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THE LINK BETWEEN RAINFALL AND FOREST CLEARANCE CASE STUDIES FROM WESTERN KARNATAKA

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ABSTRACT : Trend of rainfall and number of rainy days of twenty-eight stations of Western Karanataka and Munnar of Kerala is assessed by (1) 20–year moving averages, (2) progressive averages of five years, (3) comparison of mean of 1966–1975 with long term average of 1906–1975, (4) comparing decennial mean of 1966-75 with those of the earlier decades beginning 1906, (5–6) comparison of below average and 20 per cent. deficit years during 1966-75 with preceding decennial periods. Thus in all twelve criteria are considered, six of rainfall and six of rainy days. Deforestation within an area of 16 Kms around each station is either measured planimetrically by comparison of earlier survey toposheets with recent revised editions or estimated from field observations.

A fairly good agreement is noted between the deforested area and the number of criteria of rainfall and rainy days showing declining trend. Wherever the area of deforestation exceeds 15 per cent. 9 to 11 criteria exhibit waning tendency. Exceptions are the coastal stations where high humidity seems to make good the loss of forest cover. Where disturbance is negligible, not more than 3 criteria show a decrease. Potential forest type of the station and the prevailing vegetation physiognomy do not seem to influence the deforestation-precipitation link.

Introduction

In literature both positive and negative evidence is presented as to the repercussion of forest clearance on the rainfall. Blanford (1888), Charney **et al.** (1977), Fox (1979), Garratt (1978), Green and Minkowski (1977), Kaulin (1962), Legris and Blasco (1969), Noirfalise (1965), Padmavati (1976), Ribbentrop (Cf. Blanford, l. c.), Sarhmah (1976), Schnell (1975), Shubert (1937) and Warren (1974) have brought to light one aspect or the other of the effect of vegetation on precipitation. Contrary cases are also reported. For example, Wadia (1955) pointed out that the forests in the Chinese Turkistan are not attracting rainfall but are dying out themselves due to the trend of augmenting aridity of the region. Feldman (1959) too noted that the precipitation in the forested area of USSR does not depend upon the extent of tree cover.

In the present study we have tried to verify the trend of rainfall and rainy days in relation to deforestation with reference to 28 stations of Western Karnataka and one (Munnar) of Kerala.

Method adopted

The loss of forest-cover within a radius of 16 Kms around each station is noted by comparison of the earlier toposheets of the Survey of India published between 1913 and 1954 at the scale of 1" = 4 miles (or 1" = 1 mile) with the revised toposheets at 1 : 250,000 (and 1 : 50,000) published from 1965 to 1973. In case of Munnar, the Preinvest-

ment Survey Map of Kerala Forests published in 1969 has also been consulted.

Since the revised maps have been published in the period 1965 to 1973, the surveys were carried out in the previous years. Therefore, the period 1965-1975 is best suited to analyse the cumilative effect of deforestation which has been accelerated in recent years to meet the ever increasing need of forest produce and to make room for the hydro-electric and other developmental projects.

The trend of rainfall and number of rainy days is assessed by the following six criteria :

(1) 20-year moving averages, which according to Winstanley (1973) indicate trends.

(2) Mean of the decade 1966–1975 expressed as percentage of the 70–years average of 1906–1975.

(3) Progressive average of the recent years (Cf. Blanford, 1888). Average of five consecutive years is calculated by assigning different weightage to the successive years a, b, c, d, e. Progressive average c' for the third year of the series is given by the formula $(a + 4b + 6c + 4d + e)/16$.

(4) It is noted whether the decennial mean of 1966–75 is the lowest compared to the mean of any of the preceding decennial periods beginning from 1906.

(5) Whether the number of below average years is higher during 1966–75 as compared to the preceding decennial periods.

(6) A below average year may fall short of the mean value by a very large or only a negligible deficit of a few mm. Therefore, the number of years showing a deficit of 20 per cent. or more in 1966–75 are compared with the earlier decades.

Results

The results obtained are presented in Table I. In column 1, the twenty-nine stations have been arranged according to the decreasing order of deforestation. The exact extent of deforestation could not be made out for some stations. For example, around Hassan and Sakleshpur, forests have been devastated due to the construction of recent railway line, yet the boundary of the reserved forests shown on the toposheets do not reflect the ravage suffered by the vegetation which one observes during field studies. The forests around Mercara, Virajpet, Somwarpet and Sirsi are very much interfered with but again the toposheets do not convey the true idea of disturbance. Finally, the reservoirs that are coming up in the vicinity of Titimati, Kollegal, Yellapur and Supa at the expense of large scale forest clearance are not depicted in the revised toposheets. Therefore, these stations for which precise statistics of the area deforested are not available are placed according to estimated area of deforestation.

Along with the name of the station are noted in brackets the number of criteria of rainfall and rainy days that present declining trend out of the total of 12 criteria, 6 of rainfall and 6 of rainy days. The potential forest type and the present day physiognomy of vegetation of each station are also given in column 1. Three potential forest types recognised are evergreen, moist deciduous and dry deciduous (cf. Gaussen **et. al.** 1965). The potential type, originally a dense forest, has been in many cases degraded chiefly by the human agency to various physiognomic stages like savanna-woodland, shrub-savanna thicket, scattered shrubs, cultivation-plantation.

In column 2 is indicated the area that has undergone deforestation. Figures are presented both in ha. as well as percentage of the area reprsented within the radius of 16 kms. In case of coastal stations, part of the area within the radius goes in the sea and therefore the percentage of deforestation with reference to the land area is also calculated.

In the remaining columns are indicated the positive or negative (increasing or decreasing) trends of rainfall and rainy days according to the selected criteria.

Fig. 1: LOCATION OF STATIONS, THEIR VEGETATION POTENTIALITY-PHYSIOGNOMY, AND NUMBER OF CLIMATIC CRITERIA SHOWING DECREASING TENDENCY OF PRECIPITATION IN RECENT YEARS 1966-1975.

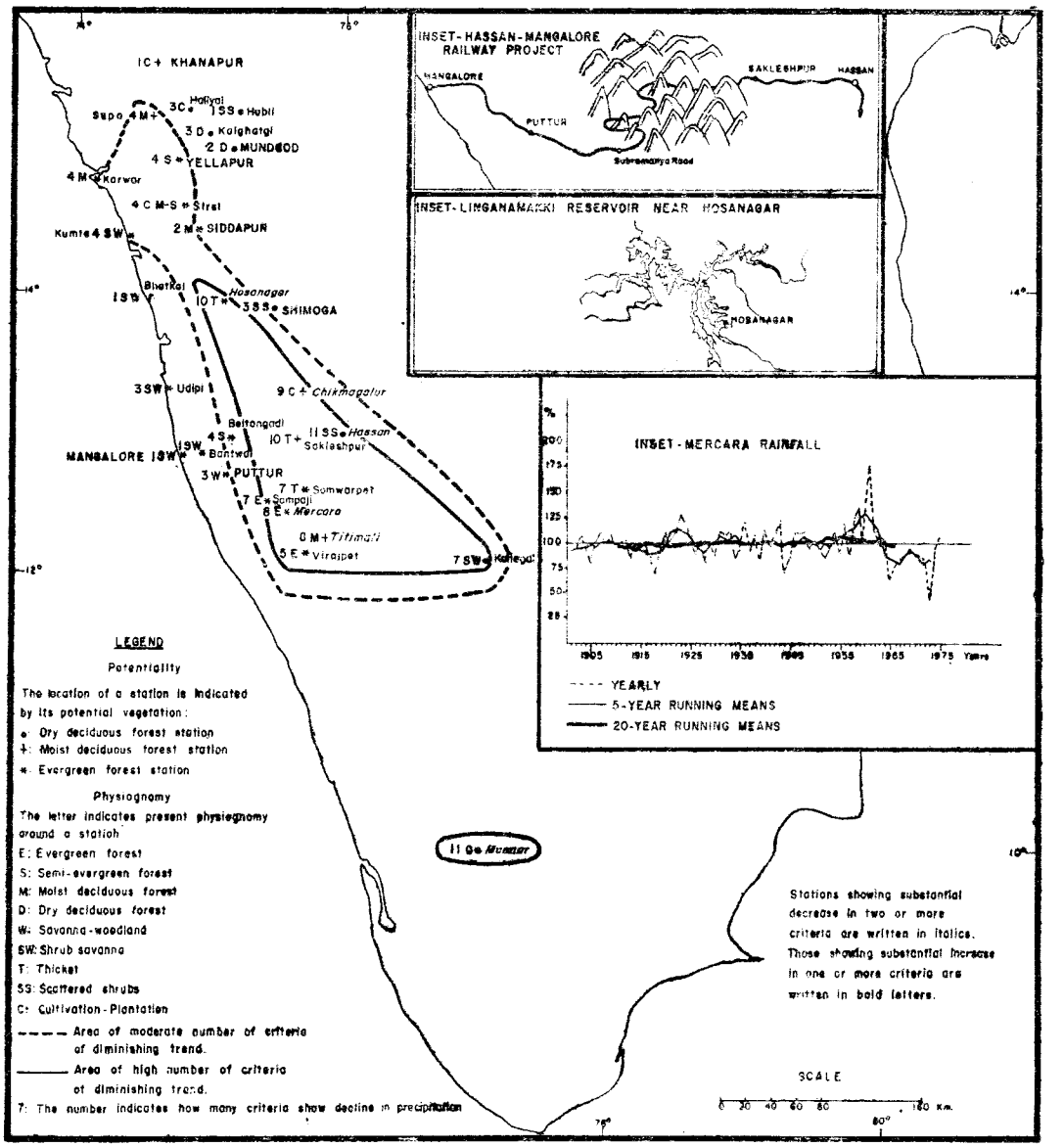

Fig. 1

Discussion

It is seen from Table I that as a rule higher the area of deforestation, more are the number of criteria showing diminishing tendency of rainfall-rainy days. Stations around which considerable forest devastation has taken place, the area affected exceeding 15 per cent. as for example in case of Hosanagar, Sampaji, Munnar, Chikmagalur, 9 to 11 criteria exhibit declining trend. Exceptions are the coastal stations Kumta, Karwar and Mangalore where in spite of considerable loss of forest wealth, the declining trends of precipitation-rainy days criteria are considerably less than warranted by the large area of deforestation. These peculiar cases may be accounted for by the high values of relative humidity due to the vicinity of sea that would compensate for the loss of forest cover. Comparison between Beltangadi, an interior station, and Mangalore, a coastal one, is particularly interesting. The former with 4455 ha of deforestation shows decrease in four criteria whereas the latter with loss of 4290 ha presents decreasing tendency in one criterion only.

Where deforestation has been of no great consequence as at Kalghatgi, Haliyal, Udipi, Shimoga, Siddapur, Mundgod, Hubli, Khanapur, Bhatkal only one to three criteria reveal declining trend.

The stations presenting decrease in five or more criteria form a triangle with Hosanagar, Virajpet and Kollegal forming three corners.

The potential vegetation type does not intervene in the mechanism of link of deforestation with precipitation. In the stations presenting high number of declining criteria, all the three potential vegetation types (evergreen, moist deciduous and dry deciduous) are represented. For example, Munnar showing decrease in eleven criteria is evergreen, Hassan also with the same number of declining criteria is dry deciduous whereas Chikmagalur and Sakleshpur with waning trend in nine to ten criteria bear potential moist deciduous forest.

At the other extremity of decline in only one criterion too, all the three potential types are involved : Hubli is clothed with a dry deciduous forest, Khanapur with moist deciduous, and Bhatkal is in potential evergreen forest belt.

As far as the present day physiognomy is concerned once again it will be noted from the column 1 of Table I that there is no strict correlation between the physiognomy and the number of criteria showing diminishing trend of rainfall–rainy days. In the category of decline in seven criteria, Sampaji is presently an evergreen forest, Titimati a moist deciduous forest, around Somwarpet dominates a thicket physiognomy and around Kollegal savanna–woodland. Another example may be taken from the category of decline in three criteria : Kalghatgi is currently under forest physiognomy, Puttur under savanna-woodland. Udipi presents the aspect of a shrub-savanna, Shimoga of scattered shrubs, and cultivation prevails around Haliyal.

Concluding remarks :

The present paper brings to light the effect of deforestation on the rainfall pattern. Whereas it is not claimed that the decline in precipitation is considerable in the wake of deforestation, the data presented brings evidence of diminishing trends of rainfall and rainy days. A slight delay in the arrival of rains in a wet station like Mercara can cause havoc with the economic crops like coffee and cocoa by upsetting the berry and fruit production schedule as it happened in 1976. This instance emphasises the imperative need to study the climatic variability for the humid zone stations.

No single criterion gives absolutely satisfactory results according to the area of forest disturbed; however, interesting results are obtained when all the twelve criteria are considered together. The present study outlines the absolute necessity of proper conservation of forests of Western India to maintain an equilibrium of the climate.

Table I

Effect of deforestation on rainfall and number of rainy days

Stations and their vegetation types	Area deforested in recent years	20-year moving average of rainfall	20-year moving average of rainy days	Mean of 1966-75 as % of 1906-75		Progressive average		Whether the decennial mean of 1966-75 is the lowest compared to preceding decades		Whether No. of low rainfall years is higher in 1966-75 than in the preceding decades		Whether No. of years low in rainy days is higher in 1966-75 than in the preceding decades	
				Rainfall	Rainy days	Rainfall	Rainy days	Rainfall	Rainy days	Below average	20% deficit	Below average	20% deficit
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hosanagar(10)*E-T	32765 ha(40%)**	+2	-3	-11	-12	Decrease	Increase	Yes	Yes	Yes-3	Yes-3	Yes-3	Yes-1
Kumta (4) E-SW	9680 ha (24%) ***	-1	+3	-11	- 3	Increase	Increase	No	No	Yes-2	No	No	No
Sampaji (7) E-F	18630 ha (23%)	-2	-6	- 2	- 8	Increase	Increase	Yes	Yes	No	Yes-1	Yes-2	Yes-1
Munnar (11) E-P	18225 ha (22%)	-3	-3	- 9	- 7	Decrease	Decrease	Yes	Yes	Yes-2	No	Yes-3	Yes-1
Hassan (11) D-SS	Forest devastation due to construction of railway line	-2	-3	-13	- 9	Decrease	Decrease	Yes	Yes	Yes-1	No	Yes-1	Yes-2
Sakleshpur(10)M-T	,,	-2	-2	- 8	- 3	Decrease	Decrease	Yes	Yes	Yes-1	No	Yes-1	No
Chikmagalur(9) M-C	11745 ha (15%)	-9	-2	-24	- 5	Decrease	Increase	Yes	No	Yes-4	Yes-5	Yes-1	No
Mercara (8) E-P	Forests are disturbed	-1	-2	-15	- 6	Increase	Decrease	Yes	Yes	Yes-4	No	No	No
Titimati (7) M-F	Construction of reservoirs at the expense of forests	+7	-2	- 1	-11	Decrease	Decrease	No	Yes	Yes-1	No	Yes-4	No
Somwarpet (7) E-T	Forests have been disturbed	+1	-4	- 2	- 6	Increase	Decrease	No	Yes	No	No	Yes-1	Yes-1
Kollegal (7) D-W	Construction of reservoirs has led to clear felling	+1	-7	- 2	- 8	Decrease	Decrease	No	Yes	No	No	Yes-3	No
Virajpet (5) E-E	Forests have been interfered with	0	0	- 6	8 5	Increase	Decrease	Yes	No	Yes-1	No	No	No

Table II (contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Karwar (4) E-F	10060 ha (13%)	+3	−1	−1	−6	Increase	Increase	No	No	No	No	No	Yes–1
Supa (4) M-F	A reservoir of an area of about 10,000 ha is coming up (12%)	+2	−1	−8	−5	Increase	Increase	Yes	No	No	No	No	No
Beltangadi (4) E-F	4455 ha (6%)	+1	−2	−2	−6	Increase	Increase	No	No	No	No	No	Yes–2
Mangalore (1) E-SW	4290 ha (5%)	+2	+1	+10	−3	Increase	Increase	No	No	No	No	No	No
Sirsi (4) E-F	Forest conversions and plantations on a large scale	+3	−3	−7	−5	Increase	Increase	Yes	No	No	No	No	No
Yellapur (4) E-F	Construction of reservoirs	+17	−3	+4	−8	Increase	Increase	No	Yes	No	No	Yes–3	No
Bantwal (1) E-SW	2430 ha (3%)	+4	0	+5	−4	Increase	Increase	No	No	No	No	No	No
Puttur (3) E-W	1215 ha (1.5%)	+9	−1	+7	−2	Increase	Increase	No	No	No	No	No	No
Kalghatgi (3) D-F	810 ha (1%)	+8	−0	+7	−5	Increase	Increase	No	Yes	No	No	Yes–1	No
Haliyal (3) D-C	Negligible	+0	+3	−7	−8	Increase	Inceease	No	No	No	No	No	No
Udipi (3) E-SW	,,	+8	−2	+5	−7	Decrease	Increase	No	No	No	No	No	No
Shimoga (3) D-SS	,,	+18	+3	+16	−2	Decrease	Decrease	No	No	No	No	No	No
Siddapur (2) E-F	,,	+11	−1	+9	−2	Increase	Increase	No	No	No	No	No	No
Mundgod (2) D-F	,,	+29	+6	+22	+4	Decrease	Decrease	No	No	No	No	No	No
Hubli (1) D-SS	,,	+5	0	+2	−4	Increase	Increase	No	No	No	No	No	No
Khanapur (1) M-C	,,	+13	+1	+6	−3	Increase	Increase	No	No	No	No	No	No
Bhatkal (1) E-SW	,,	+7	+2	+1	−7	Increase	Increase	No	No	No	No	No	No

* Number of criteria of rainfall and rainy days showing declining trend are given in brackets. Potential vegetation : E = Evergreen forest; M = Moist deciduous forest; D = Dry deciduous forest. Present physiognomy : F = Forest; W = Savanna woodland; SW = Shrub–savanna; T = Thicket; SS = Scattered shrubs; C = Cultivation; P = Plantation.

** Percentage of the area deforested within 16 kms radius is given in brackets.

*** Percentage of the total land area deforested in case of the coastal stations Kumta is 37%, Karwar (24%) and Mangalore (9%).

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