CHAPTER - I

BASES OF IRRIGATION FACILITIES

1.1 LOCATION :

An old Sanskrit text "Vishwagunadarshachampu" written about 1640 A.D. by the author Shri Venkateshwari beautifully describes the state as follows :-

" महाराष्ट्रामिस्थौ मधुरजलाढ्यो निरुपम:
प्रकाशी देशोऽयं सुरपुरविकाशी विलसते ॥
गुहव्या यत्राऽपि गुणजलधय: कैऽपि विभवै :
समृध्दा: श्रध्दातो मुदुरतिथि पूजा विदधते ॥"

"Maharashtra is just like Heaven. There are numerable reservoirs of extremely sweet water for which there is no similarity anywhere else. The people are oceans of virtues and some of them are extremely prosperous. They always serve guests, tourists and others with great devotion", (Maharashtra at a glance,1984).

With the formation of the separate state of 'Maharashtra' on first of May 1960, as a consequence of the state's reorganisation scheme of the Government of India, it is the third largest state in India both in population (6,278,471 - 1981) and area (307,762 sq.kms.). It lies between 15°45' N to 21°1' N latitude and 72°6' E to 80°9' E longitude. Administrative zones, namely Bombay, Poona, Nasik, Aurangabad, Amravati, Nagpur and Konkan. Territorially Maharashtra has Gujarat to its north-west, Madhya Pradesh to its north and east and the states of Andra Pradesh, Karnatak and Goa to its south and Arbian sea to the west (Fig.1.1).

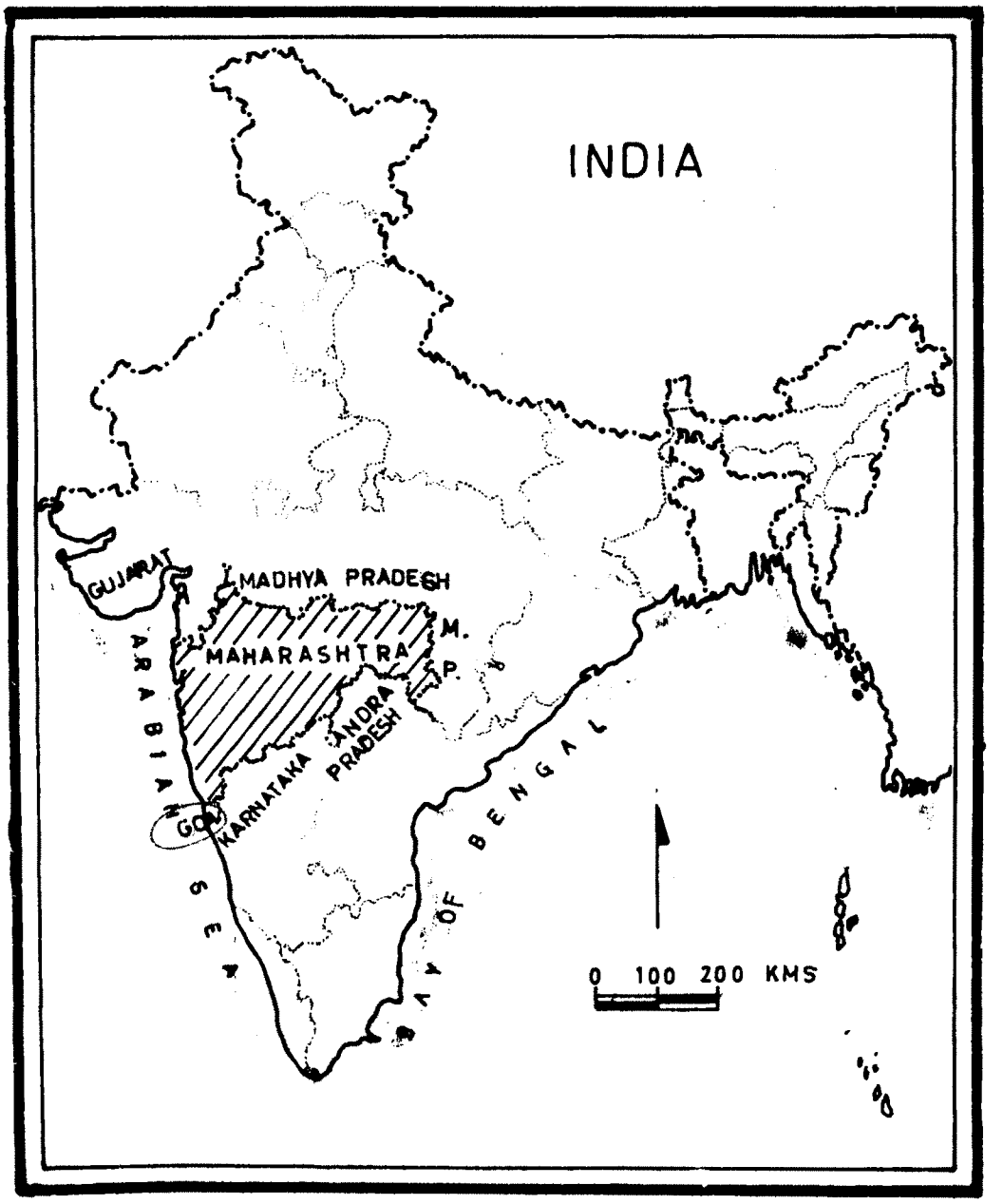
INDIA
GUJARAT
MADHYA PRADESH
MAHARASHTRA
M.
P.
ANDRA
PRADESH
KARNATAKA
GOA
ARABIAN SEA
BAY OF BENGAL
0 100 200 KMS

FIG. 1.1

1.2 PHYSIOGRAPHY AND IRRIGATION FACILITIES :

The origin distribution and utilisation of water resources of any region are profoundly affected by its physical features. As such two out-standing divisions like, vast plateau sloping eastwards and narrow coastal lowland to the west are dominant. Physiographically, the land of Maharashtra can be divided as follows :-

i) The Konkan Lowlands
ii) The Sahyadri Ranges
iii) The Deccan Plateau
iv) The Wardha-Wainganga Valley
v) The Tapi-Purna Basin

i) The Konkan Lowlands

The narrow strip of land between the Arbian sea on the west and the Sahyadri Range on the east is called Konkan (Fig. 1.2). It stretches north-south for 720 kms. and its width ranges between 45 to 75 kms. It is about 31,100 sq.kms. in area. The zone falls into three longitudinal sub-divisions, the coastal belt, the middle tract and the foot hills of the Sahyadri. The heavy monsoon rain during the summer and extreme humidity mark its climate. Its rivers flow transversely. During the monsoon they are ringing torrents, while in other parts of the year they are either rivulets or mostly dry. For irrigating the lands, though coastal belt is suitable, the other two tracts are not suitable due to the rugged topography and steep slopes.

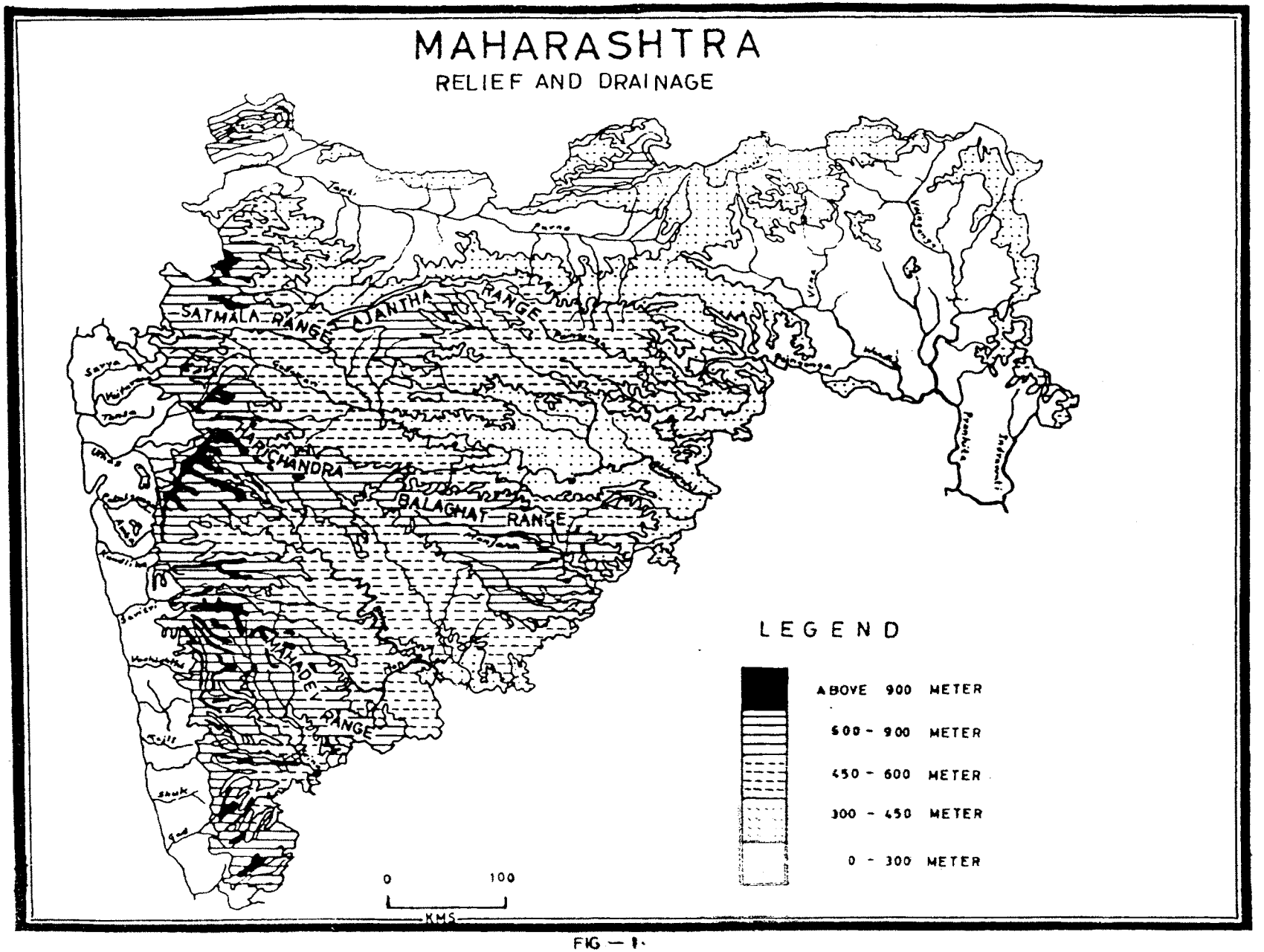
MAHARASHTRA
RELIEF AND DRAINAGE
SATMALA RANGE
AJANTHA RANGE
HARICHANDRA
BALAGHAT RANGE
AMBOLI
RANGE
LEGEND
ABOVE 900 METER
600 - 900 METER
450 - 600 METER
300 - 450 METER
0 - 300 METER
0
100
KMS

FIG — 1.

ii) The Sahyadri Ranges

The Sahyadri forms the watershed between the east flowing streams and the west flowing streams. Sahyadri with an average height of 1,200 metres runs southwards along the western edge of the Deccan Plateau from near the Tapi mouth and extends much further beyond the southern limits of the state. In constrast to its steep western face the range slopes gently east and along the Maharashtra Plateau. Its three main transverse spurs demarcate the major river basin of the state namely Tapi-Purna, Godavari and Bhima-Krishna. The Thalghat and the Bhorghat are the two important passes at the heart of the Sahyadri through which communication lies between the plateau and the Konkan coast land. The other important Ghats are Kumbharli, Amba, Phonda and Amboli. Non the less, this part of the state provides great potentials for the construction of several medium and major irrigation projects.

iii) The Deccan Plateau

Nearly nine-tenths of the area of the state consists of the plateau with its local variation in relief. The average height of the plateau is about 900 meters above sea level with peaks like Mahabaleshwar (1,438 meters), Kalsubai (1,646 meters) recording higher elevations. It is formed by the Sahyadri running north-south to the west and the Satpuda running east-west to the north. The Lava through tropical weathering has produced a soil

known as regur, black in colour and capable of retaining moisture. The plateau is deeply dissected by the eastward flowing Godavari, Bhima, Krishna and their tributaries. The plateau falls in height to less than 300 meters both towards the north and the east. The plateau region is mostly suitable for flow irrigation as well as well irrigation.

iv) The Wardha-Vainganga Valley

In the district of Chandrapur, to the extreme eastern boundary of the state, there occurs a series of detached low hills about 500 metre in elevation. It is also an interior alluvial lowland drained by the Wardha-Vainganga-Pranhita rivers. The Ramtek hill (400 metre) is a representative, through more prominent, features in landscape. The eastern part of this division is suitable for tank irrigation whereas central and western portions are favourable for both well irrigation and flow irrigation.

v) The Tapi-Purna Basin

The Tapi-Purna basin stretching latidunally across northern Maharashtra is located between Satpuda in the north and Satamala, Ajantha in the south. This rift valley slopes from east to west. The Tapi rises near Betul in the Satpuda range in Madhya Pradesh and enters Jalgaon district from the north. The upper Purna also rises in the Satpuda and flows through Amravati, Akola and Buldhana districts and meets the Tapi near Changdev. Like Purna the Bhogavati, the Vaghur,

the Girna and the Bori all join the Tapi when it enters Dhule district. This part of the state is mostly suitable for tube well irrigation due to its identical geological structure.

Geologically, the area of the state nearly coincides with the limits of Deccan trap formation. The areal distribution of various rock formation reveals that about 94% of area is covered by the hard rock formation. It presents many structural complexities which control the mode of occurence of groundwater. The capacity of retaining and transmiting groundwater through hard rock formations is very much limited. The quarternary older alluvial deposits in Tapi-Purna basin provide suitable site for digging tube wells in the state (Maggirwar,1979).

1.3 CLIMATE AND IRRIGATION FACILITIES :

The prerequisite for irrigation is that the conditions for realization of agriculture in other words, for plant growth are satisfied. The main factor in agricultural development may be the degree of coldness and dryness which are related to temperature and rainfall.

The necessity of irrigation is determined by the amount of rainfall during the period when plants grow. Thus demand for irrigation depends on the relation between the seasonal distribution of rainfall and temperature.

The climate of Maharashtra is typically monsoonal in character with 'hot' 'rainy' and 'cold' weather seasons.

North-south stretching Sahyadris is important factor in determining the climate of Maharashtra. The months of March, April and May are the months of maximum heat. The Konkan as well as the plateau wears a parched appearence under intense heat and dry winds. During this season, especially in April and May, thunderstorms are a common feature all over the state. Usually the first week of June is the time for the onset of the south-west monsoon, preceded by days of very sultry weather, thunder showers and heavy gusts of wind. Rains spread out from the south-western and western side all over Maharashtra. July is the wettest month (in the eastern part); August is substantially rainy; by September, the south-west monsoonal current weakens, the skies start clearing and there are less frequent showers. October marks the transition from the rainy season to winter. The general drying up of the land and greater sunshine accompanied by high humidity, produce the familiar phenomenon of 'October Heat'. From November to the end of February, there is a cool dry spell, with clear skies, gentle breezes, and pleasent weather, though the eastern margins of Maharashtra receive some rainfall quite significant for winter crops from the Bay of Bengal cyclones some of which persist for a while even after they cross the coast and travel inland.

A) Temperature

The temperature in the daytime affects the functions of transpiration and photosynthesis; high temperatures of hight cause wasteful respiration. Most crops stop growing at about

5°C, trees and higher plants cease growing when mean monthly temperature is less than 10°C. The temperature in the states changes from season to season and from place to place. Some of the salient features of temperature distribution are as follows :-

a) In cold season daily maximum temperature is 28°C in the coastal belt which rises upto 30°C to 33°C in inland part.

b) In hottest month of a year the mean daily maximum temperature recorded falls between 35°C to 43°C in Vidarbha and 30°C to 33°C along the coast.

c) In rainy season, day temperatures drop appreciably. The diurnal variation is not much remarkable. The daily maximum temperatures recorded fall between 29°C to 31°C in coastal area and 29°C to 38°C in the interior part of the region.

d) During the post-monsoon period the day temperatures show increase in October but thereafter the temperatures drop appreciably. The mean daily maximum temperatures are 29°C to 34°C in the interior and 29°C to 31°C in coastal division.

B) Rainfall - Seasonal distribution

Yearly fluctuation of seasonal or monthly rainfall is very significant for indicating climatic characteristics. As more water is generally required when it gets hot the water requirements of crops vary depending on the temperature conditions in the months in which they must grow.

The major rainfall received in Maharashtra comes from south-west monsoon. June, July, August and September are the rainy months where 70% of the annual rainfall of a year is concentrated. The regional variation in the distribution of rainfall is obvious. The Konkan has an average of 267 cms. Deccan Plateau records 35 cms. to 50 cms., Marathwada 60 cms. and Vidarbha 100 cms.

i) Rainy Season (June to September) : This season starts from 7th June and continues upto the middle of September. It is also known as south-west monsoon period. The major amount of rainfall received in the state is concentrated in this period. Particularly the coastal districts along with Dhule and Amravati district have recorded more than 90% of the total annual rainfall concentrated in this period. Relatively less amount of rainfall is recorded to the east of Western Ghats as this area falls in rainshadow zone of Sahyadri ranges.

ii) Post-monsoon Season (October to November) : Certain amount of rainfall during the month of October is associated with thunder-storms. Very little rainfall occurs in the months of November and December. About 8% to 12% of the total annual rainfall is recorded in the adjacent district to the east of Western Ghats. Insignificant rainfall is recorded in the Vidarbha region.

iii) Cold Weather Season (December to February) : This is the coolest part of the year when continental tropical air prevails over the region. There is very little rainfall, except in the

eastern part of the state which gets only 1 to 4 percent of the total rain. Elsewhere rainfall recorded is very insignificant i.e. less than 2 percent.

iv) Hot Season (March to May) : During this season local sea winds prevail in the coastal district and dry land winds in the interior. This is a period of thunderstorm and thundershowers. Relatively more rainfall i.e. above 9% of the annual total rainfall is recorded in Sangli and Kolhapur districts. Less than 3% in northern and western part of the Maharashtra. Elsewhere it ranges between 3 to 9 percent of the annual rainfall. As will be seen later, the rainfall in its annual amount, seasonal occurrence and regional distribution influence agriculture in Maharashtra by giving its regional orientation as 'rice-lands', 'millet-zone', 'cotton-belts' etc. But its distressing feature is 'variability'. The monsoonal rains in many years do not arrive at the normal time; even if they do, long and unexpected 'breaks' may intervene, or they may arrive late or as heavy downpours and finally there have been some years when the rains have atmost totally failed to materialise. This unpredictable behaviour of the monsoonal rains is common all over Maharashtra, but its impact in terms of economic distress and human suffering is greater in the regions of intermediate and scanty rainfall. Even a partial irregularity or failure of rains in these areas upsets the delicately poised rural economy more than in the wetter parts.

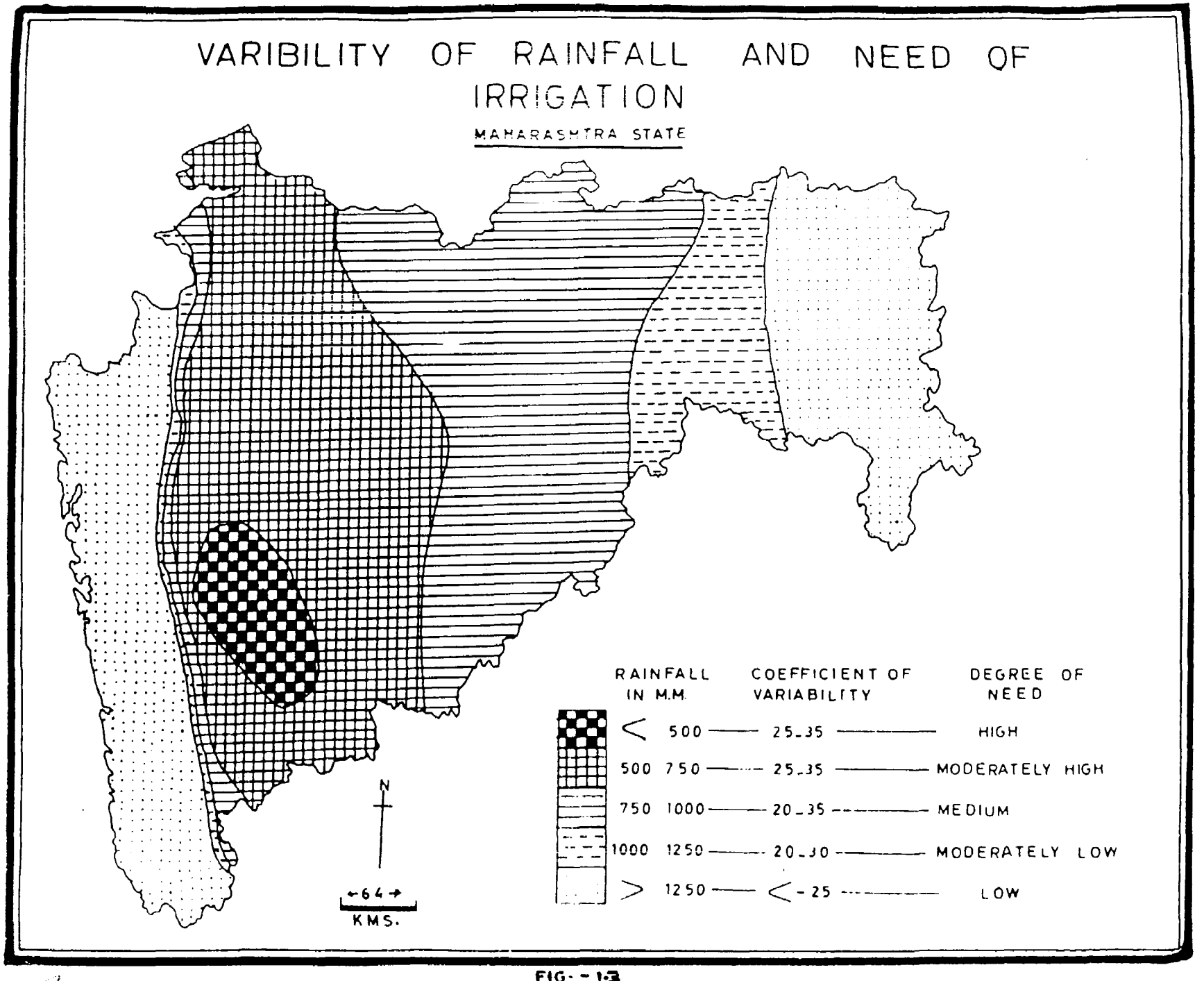
VARIBILITY OF RAINFALL AND NEED OF IRRIGATION
MAHARASHTRA STATE
RAINFALL IN M.M.
COEFFICIENT OF VARIABILITY
DEGREE OF NEED
< 500 — 25_35 — HIGH
500 750 — 25_35 — MODERATELY HIGH
750 1000 — 20_35 — MEDIUM
1000 1250 — 20_30 — MODERATELY LOW
> 1250 — < - 25 — LOW
N
←64→
KMS.

FIG. - 1-3

C) Variability of Rainfall and Need of Irrigation

The co-efficient of variability of rainfall is comparatively low (15 to 20%) only in South Konkan and along the Western Ghats (i.e. along Sahyadri ranges). This is the only region of high reliability of rainfall in the state, where need of irrigation is low. Whereas 20 to 25% variability is observed in the eastern five districts of Vidarbha and western part of the state comprising parts of Thane, Raigad, Ratnagiri, Shindudurg, Poona, Satara and Sangli districts (Fig.1.3). This is the region of slightly high reliability of rainfall and moderately low need of irrigation. On the contrary very high variability of rainfall is confined to the central part of the state stretching in north south direction. This is the drought prone area of the state where reliability of rainfall is very low and need of irrigation is high. Surrounding this region lies the area where variability ranges between 25 to 30 p.c. This is the area of moderate reliability of rainfall (Government of Maharashtra, 1961 Report).

1.4 SOIL AND IRRIGATION FACILITIES :

Soil-plant-water relationship relate to the properties of soil and plants that affect the movement, retention and use of water. Soil provides the room for water to be used by plants through the roots present in the same medium. Water as such and also as a carrier of large amount of nutrients, is required in a large measure for the successful growth of crops. Due to inadequate and uneven distribution of rainfall during the growth

span of a crop, it becomes essential to apply additional water to the soil for plant use in the form of irrigation. The rate of entry of water into the soil and its retention, movement and availability to plant roots are all physical phenomenas. Hence, it is important to know the physical properties of soil in relation to water for efficient management of irrigated agriculture.

Soil : Physical properties influencing irrigation

Soil is a three phase system comprising of the solid phase made of mineral and organic matter and various chemical compounds, the liquid phase called the 'soil moisture and the gaseous phase called the soil air'. The main component of the solid phase is the soil particles, the size and shape of which give rise to pore spaces of different geometry. These pore spaces are filled with water and air in varying proportions, depending on the amount of moisture present. The presence of solid particles, liquid (soil solution) and gas (soil air) constitute a complex polyphasic system. The volume composition of the three main constituents in the soil system varies widely. A typical silt loam soil, for example, contains about 50% solids, 30% water, and 20% air. In addition to the three basic components, soil usually contains numerous living organisms such as bacteria, fungi, algaes, protozoa, insects and small animals which directly or indirectly affect soil structure and plant growth. The most

important soil properties influencing irrigation are its infiltration characteristics and water holding capacity. Other soil properties such as soil texture, capillary conductivity, soil profile conditions, and depth of water table are also given consideration in the management of irrigation water (Michael,1978).

In the Maharashtra's peninsular soil there is a mixture of different rock materials. The fertility of the alluvials soils depends upon the chemical constituents of the rocks from which are derived. The Indian Council of Agriculture Research, Delhi divides the soil of Maharashtra into following main classes.

i) Regur soil ii) Laterite soil

iii) Red soil iv) Alluvium soil

v) Costal Alluvium soil

i) Regur or Black Soil

This soil is called 'Regur Soil' or 'Black Soil' or 'Black Cotton Soil'. It is spread all over the northern central districts of Maharashtra. It has been derived from the old lava deposits and it is among the most fertile soil. It is so rich in plant food. This soil has greatest depth about 60 meter in its deepest parts. They are rich in the iron, lime and alumina. They are poor in phosphorus and organic materials. Black soil is clay to loamy soil composed

largely of clay materials so it is specially suited for cotton and wheat. It is useful for Rabi and Kharif crops. This type of soil is divided in the following sub-types.

a) Shallow black soil b) Medium black soil c) Deep black soil

In black soils the cropping patterns recommended depends on the availability of water. As the soils are fairly rich in plant nutrients and have a high cation exchange capacity, a rich harvest can be expected out of these soils, if they are properly managed. Under efficient water management, coupled with agronomic practices, it is possible to work with these soils both under wet and dry conditions. The advantage of these soils lies in their possessing a high water holding capacity. The disadvantage is their poor drainage and consequent waterlogging. With proper water management these soils can be efficiently managed for successful crop production.

ii) Laterite Soil

This soil is highly infertile and is marked by barren areas where there is no vegetation. It is composed of a little clay and much gravel of red sandstone rocks. It is very poor in phosphoric acid which is the most important plant food for plants like cashewnut and mango. It is well developed on the hilly region. It is common in the areas occupied by the Deccan traps of Maharashtra. This soil is located particularly in the Western Ghats in the districts of Ratnagiri, Sindhudurg and western parts of Kolhapur and Satara.

iii) Red Soil

The red soil is not always necessarily red in colour though frequently it is light red to brown. Generally it is deficient in phosphorus, lime, nitrogen and organic materials. It is moderately fertile for agricultural purposes. It is observed in uplands and hills covered by the Vindhyan and Cuddapah formation and gneisses. This soil is sandy loam in texture. It responds well to irrigation and farm management practices. In the Wainganga, Wardha Valley and adjacent areas soil is sandy and red. This soil is locally known as 'Dhata' and 'Wardi'. This type of soil is divided in the following sub-types. a) Deep red soil b) Medium red soil c) Light red soil.

The water retention properties of black and red soils differ from region to region. The water retention capacity at high moisture tensions is greater in the black soil than that in the red soil.

iv) Alluvium soil

This soil is formed by the transportation of the streams and rivers and deposition over the flood plains or along the coastal belts. It represents the vast tract of Tapi-Purna, Godavari, Bhima, Krishna and the tributaries plains. It is most fertile for growing food crops and sugarcane. The alluvium soils have fairly good water holding capacity and are easily

manageable from tillage and water management points of view. Unless badly affected by salts and poor drainage, these soils are fertile and respond well to manuring.

v) Coastal Alluvium Soil

It is mostly found in the coastal belt. It extends in varying widths between the Arabian sea and the Western Ghats hills along the west coast. Some of the areas are found unfit for any useful cultivation. In Maharashtra, Konkan coastal lowlands are covered by a mixture of coastal and river alluvium. They are mostly sandy loams often irrigated with well water and used for raising rice and vegetables. The soil becomes sandy along the immediate shores of the sea and is devoted to palm-groves and casuarina plantations that act as wind-breaks.

1.5 AGRICULTURAL IMPLEMENTS AND IRRIGATION FACILITIES :

The tools and implements used by the Maharashtra farmers are few in number, smaller in size, crude and antiquated in character. The implements used in Maharashtra are light portable and within the capacity of drought oxen.

But with the introduction of high investiment, intensive agriculture and multiple cropping, it has become essential to ensure timely operations of satisfactory quality that can only be achieved by using efficient and well-adopted machinery and implements.

Now adays Maharashtrian farmers have started using extensively power driven machines, electric motors, diesel engines etc. Table 1.1 shows Agricultural machinary and equipments in Maharashtra.

Table 1.1 : Agricultural machinary and equipment in Maharashtra.

Sr. No.	Description	1960-61	1965-66	1970-71	1980-81
1	Pumps				
	Electric	7,100	37,979	169,778	378,009
	Diesel	63,747	146,786	172,003	165,827
2	Tractors	1,427	3,274	6,697	12,348
3	Plough				
	Wooden	1,678,000	1,765,000	1,780,000	1,919,000
	Iron	398,000	466,000	527,000	575,000
4	Sugarcane Crushers				
	Power divers	7,155	7,371	5,864	7,467
	Bullock drivers	8,647	10,323	2,884	2,023
5	Plant protection Equipments	N.A.	N.A.	45,847	117,086

SOURCE : Epitome of Agriculture in Maharashtra, 1984-85.

The advent of intensive cultivation has increased the demand for tractors. While wheel tractors in the range of 20 H.P.

are used for cultivation on farms of 25 to 50 acres; crawler tractors and bigger wheel tractors are used for land levelling, deep polughing and other kinds of soil and water conservation measures. Power tillers and small walking tractors with horse powers ranging from 5 to 8 are suitable for wet land cultivation, where the smallness of holdings with intervening buds and irrigation ditches would render the four wheeler tractors difficult to operate. These are very versatile and can be used for power pumping, spraying, harvesting and transport with appropriate attachment.

The promotion of improved implements can be encouraged if the government assumes the responsibility for undertaking research, testing, standardisation, production of proto-types, financial support, quality control, development of infrastructure and demonstration.

It is also necessary to see that our water supplies are put to utmost efficient use. Water management is regarded as a 'must' in agricultural technology. Water management has to be accompanied by suitable use of agricultural implements, crop patterns and crop rotation, use of high yielding seeds,application of adequate and appropriate quantities of chemical fertilisers, adoption of improved scientific agricultural practices, designing proper layout for irrigated farming are extremely important for optimum use of available water supply (Mamoria,C.B. 1979).

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