its area (Horton, R.E., 1932). Applying this formula the area of the Rammam basin has been divided into six Drainage Density zones:

A. **VeryLow Drainage Density Zone**: The value of Drainage Density in this zone is less than 1.25 km^{-1}. Chumbong Hill, Malbasey, Soreng, Karthok Spur, Terrace of Daramden, Parts of Okhery Spur in the northern part of the basin and Terrace of Karmatar in Goke, Kaijalia and eastern part of Rimbick danra exhibit such lowest values. Total area of this zone is 65.60 sq.km.

B.Low Drainage Density Zone: This zone lies between the values of 1.25 $km^{-1}$to 2.50 km^{-1}. Most part of the basin lying below 2000m altitude, especially, along the slopes of the extended spurs, are located in this zone. This zone covers an area of 160.74 sq. km.

C. Moderate Drainage Density Zone: The drainage Density values of this zone lie between 2.50 km^{-1}- 3.75 km^{-1}. The areas lying mostly along the lineation of 2000m belong to this zone. Total area covered by this zone is 116.60 sq.km.

D. Moderately High Drainage Density Zone: The minimum and maximum values of drainage Density in this zone are 3.75 km^{-1} and 5.00 km^{-1}. Parts of Kingsa danra, Sabarkum danra and Sandakphu danra, especially along the steep slopes, lie in this zone. Total area covered by this zone is 60.25 sq.km.

E. High Drainage Density zone: The minimum and maximum values of Drainage Density in this zone are 5.00 km^{-1} and 6.25 km^{-1}. The escarpment over Sabarkum danra and that on the upper parts of Deorali danra are part of this zone. Total area covered by this zone is only 8.92 sq.km.

F. Very High Drainage Density Zone: The areas having Drainage Density value of more than 6.25 km^{-1} are located in this zone. Two small portions of precipice on Sabarkum danra and Deorali danra are located in this zone. This zone covers only 0.65 sq. km.

3.3.7. Ruggedness Index

Ruggedness index is the product of the basin relief and the drainage density.

$$\mathbf{R} = \frac{D\ X\ H}{1000}$$

Where, R = Ruggedness Index, D = Drainage Density, H = Relative Relief (H_1-H_2), H_1 = Highest Elevation, H_2 = Lowest Elevation, 1000 is the constant for metric unit

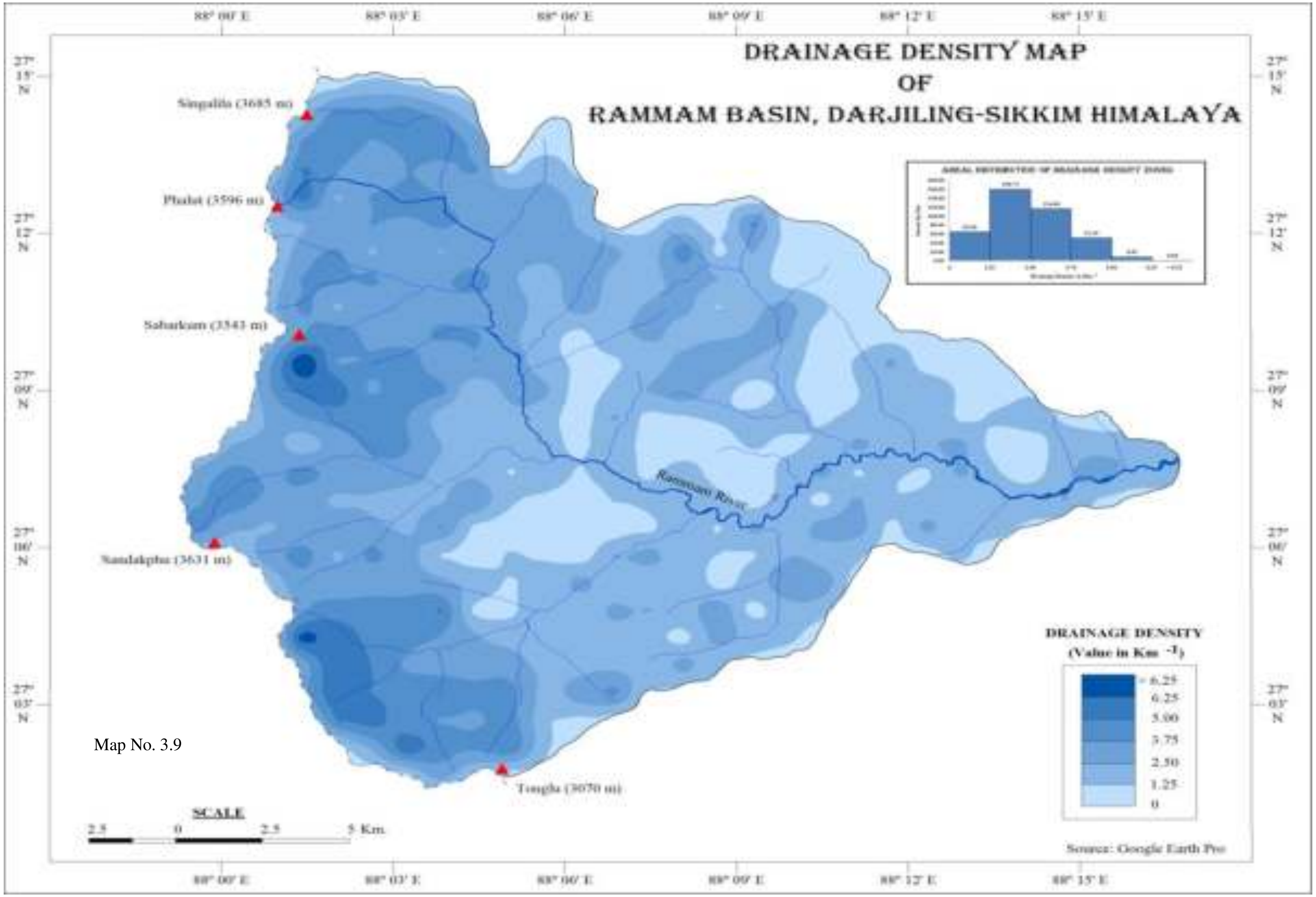
The study area has been divided into six ruggedness index zones which are as follows:

A. Zone 1 is characterized by **very low ruggedness index** value of less than 0.5 and covers 95.35 sq. km. (23.65%) area. Almost all the habitations in the northern part of the basin and habitable part of the Rimbick danra are located in this zone.

B. Zone 2 is characterized by **low ruggedness index** value lying between 0.5 to 1.0 and covers highest area of 213.68 sq. km. (53.00%). Upper part of Okhery spur in the northern part and all parts of southern Rammam Basin except Rimbick Danra fall under this zone.

C. Zone 3 is characterized by **moderate ruggedness index** value lying in between 1.0 to 1.5 and covers an area of 76.04 sq. km. (18.86%). A small patch near Nayabazar, near Okhery spur in the northern part falls in this zone.

D. Zone 4 is characterized by **moderately high ruggedness index** value lying between 1.5 to 2.0 and covers an area of 15.76 sq. km. (3.91%). Upper parts of Okhery spur in the northern part, upper parts of Deorali danra and Rimbick danra in the southern part fall in this zone.


DRAINAGE DENSITY MAP
OF
RAMMAM BASIN, DARJILING-SIKKIM HIMALAYA
Singalila (3685 m)
Phalut (3596 m)
Sabarkum (3543 m)
Sandakphu (3631 m)
Tonglu (3070 m)
Rammam River
DRAINAGE DENSITY
(Value in Km -1)
> 6.25
6.25
5.00
3.75
2.50
1.25
0
SCALE
2.5
0
2.5
5 Km
Source: Google Earth Pro
88° 00' E
88° 03' E
88° 06' E
88° 09' E
88° 12' E
88° 15' E
27° 15' N
27° 12' N
27° 09' N
27° 06' N
27° 03' N
Map No. 3.9

E. Zone 5 is characterized by **high ruggedness index** value ranging between 2.0 to 2.5 and covers an area of 2.23 sq. km. (.55%). Small patches in the upper parts of Okhery spur in the northern part, upper parts of Deorali danra and Rimbick danra in the southern part fall in this zone.

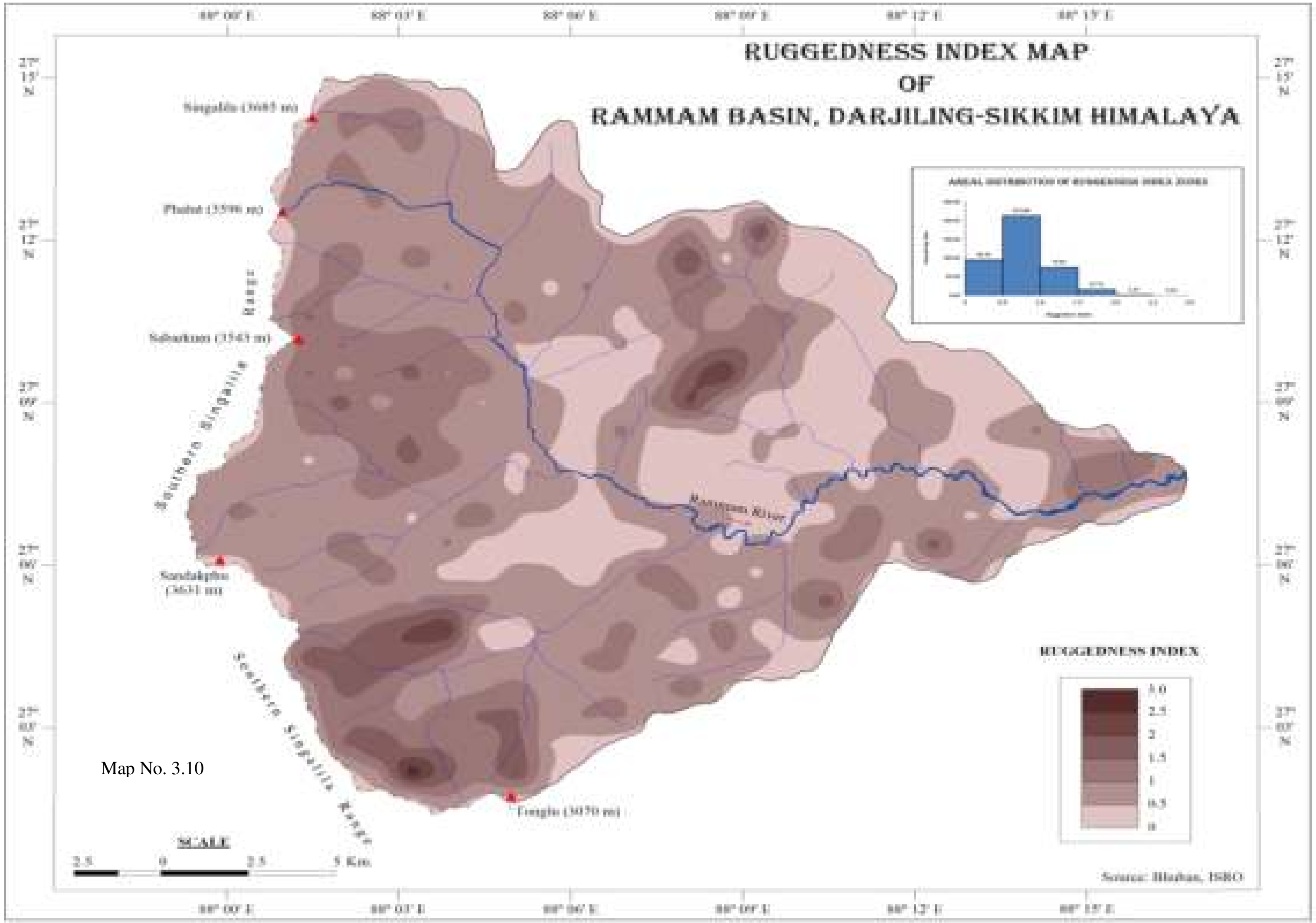
F. Zone 6 is characterized by **very high ruggedness index** value lying between 2.5 and 3 covering an area of 0.1 sq. km. (.03%). A small patch on Deorali danra in the southern part belongs to this zone.

In the first ruggedness index zone 88 (46.81%) are located. In the second ruggedness index zone has highest number of hamlets which is 88 (46.81%). In the third and fourth zone 9 (4.79%) and 03 (1.60%) hamlets are located respectively. Sixth ruggedness index zone is devoid of any settlement. Distribution of hamlets in the various ruggedness index zones has been shown in details in table 3.11.

3.4. Correlation between Spatial distribution and Spacing of Settlements with Terrain Characteristics

In the previous segments spatial distribution of settlements and various morphometric indices have been discussed to understand the overall distribution of settlements and terrain characteristics of the basin. In this segment, the correlation between spatial distribution of settlements and various morphometric indices has been discussed. Among various morphometric indices altitudinal zone, dissection index and ruggedness index have been taken into consideration for showing correlation with distribution of hamlets (zone-wise), spacing of hamlets and dispersion of hamlets in the settlements of the basin. Thus, there are three variables such as altitudinal zone, dissection index and ruggedness index to represent terrain characteristics and three variables namely distribution of hamlets, spacing of hamlets and dispersion of hamlets in the villages to represent spatial distribution of settlements in the basin.

The purpose of finding correlation between the above mentioned variables is to find out whether there is any statistically significant correlation between spatial distribution of settlements and terrain characteristics and at the same time how the variable are correlated. For this purpose Pearson's Correlation Coefficient (r) values have been computed using SPSS software and the scatter plots have been represented.



RUGGEDNESS INDEX MAP
OF
RAMMAM BASIN, DARJILING-SIKKIM HIMALAYA
88° 00' E
88° 03' E
88° 06' E
88° 09' E
88° 12' E
88° 15' E
27° 15' N
27° 12' N
27° 09' N
27° 06' N
27° 03' N
Phalut (3596 m)
Sabarkum (3543 m)
Sandakphu (3631 m)
Tonglu (3070 m)
Southern Singalila Range
Rammam River
RUGGEDNESS INDEX
3.0
2.5
2
1.5
1
0.5
0
SCALE
2.5
0
2.5
5 Km.
Source: Bhuban, ISRO

Map No. 3.10

Table No. 3.11: Hamlets and Ruggedness index Zone

Sl. No.	Part of the Basin	Settlement	Zone I	Zone II	Zone III	Zone IV	Zone V	Zone VI	Total
1	North	Bhareng	1	1	0	0	0	0	02
2		Ribdi	3	1	0	0	0	0	04
3		Okhery	4	2	0	0	0	0	06
4		Tikpur	4	1	0	0	0	0	05
5		Siktam	2	0	0	0	0	0	02
6		Salyangdang	1	2	0	0	0	0	03
7		Longchok	3	0	0	0	0	0	03
8		Lower Fambong	1	2	0	0	0	0	03
9		Dhalam	3	0	0	0	0	0	03
10		Upper Fambong	3	2	0	1	0	0	06
11		Rumbuk	1	1	0	1	0	0	03
12		BurikhopRumbuk	0	0	2	1	0	0	03
13		BurikhopDodaak	2	8	0	0	0	0	10
14		Karthok	3	2	0	0	0	0	05
15		Timberbong	7	0	0	0	0	0	07
16		Tharpu	3	2	0	0	0	0	05
17		Soreng	4	3	0	0	0	0	07
18		Malbasey	5	0	0	0	0	0	05
19		Chumbong	7	1	0	0	0	0	08
20		Nayabazar	0	1	0	0	0	0	01
21		Nayabazar Forest Block	0	0	1	0	0	0	01
22		Soreng Forest Block	1	0	0	0	0	0	01
23		Sombaria Forest Block	0	1	0	0	0	0	01
24		Hilley Forest Block	0	1	0	0	0	0	01
25	South	Singalila Forest	3	7	2	0	0	0	12
26		Rimbick	12	10	0	0	0	0	22
27		Namla	1	1	0	0	0	0	02
28		Lodhama	2	2	1	0	0	0	05
29		Hatta	0	5	1	0	0	0	06
30		Kankibong	1	9	0	0	0	0	10
31		Jhepi	1	4	0	0	0	0	05
32		Lamagaon*	0	3	0	0	0	0	03
33		Kaijalia*	5	2	0	0	0	0	07
34		Samalbong*	1	1	0	0	0	0	02
35		Kolbong	0	1	1	0	0	0	02
36		Murmidong	1	3	1	0	0	0	05
37		Karmi	0	2	0	0	0	0	02
38		Goke*	3	7	0	0	0	0	10
Rammam Basin			**88**	**88**	**09**	**03**	**00**	**00**	**188**
North Rammam Basin			**58**	**31**	**03**	**03**	**00**	**00**	**95**
South Rammam Basin			**30**	**57**	**06**	**00**	**00**	**00**	**93**

Source: Computed by Researcher

(* Settlements partly under the Basin)

The formula of Pearson's Correlation Coefficient is as follows:

$r = (\sum(X_i-\bar{X})(Y_i-\bar{Y}))/\sqrt{(\sum(X_i-\bar{X})^2 \sum(Y_i-\bar{Y})^2)}$

Where,

r =Correlation Coefficient

Xi = Values of the X-variable in a sample

$\bar{X}$= Mean of the values of the X-variable

Yi = Values of Y-variable in the sample

$\bar{Y}$ = Mean of the values of Y variable

The overall hypothesis written in chapter 1 was '***The spatial distribution and spacing of settlements in the study area is closely linked with the terrain characteristics of the basin under study***'. As there are three variables representing terrain characteristics so the Pearson's correlation coefficient (r) values have been found out in the following way:

A. ***Correlation between Altitude and distribution of settlements***

Variables

To find out the correlation between altitude and distribution of hamlets, the whole tract has been divided into six altitudinal zones as discussed in the earlier paragraphs. Then the numbers of hamlets falling in these altitudinal zones have been computed. The mid-value of altitudinal zones are taken as independent variable (x) and the number of hamlets falling in these zones are taken as dependent variable (y).

Hypothesis

Null Hypothesis: H_0: p = 0 (there is no prominent correlation between altitude and distribution of hamlets)

Alternative Hypothesis: H_a: p ≠ 0 (there is correlation between altitude and distribution of hamlets)

Method

To prove the hypothesis Karl Pearson's correlation coefficient (r) has been computed.

Result

The result of Pearson's Correlation analysis revealed that there is moderate negative correlation between altitude and distribution of hamlets in the Rammam Basin [r (4) = -.475, p =.342].

As the "*p* value" is more than .05 (where Level of significance is .05 and 4 d.f), the relationship between altitude and distribution of hamlets in the Rammam Basin is not statistically significant. Therefore, null hypothesis is accepted and alternative hypothesis is rejected.

B. Correlation between Altitude and Spacing of Settlements

Variables

To find out the correlation between altitude and spacing of settlements, altitudes of geocenters of thirty eight villages have been considered as independent variable (x). Then spacing of hamlets in thirty eight villages have been taken as dependent variable (y).

The correlation coefficient (r) has been computed following Karl Pearson's Correlation coefficient method.

Hypothesis

Null Hypothesis: H_0: p = 0 (there is no correlation between altitude and spacing of settlementsin the villages)

Alternative Hypothesis: H_a: p ≠ 0 (there is correlation between altitude and spacing of settlements in the villages)

Method

Karl Pearson's correlation coefficient (r) has been computed.

Result

The result of Pearson's Correlation analysis revealed that there is very weak positive correlation between altitude and spacing of hamlets in the villages of Rammam Basin [r (36) =.130, p =.437]. As the "*p* value" is more than .05 (where Level of significance is .05 and 36 d.f), the relationship between altitude and spacing of hamlets in the villages of Rammam Basin is not statistically significant. Therefore, null hypothesis is accepted and alternative hypothesis is rejected.

C. Correlation between Altitude and dispersion (Nearest neighbor Value R) of settlements

Variables

To find out the correlation between altitude and dispersion of settlements, altitudes of geocenters of thirty eight villages have been considered as independent variable (x). Then nearest neighbor value (R) of thirty eight villages have been taken as dependent variable (y).

Hypothesis

Null Hypothesis: H_0: p = 0 (there is no correlation between altitude and dispersion of settlementsin the villages)

Alternative Hypothesis: H_a: p ≠ 0 (there is correlation between altitude and dispersion of settlements in the villages)

Method

Karl Pearson's correlation coefficient (r) has been computed

Result

The result of Pearson's Correlation analysis revealed that there is almost no correlation between altitude and dispersion of hamlets in the villages of Rammam Basin [r (36) =.008, p =.964]. As the "*p* value" is more than .05 (where Level of significance is .05 and 36 d.f), the relationship between altitude and dispersion of hamlets in the villages of Rammam Basin is not statistically significant. Therefore, null hypothesis is accepted and alternative hypothesis is rejected.

D. ***Correlation between Dissection Index and distribution of settlements***

Variables

To find out the correlation between dissection index and distribution of hamlets, the whole tract has been divided into six dissection index zones as discussed in the earlier paragraphs. Then the numbers of hamlets falling in these dissection Index zones have been computed. The mid-value of dissection index zones are taken as independent variable (x) and the number of hamlets falling in these zones are taken as dependent variable (y).

Hypothesis

Null Hypothesis: H_0: p = 0 (there is no prominent correlation between dissection index and distribution of hamlets)

Alternative Hypothesis: H_a: p ≠ 0 (there is correlation between dissection index and distribution of hamlets)

Method

Karl Pearson's correlation coefficient (r) has been computed

Result

The result of Pearson's Correlation analysis revealed that there is moderate negative correlation between dissection Index and distribution of hamlets in the Rammam basin [r (4) = -.419, p =.409]. As the "*p* value" is more than .05 (where Level of significance is .05 and 4 d.f), the relationship between Dissection Index and distribution of hamlets in the Rammam Basin is not statistically significant. Therefore, null hypothesis is accepted and alternative hypothesis is rejected.

E. *Correlation between Dissection Index and Spacing of Settlements*

Variables

To find out the correlation between Dissection Index and Spacing of hamlets, Average Dissection Index values of the villages have been considered as independent variable (x) and spacing of hamlets in thirty eight villages have been taken as dependent variable (y).

Hypothesis

Null Hypothesis: H_0: p = 0 (there is no prominent correlation between Dissection Index and Spacing of hamlets)

Alternative Hypothesis: H_a: p ≠ 0 (there is correlation between Dissection Index and Spacing of hamlets)

Method

Karl Pearson's correlation coefficient (r) has been computed

Result

The result of Pearson's Correlation analysis revealed that there is no correlation between dissection Index and spacing of hamlets in the villages of Rammam basin [r (36) = -.059, p =.727]. As the "*p* value" is more than .05 (where Level of significance is .05 and 36 d.f), the relationship between dissection Index and spacing of hamlets in the villages of Rammam basin is not statistically significant. Therefore, null hypothesis is accepted and alternative hypothesis is rejected.

F. *Correlation between Dissection Index and Dispersion of Settlements*

Variables

To find out the correlation between Dissection Index and Dispersion of settlements, , Average Dissection Index values of the villages have been considered as independent variable (x) and Nearest Neighbour Values (R) in thirty eight villages have been taken as dependent variable (y).

Hypothesis

Null Hypothesis: H_0: p = 0 (there is no prominent correlation between Dissection Index and Dispersion of settlements)

Alternative Hypothesis: H_a: p ≠ 0 (there is correlation between Dissection Index and Dispersion of settlements)

Method

Karl Pearson's correlation coefficient (r) has been computed

Result

The result of Pearson's Correlation analysis revealed that there is very weak negative correlation between dissection Index and dispersion of hamlets in the villages of Rammam basin [r (36) = -.196, p =.237]. As the "*p* value" is more than .05 (where Level of significance is .05 and 36 d.f), the relationship between dissection Index and dispersion of hamlets in the villages of Rammam basin is not statistically significant. Therefore, null hypothesis is accepted and alternative hypothesis is rejected.

G. Correlation between Ruggedness Index and distribution of settlements

Variables

To find out the correlation between Ruggedness Index and distribution of hamlets, the whole tract has been divided into six Ruggedness Index zones as discussed in the earlier paragraphs. Then the numbers of hamlets falling in these Ruggedness Index zones have been computed. The mid-value of Ruggedness Index zones are taken as independent variable (x) and the number of hamlets falling in these zones are taken as dependent variable (y).

Hypothesis

Null Hypothesis: H_0: p = 0 (*there is no prominent correlation between Ruggedness Index and distribution of hamlets*)

Alternative Hypothesis: H_a: p ≠ 0 (*there is correlation between Ruggedness Index and distribution of hamlets*)

Method

Karl Pearson's correlation coefficient (r) has been computed

Result

The result of Pearson's Correlation analysis revealed that there is very strong negative correlation between Ruggedness Index and distribution of hamlets in the Rammam basin [r (4) = -.862, p =.027]. As the "*p* value" is less than .05 (where Level of significance is .05 and 4 d.f), the relationship between Ruggedness Index and distribution of hamlets in the Rammam basin is statistically significant. Therefore, null hypothesis is rejected and alternative hypothesis is accepted.

H. Correlation between Ruggedness Index and spacing of settlements

Variables

To find out the correlation between Ruggedness Index and Spacing of hamlets, Average Ruggedness Index values of the villages have been considered as independent variable (x) and spacing of hamlets in thirty eight villages have been taken as dependent variable (y).

Hypothesis

Null Hypothesis: H_0: p = 0 (*there is no prominent correlation between Ruggedness Index and Spacing of hamlets*)

Alternative Hypothesis: H_a: p ≠ 0 (*there is correlation between Ruggedness Index and Spacing of hamlets*)

Method

Karl Pearson's correlation coefficient (r) has been computed

Result

The result of Pearson's Correlation analysis revealed that there is moderate positive correlation between Ruggedness Index and spacing of hamlets in the villages of Rammam basin [r (36) = -.531, p =.001]. As the "*p* value" is .001 (where Level of significance is .001 and 36 d.f), the relationship between Ruggedness Index and spacing of hamlets in the villages of Rammam basin is statistically significant. Therefore, null hypothesis is rejected and alternative hypothesis is accepted.

I. Correlation between Ruggedness Index and Dispersion of settlements

Variables

To find out the correlation between Ruggedness Index and Dispersion of hamlets, Average Ruggedness Index values of the villages have been considered as independent variable (x) and Dispersion of hamlets in thirty eight villages have been taken as dependent variable (y).

Hypothesis

Null Hypothesis: H_0: p = 0 (*there is no prominent correlation between Ruggedness Index and Dispersion of hamlets*)

Alternative Hypothesis: H_a: p ≠ 0 (*there is correlation between Ruggedness Index and Dispersion of hamlets*)

Method

Karl Pearson's correlation coefficient (r) has been computed

Result

The result of Pearson's Correlation analysis revealed that there is very weak negative correlation between Ruggedness Index and dispersion of hamlets in the villages of Rammam basin [r (36) = -.225, p =.174]. As the "*p* value" is more than .05 (where Level of significance is .05 and 36 d.f), the relationship between Ruggedness Index and dispersion of hamlets in the villages of Rammam basin is not statistically significant. Therefore, null hypothesis is accepted and alternative hypothesis is rejected.

Table no. 3. 12: Altitude, Dissection and Ruggedness Index Zones and Hamlets

Zone	Altitude (m)	Number of Hamlet	Dissection Index Zone	No. of hamlets	Ruggedness Index Zone	No. of Hamlets
I	350-700	09	0-0.1	13	0-0.5	88
II	700-1400	74	0.1-0.2	54	0.5-1.0	88
III	1400-2100	72	0.2-0.3	78	1.0-1.5	09
IV	2100-2800	33	0.3-0.4	28	1.5-2.0	03
V	2800-3500	0	0.4-0.5	13	2.0-2.5	0
VI	3500 above	0	0.5 above	2	2.5-3.0	0
	Total	188		188		188

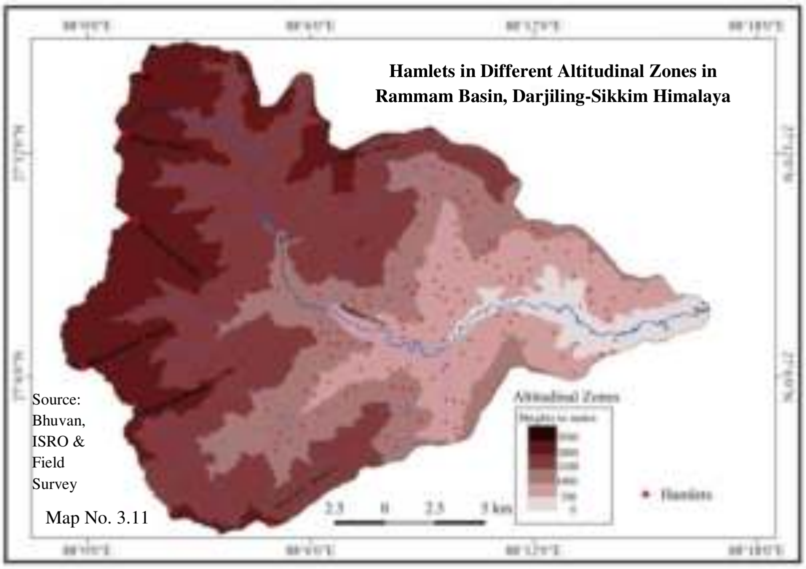
Source: Computed by the Researcher

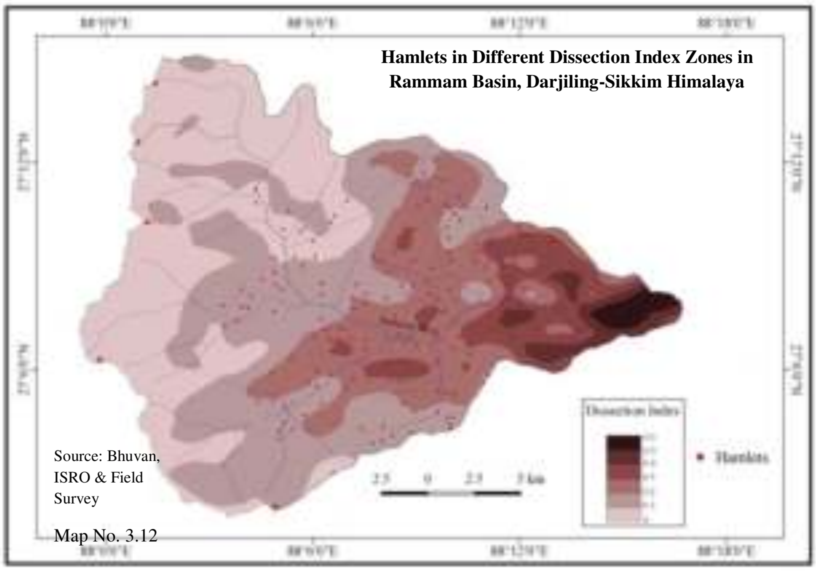
Table 3. 13: Correlation Coefficient (r) between Terrain Characteristics and Spatial Distribution, Spacing of settlements in the Rammam basin

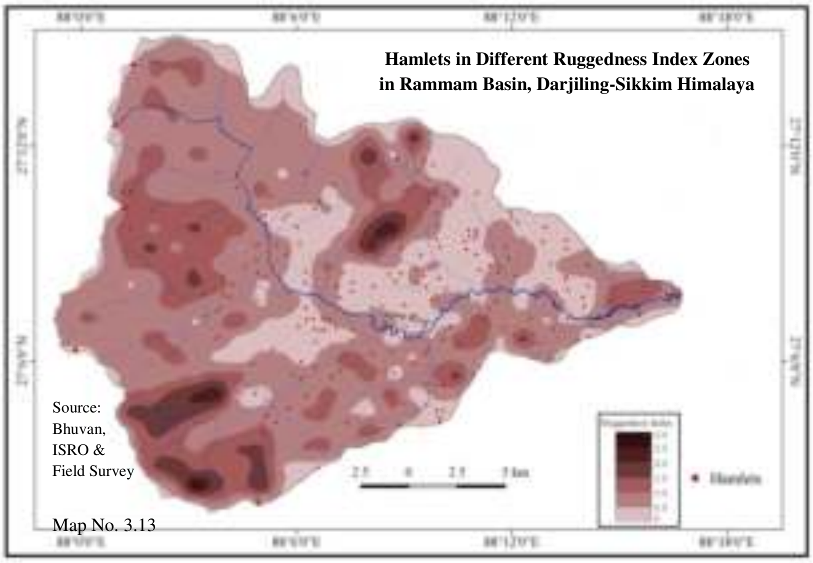
Correlation between	Correlation Coefficient value 'r'	'P' Value	Degree of freedom (n-2)	Whether statistically significant or not	Accepted Hypothesis	Significance Level
Altitudinal Zone and Distribution of Hamlets	-.475	.342	4	Not significant	null	
Altitude of Villages and Dispersion of settlements	.008	.964	36	Not significant	null	
Altitude of Villages and Spacing of settlements	.130	.437	36	Not significant	null	
Dissection Index Zone & Distribution of Hamlets	-.419	.409	4	Not significant	null	
Dissection Index of Villages and Dispersion of settlements	-.196	.237	36	Not significant	null	
Dissection Index of Villages and Spacing of settlements	-.059	.727	36	Not significant	null	
Ruggedness Index Zone & Distribution of Hamlets	-.862	.027	4	significant	Ha	0.05 (two-tailed)
Ruggedness Index of Villages and Dispersion of settlements	-.225	.174	36	Not significant	null	
Ruggedness Index of Villages and Spacing of settlements	.531	.001	36	significant	Ha	0.01 (two-tailed)

Source: Computed by the Researcher

Distribution of Hamlets in Different Morphometric Zones of Rammam Basin







Correlation between Different Morphometric Indices and Zone wise Distribution of Hamlets in the Rammam Basin

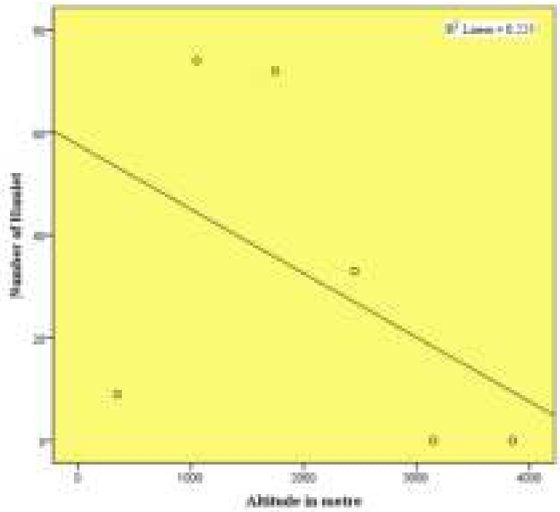


Figure 3.6

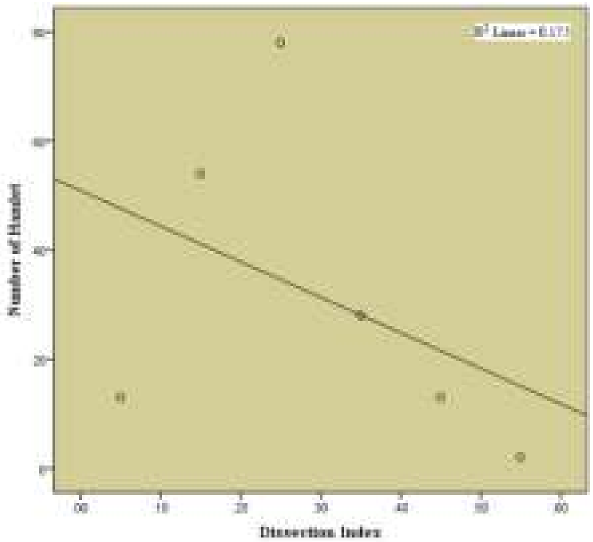


Figure 3.7

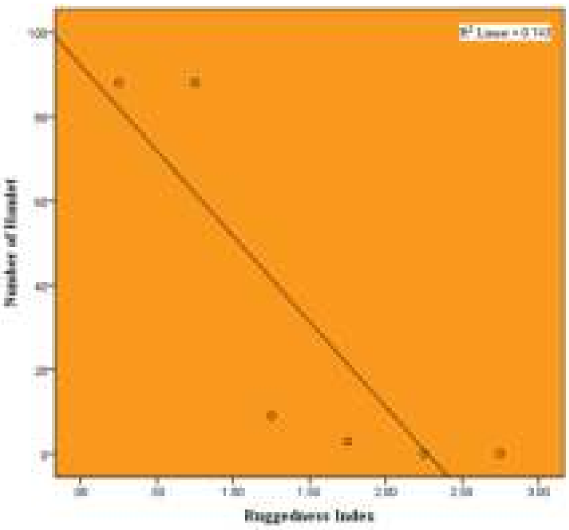


Figure 3.8

Source: Computed by the Researcher

Correlation between Different Morphometric Indices and Spacing of Hamlets in the settlements of Rammam Basin

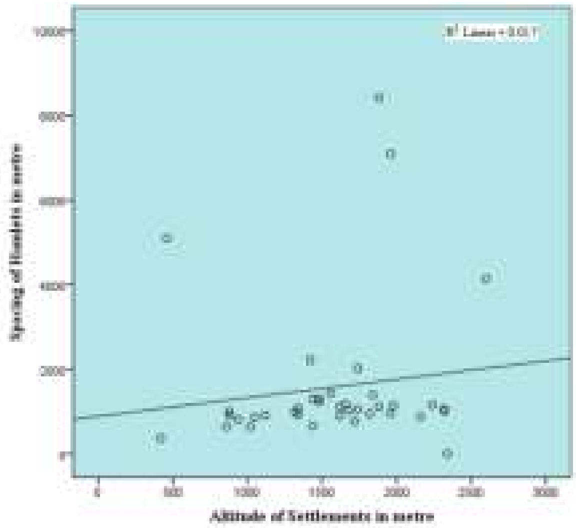


Figure 3.9

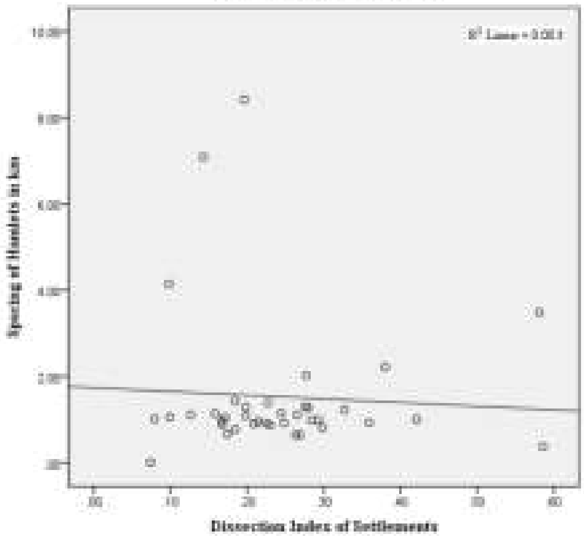


Figure 3.10

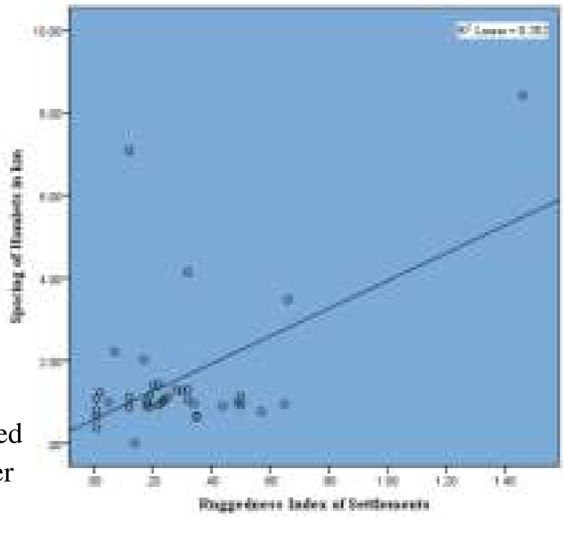


Figure 3.11

Source: Computed by the Researcher

Correlation between Different Morphometric Indices and Dispersion of Hamlets in the settlements of Rammam Basin

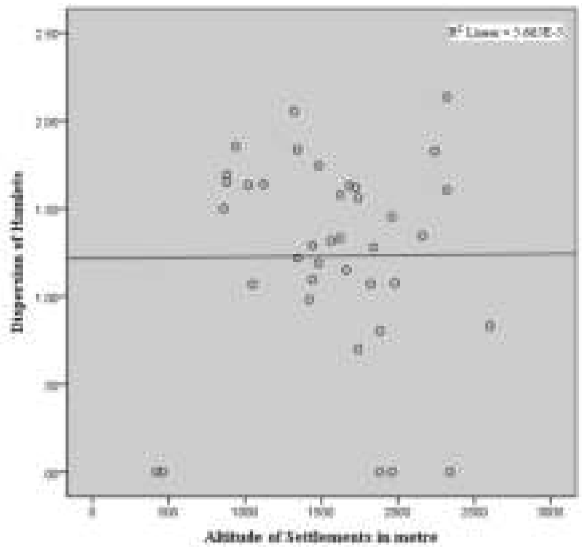


Figure 3.12

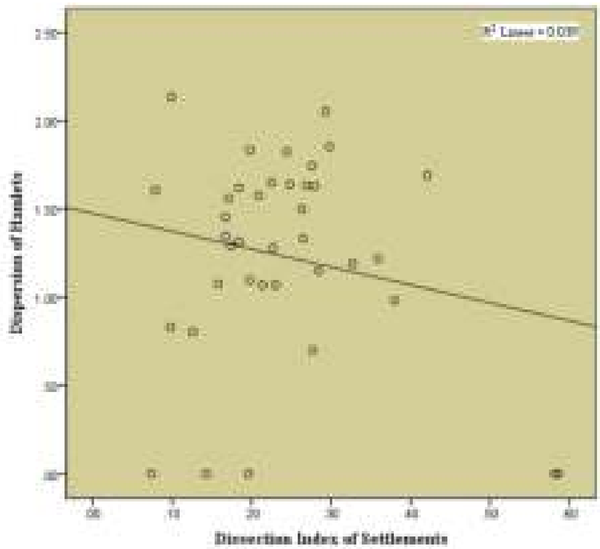


Figure 3.13

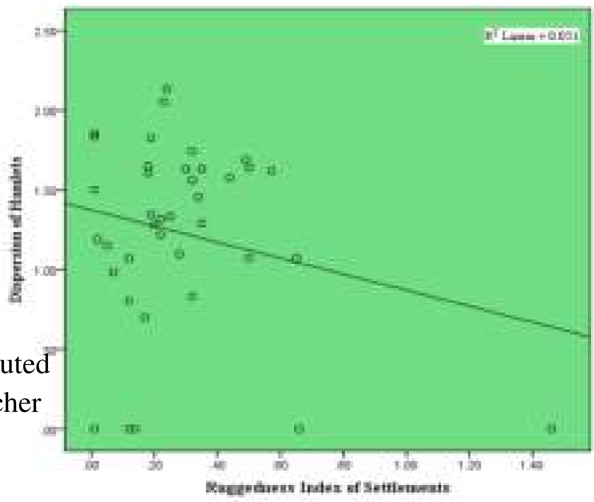


Figure 3.14

Source: Computed by the Researcher

3.5. Conclusion

From the previous discussions the following facts are very much clear that

1. The distribution of hamlets are negatively correlated with altitude, dissection index and ruggedness index of the terrain of Rammam Basin
2. The spacing of hamlets in the villages of Rammam Basin is positively correlated with terrain characteristics such as altitude and Ruggedness index.
3. There is no such correlation between Dissection Index and Spacing of Hamlets in the Villages of Rammam Basin.
4. There are no correlations between altitude and dissection index with dispersion of hamlets in the settlements of Rammam Basin.
5. There are statistically significant negative correlation between ruggedness index and distribution of hamlets and statistically significant positive correlation between ruggedness index and spacing of hamlets.

Overall it can be said that the spatial distribution and spacing of settlements are not closely linked with the terrain characteristics of the basin under study as there are insignificant correlation between most of the variables representing terrain characteristics and spatial distribution, spacing of settlements in the basin under study. Therefore, it can be concluded that distribution of settlements in the basin under study, is guided by factors other than terrain characteteristics of the tract. Suitable temperature and rainfall condition, history of habitation, location of rural service centres might be some factors guiding the distribution of settlements in the basin under study.

References

Barns, J.A. and Robinson, A.H.: "A new Method for the Representation of Dispersed Rural Settlement", Geographical Review, Vol.30, 1940, pp. 134-137.

Census of India, 2011, Series 12, Part XII B, Sikkim, District Census Handbook Registrar General of India, Ministry of Home Affairs, Govt. of India.

Census of India, 2011, Series 20, Part XII B, Darjiling, District Census Handbook Registrar General of India, Ministry of Home Affairs, Govt. of India.

Clark, P.J. and Evans, F.C.: "Distance to Nearest Neighbour as a Measure of Spatial Relationships on Population" Ecology, Vol. 35, 1954, pp.445-453.

Haggett, P.: Locational Analysis in Human Geography, London, Edward Arnold, 1966, pp.107-13.

Mather, E.C.: "A Linear-Distance Map of Farm Population in the United States", Annals of the Association of American Geographers, Vol. 34, Issue 3, 1944, pp. 173-180.

Mukerji, A.B.: "Spacing of Rural Settlements in Rajasthan: A Spatial Analysis", Geographical Outlook (Agra), Vol.1, No. I, April 1970, pp. 1-19.

Mukhopadhyay, S.C.: The Tista Basin: A Study in Fluvial Geomorphology, K.P. Bagchi & Co., 1982, pp. 41-42.

Singh, S. and Srivastava, R.: Geomorphology, Prayag Pustak Bhawan, Allahabad, 1975, pp.379.