

REPORT
ON
MINOR IRRIGATION WORKS
IN
ASSAM STATE



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COMMITTEE ON PLAN PROJECTS
IRRIGATION TEAM
NEW DELHI

September, 1965

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LETTER

M. THIRUMALA RAO, M.P.
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Committee on Plan Projects

Camp: Care Hotel Wyndham,
42, West 58th Street,
NEW YORK-19.

Dated the 27th November, 1965.

My dear NANDA JI,

The Irrigation Team of Committee on Plan Projects has completed the study of minor irrigation works in the State of Assam. A report thereabout is enclosed for your perusal.

Assam is a heavy rainfall area and generally need for irrigation is not keenly felt. Only when there is a drought or long break in monsoon there is need for irrigation.

A single crop of paddy usually matures on normal rainfall. A second paddy crop can sometimes be raised successfully where irrigation facilities exist or can be improvised. Still optimum use of irrigation works so far built does not seem to have been made. Recording of irrigation, and water assessment do not exist in the State. If steps are taken for systematic assessment of benefits from irrigated agriculture, it would help introducing systematic second cropping in irrigated areas, leading to better productivity per acre.

Possibilities of introducing sugarcane cultivation in suitable areas, where irrigation facilities can be provided has been discussed in the report. The State will do well to give due consideration to the recommendations of the Team as also to extension of tea gardens and horticulture programme in such areas, where irrigation is possible.

Assam also suffers from the practice of shifting cultivation commonly called 'Jhum'. If such areas are utilised for fruit growing on commercial scale, better use could be made of the lands available apart from helping soil conservation.

A complacency seems to exist in Assam with regard to the promotion of agricultural production, presumably because the State is self-sufficient in food. If properly planned irrigation works are located and made use of, the State can help the national agricultural production programme significantly. Even unirrigated areas can produce more. Team's recommendations have been directed towards such an objective to be achieved.

I take this opportunity to express our gratitude to the State authorities for extending to the Team their cooperation in conducting the studies.

With best regards,

Yours sincerely,

M. THIRUMALA RAO

Shri Gulzarilal Nanda,
Minister of Home Affairs,
NEW DELHI.

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P R E F A C E

Study of Minor Irrigation Works in Assam was conducted by the Irrigation Team, Committee on Plan Projects, Planning Commission as part of the programme laid down in the Terms of Reference communicated *vide* Committee on Plan Projects Memorandum No. COPP/(4)/17/58 dated the 4th August 1958 (Appendix I). The Irrigation Team comprised Shri M. Thirumala Rao, M.P., Leader, Shri Baleshwar Nath, Chief Engineer, Member, Dr. Arjan Singh, Retd. Director of Agriculture, Punjab, Member, Shri Mahavir Prasad Irrigation Advisor, Ministry of Food & Agriculture Govt. of India, Member (Ex-officio).

A preliminary meeting was held with the State authorities at Shillong on April 24, 1965. Minutes of this meeting are given in Appendix II. The Team subsequently visited a number of minor irrigation works of various types and under the control of various agencies constructed during the different five year Plans.

The studies conducted primarily aimed at getting techno-economic appraisal of the works, as also their maintenance, irrigational practices and performances and overall benefits accruing to the community.

The scope of irrigation in Assam is only limited. During the field visits discussions were held with the State Officers at various levels, more particularly with regard to the scope and utility of irrigation works in the State. The report reflects, by and large, the concensus of discussion so held.

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CHAPTER I

GENERAL

1.1. Assam is the eastern most State in the Indian Union and is sparsely populated. Its population of about 1,18,73,000 (1960-61 census) is 2.7 per cent of the total Indian population and is the second lowest among the Indian States, the lowest being that of Jammu and Kashmir. It extends between 21° 40' and 28° 40' North Latitude and between 89° 30' and 96° 15' East Longitude. It is bounded by Bhutan and NEFA on the north and north-east, Nagaland and Manipur on the east and south and Tripura, East Pakistan and West Bengal on the west.

1.2. Topographically the State can be divided into three regions:—

- (i) Alluvial plains of Brahmaputra.
- (ii) Alluvial plains of Barak *viz.*, Cachar valley.
- (iii) Hills.

The population is overwhelmingly rural. About 95 per cent of the people live in villages. The villages are generally small and 50 per cent of the rural dwellers live in villages having a population of less than 2,000.

Physical Features

1.3. The total area of Assam is about 47,091 square miles which is about 4 per cent of the total area under Indian Union. It is about half plains and half hills. The plains are in two tracts separated by Central Assam hills. The northern part is the valley of Brahmaputra river system while the southern part is the valley of Barak river system known also as Cachar valley.

1.4. The plains are divided into seven districts. Six of them namely Lakhimpur, Sibsagar, Darrang, Nowgong, Kamrup and Goalpara are in the Brahmaputra valley. Cachar district covers the entire valley of Barak system. Brahmaputra valley is about 450 miles long and 50 miles wide and opens into East Pakistan. The Cachar valley is about 40 miles wide and 45 miles long.

1.5. The hills comprise the following main ranges:—

- (i) Mizo Hills forming the northern extension of the Arakan Yomas along the eastern Burma Frontier.
- (ii) The Central Assam range consisting of the detached hill masses of Garo Hills, Khasi, Jaintia Hills and Mikir Hills.

1.6. There are four hill districts namely (i) Garo hills (ii) United Khasi and Jaintia Hills (iii) United Mikir and North Cachar Hills and (iv) Mizo. Figure 1.1 shows the different regions and the district boundaries in the State.

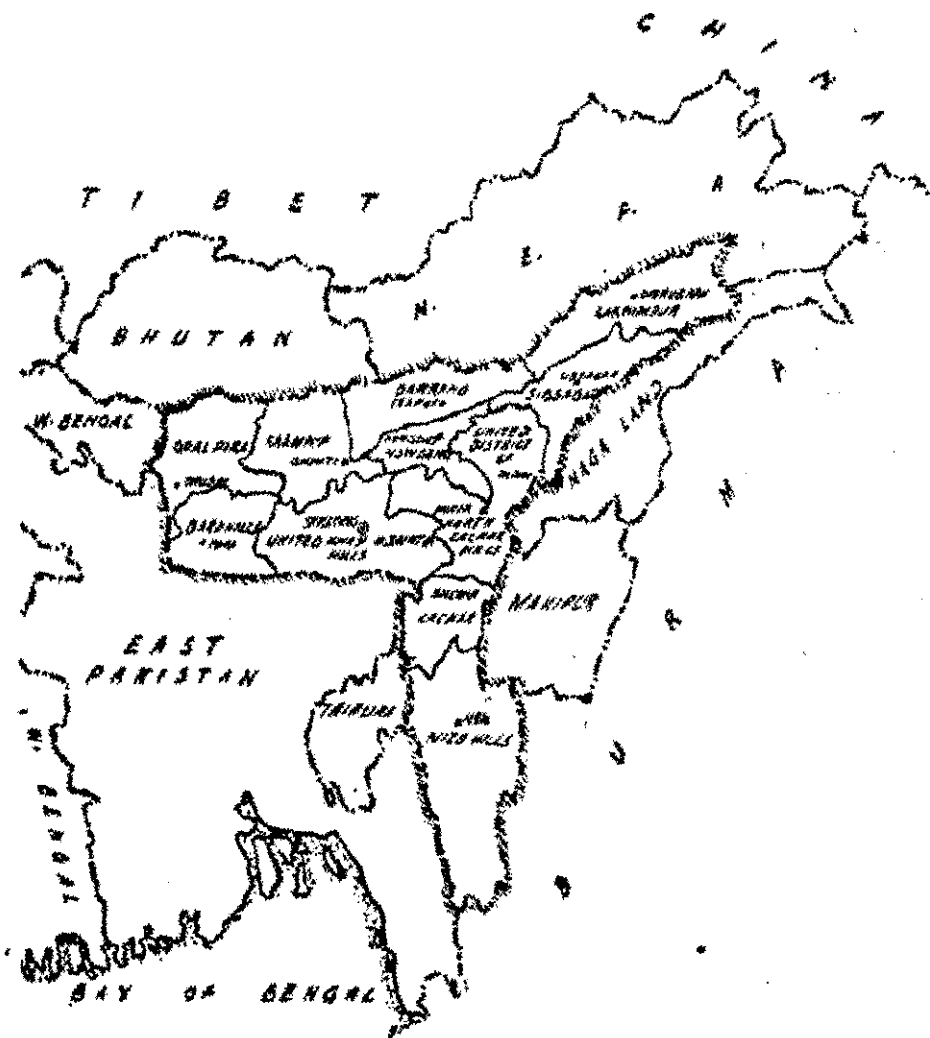


Fig: 1.1. Administrative Map of Assam.

River Basins

1.7. There are two main river basins in the State. The Brahmaputra, which originates near Mansarover lake in Tibet, enters Assam after running parallel to the Himalayas for about 1,000 miles. It joins the bay of Bengal after passing through East Pakistan. Barak river has its source in Manipur. It flows from south to north along the border of Manipur and Assam and then flows from east to west to enter East Pakistan. A map of Assam depicting the river systems appears at figure 1.2.

Soil

1.8. The Brahmaputra valley has coarser alluvial soil. Due to heavy rains and steep slopes there is leaching of the soil and thus the soils are acidic. However new alluvial soils on the river banks are less acidic, they are often neutral and even alkaline. In the upper valley the phosphoric content is good and tea is grown there while it is low in the lower valley. There is sufficient content of nitrogen and organic matter which is particularly high in the low lying soils. The soils in this valley are suitable for production of rice, jute, sugarcane and tea.

1.9. The Cachar valley has finer alluvial soil. This valley is characterised by an abundance of marshes and lakes, the soils of which contain a large proportion of organic matter. The soils are suitable for growing rice, jute and other crops.

1.10. Hills have red loams and lateritic soils. The soils of hills are more acidic than those of plains and contain a high proportion of nitrogen and organic matter. The soils are suitable for horticulture. Rice is also grown on the terraces and in the valleys. A soil map is given at figure 1.3.

Land Utilisation

1.11. The pattern of land utilisation in comparison to that of All-India is shown in the following table:—

TABLE 1.1
Land Utilisation in Assam (1957-58)

| Sl. No. | Classification | Assam | | All-India Percentage to Total Area |
|---------|---|----------------------|--------------------------|------------------------------------|
| | | Area (Million Acres) | Percentage to total area | |
| 1. | Total | 30.17 | 100 | 100 |
| 2. | Forests | 10.99 | 36.4 | 17.9 |
| 3. | Not available for cultivation | 9.22 | 30.5 | 15.8 |
| 4. | Other uncultivated lands excluding fallow lands . | 3.64 | 12.1 | 13.4 |
| 5. | Fallow lands | 0.96 | 3.2 | 8.2 |
| 6. | Net area sown | 5.36 | 17.8 | 44.7 |
| 7. | Total cropped area | 6.25 | — | — |
| 8. | Area sown more than once | 0.89 | — | — |

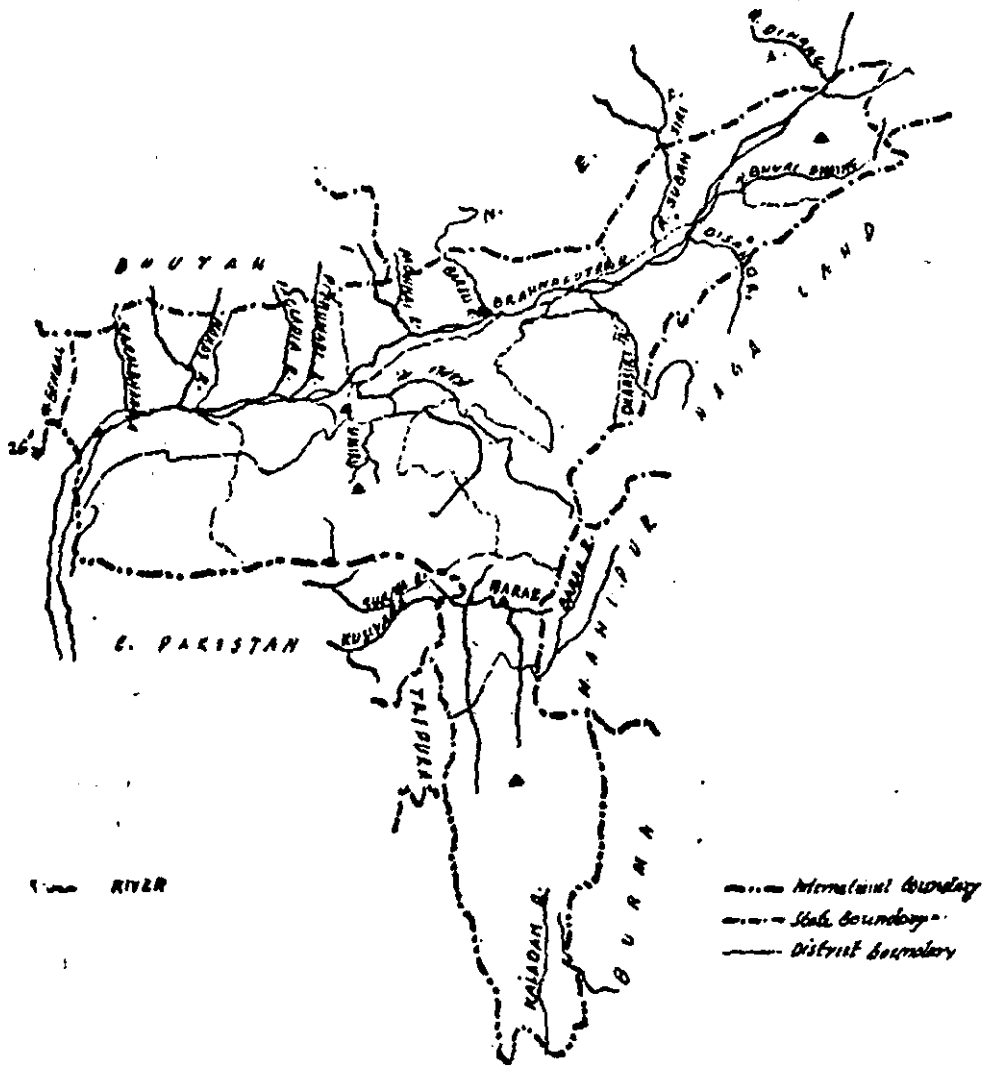


Fig: 1.2. Map showing River Systems in Assam.

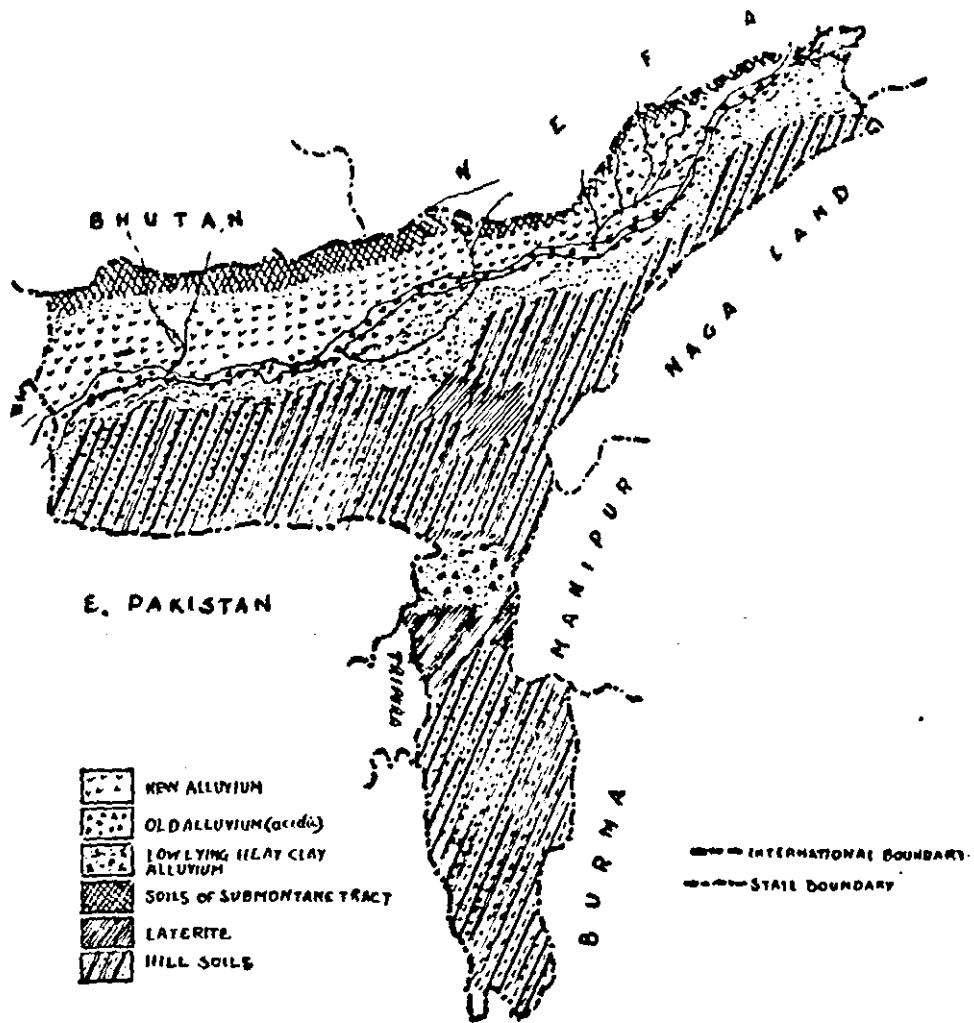


Fig: 1.3. The Soil Map of Assam.

Rainfall

1.12. There is abundance of rainfall in Assam. Cherrapunji, the world famous place for highest rainfall is located in Assam, where the rainfall is about 450 inches per annum. Leaving aside Cherrapunji area the rainfall varies between 40 inches and 160 inches. As will be evident from the isohyetal map shown in figure 1.4, there are pockets of heavy rainfall on either end of the Brahmaputra valley, while there is something of a rain shadow effect along the southern flank of the valley.

1.13. Unlike rest of India the rainfall in Assam is generally spread over a period of eight months *i.e.*, from March to October. There are heavy monsoons from May to October and about 90 per cent of the total precipitation occurs in these months. The winter season from December to March remains practically dry. A statement giving the average monthly rain fall in the eleven districts of Assam is given in *Appendix III*.

1.14. The general rainfall pattern is suitable for raising paddy, jute and tea. It is even possible to raise three crops successively from the same land if the fertility of the land is maintained. However, sometimes the advent of south west monsoon is delayed considerably which affects the sowing of kharif paddy crops and sometimes it terminates much earlier causing damage to the kharif crops and the sowing of winter crops difficult or uncertain. Occasionally, there are prolonged gaps within the monsoon period itself which affect the kharif crops.

Agriculture

1.15. Principal crops raised in Assam are paddy, tea, oil-seeds and jute. Various other crops like wheat, gram pulses, sugarcane, tobacco, cotton and potato etc. are also grown in small quantities. Paddy occupies 75.2 per cent of the total cropped area while area under tea is 7.0 per cent, oil seeds area is 6.2 per cent, jute is 6.1 per cent and the remaining crops are 5.5 per cent.

1.16. The following table shows the area under various crops, production and yield in the State for the year 1962-63 compared to the All India yields.

TABLE 1.2

| Name of crop | Sown area | Total Production | Yield/acre | All India yield/acre |
|---------------|-----------|------------------|------------|----------------------|
| Rice | 4,419 | 1,501 | 756 | 821 |
| Maize | 42 | 8 | 427 | 881 |
| Small millets | 17 | 3 | 396 | 351 |
| Wheat | 10 | 3 | 674 | 738 |
| Gram | 4 | 1 | 560 | 556 |
| Tur | 6 | 2 | 747 | 581 |
| Pulses | 183 | 28 | 343 | 335 |
| Cotton | 40 | 7 | 69 | 106 |
| Jute | 335 | 696 | 831 | 1,025 |
| Mesta | 17 | 25 | 588 | 705 |
| Sugarcane | 70 | 982 | 31,424 | 35,636 |
| Gur | | 98 | 3,142 | 3,649 |
| Oilseeds | 323 | 49 | 340 | 422 |

Area—thousand acres Production—thousand tons in all cases except Jute, Cotton and Mesta where it is in '000 bales of 400 lbs. each. Yield—lbs. per acre.

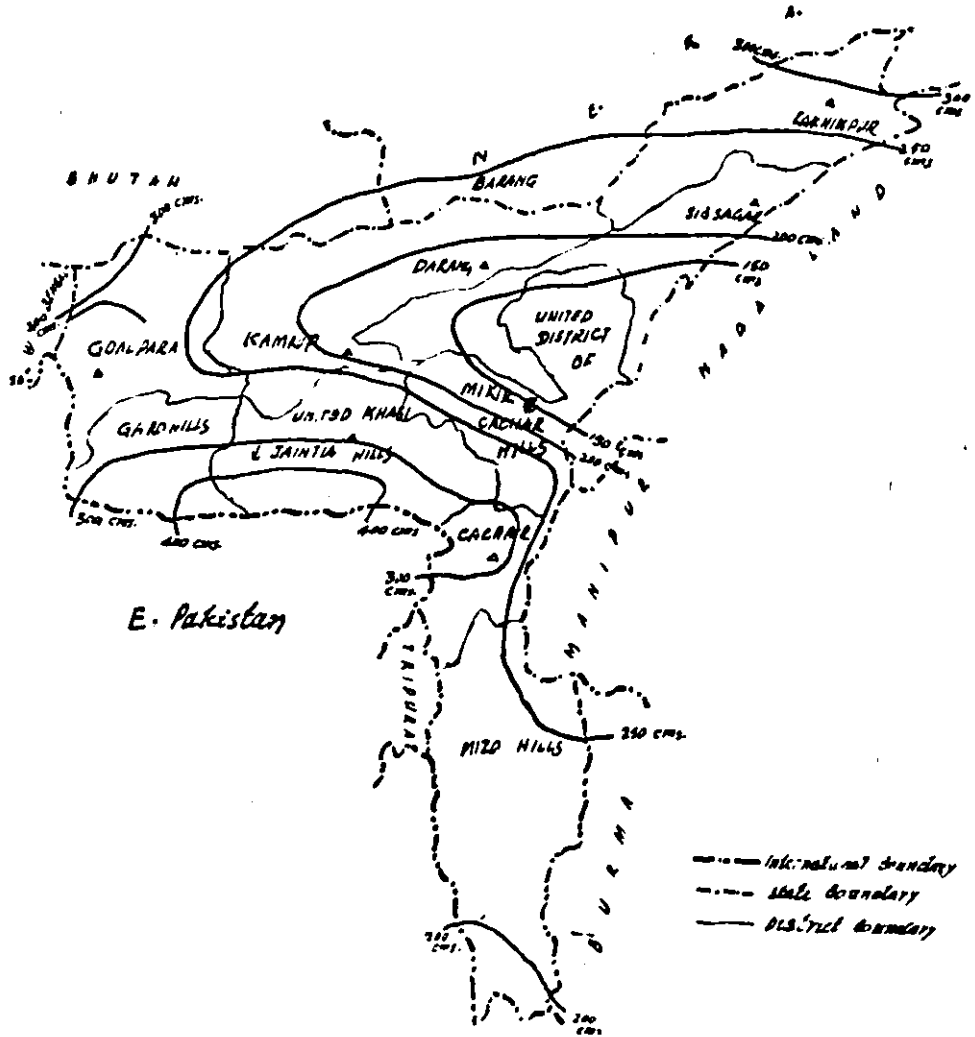


Fig: 1.4. An Isohyetal Map of Assam.

Principal Crops

1.17. Depending on the soil, rainfall and drainage of the fields, four different types of paddy are grown in the State.

(i) *Ahu* (Autumn rice) is an early ripening variety which is grown in comparatively higher fields. It is sown from February to April and harvested from June to August.

(ii) *Bao* (Winter rice) is the broad cast variety of the deep water paddy generally grown in low lying areas. It is sown from April to May and harvested from December to January.

(iii) *Sali* (Winter rice) is the most common type of paddy in the State. It is a transplanted variety sown in seed beds from June to July, transplanted from July to August and harvested from December to January.

(iv) *Boro* (Spring rice) is the winter variety grown in the fringes of 'Beels' (pools of water) transplanted from December to January and harvested from April to May.

The average yield of rice per acre in 1962-63 was 756 lbs. against 821 lbs. for All India.

Tea

1.18. In Assam, tea is grown in almost all the plain districts. However, out of the total tea area of about 3.84 lakh acres three fourth area is in the upper Assam districts of Lakhimpur, Sibsagar and Darrang. Tea estates of Assam are bigger than elsewhere in India, the average size being 489 acres compared to the All India average of 110 acres. Assam has got 50 per cent of the country's tea area and 55 per cent of the produce. Average yield of tea per acre in Assam in 1956-57 has been 940 lbs. compared to the All India average of 880 lbs.

Oilseeds

1.19. Oilseeds are grown mostly in lower valley of Brahmaputra. However, they are also widely distributed in hills and plains all over the State. Area under oilseeds is about 3.23 lakh acres. Average yield per acre is 340 lbs. compared to the All India average of 422 lbs.

Drainage and Flood Control

1.20. Assam is the most flood affected State of the Indian Union. The mighty Brahmaputra which carries a minimum discharge of more than one lakh cusecs, swells during the monsoons, specially when the snow melting coincides with the heavy rains. The river brings large quantities of silt and debris which causes continuous raising of river beds.

1.21. After the earthquake of 1950 the condition has become worse on account of rising of river bed in the lower reaches of Brahmaputra by deposits of debris. Rivers Surma and Kusiara (Barak) have also raised their beds compared to the level of surrounding country. Poor draining capacity of the rivers accompanied by the heavy rainfall causes serious floods in the State.

1.22. In rainy season large areas remain under water for weeks together. Many depressions remain water-logged even after the monsoon. *Kharif* crops frequently suffer on account of floods and in some years the crops in the flood affected areas perish totally. The bigger problem in the State is thus of getting excess water out than bringing more water over the land for irrigation.

1.23. Large scale measures for making the area free from the menace of floods are being taken. During the First Plan flood works in the shape of embankments and drainage works were carried out under the head 'Minor Irrigation'. After the severe and widespread floods of 1954 a special flood control programme has been initiated. By the end of Second Plan an expenditure of Rs. 711 lakhs was incurred on flood works. Flood works executed by the end of Second plan are as follows:—

| | |
|------------------------|------------|
| (i) Embankments | 1959 miles |
| (ii) Drainage Channels | 586 miles |
| (iii) Towns Protected | 16 Nos. |

Total area protected by these works is about 12 lakh acres. In the Third Plan there is a provision of Rs. 500 lakhs for protection of about 3.84 lakh acres.

Irrigation

1.24. Though Assam receives heavy rainfall, yet in some parts of the State artificial irrigation is at times needed for successful crop production, especially when the rains are delayed or when there are long breaks in the monsoons. Some areas of the state e.g. Nowgong district receive comparatively low rainfall. There, provision of artificial irrigation as a standby in order to grow good crops is almost a necessity.

1.25. The following table shows the pre-plan and post-II plan position of the total cropped area and the irrigated areas from various sources:—

| Classification | Area in thousand acres | |
|-----------------------------|------------------------|-------|
| | 50-51 | 60-61 |
| 1. Total cropped area | 6313 | 6483 |
| 2. Total irrigated area | 1349 | 1533 |
| 3. Area irrigated by canals | 791 | 899 |
| (i) Private Canals | 641 | 721 |
| (ii) Govt. Canals | 150 | 178 |
| 4. By other sources | 548 | 634 |

1.26. Minor Irrigation Works in Assam are mostly diversion schemes where the water is tapped from a stream and is utilised for irrigating the area nearby. The commands are generally small and hence costly schemes providing for storage have not been feasible so far. Ground water resources are also available in some regions. As indicated by the results of exploratory tube-wells bored, the possibilities of having successful deep tube-wells are there.

1.27. There are not many possibilities of any large scale expansion of irrigation in the State. A modest provision to provide supplemental irrigation to mature the crops is all that seems warranted. With ground water resources, however, some winter cropping could be planned with success. The Team has looked into the operational performance of some of the existing works as described in the following chapters.

CHAPTER II

DIVERSION CANALS

2.1. There are numerous streams in the Brahmaputra valley joining the river as it traverses across the alluvial plains. The important of these have been shown in figure 1.2. Most of these streams are rainfed and have only little discharge in non-monsoon months. Minor Irrigation schemes on some of these tributaries have been constructed by providing cross regulators across the streams for controlling the level of water and taking out canals upstream from one or both banks. In some cases a feeder channel has been taken out from the main stream and the head works constructed on this feeder channel.

2.2. The Team had the occasion to visit some diversion canals. Their locations are marked on the index map at figure 2.1. The details of the works visited and the Teams' observations thereon are contained in the following paragraphs.

C.M. Datta Canal

2.3. This scheme lies in Kamrup district. This canal was taken up for construction on the suggestion by a local man and is named after him. This is a diversion scheme constructed in the first plan period. Its supplies are tapped from a small stream known as Noanadi in the Darrang district near Mangaldai. The maximum flood discharge and minimum discharge of the stream are 2,649 and 16 cusecs respectively. A table showing the maximum, minimum and average monthly discharges in this stream during 1964 is given at *Appendix II*. The cross regulator is a concrete structure with steel vertical lift type gates having 8 bays 8' wide each.

2.4. The canal takes off from the left bank and the head regulator has one bay of 5 ft. width. The full supply discharge of the canal is 95 cusecs and the length of the main canal is 39,800 feet. A distributary takes off at 15,000 R.D. with a head discharge of 45 cusecs. The length of this distributary is 28,000 feet. There are 16 outlets in the main canal and 14 in the distributary. The total area commanded by the canal is 75,000 acres.

2.5. The canal was not running at the time of the visit and from a perusal of the gauge register it appeared that usually sufficient discharge flows in the stream from May to October and the canal is run generally from middle of May to middle of October except for brief periods at the time of heavy rains when there is no demand. The main crop sown in the command is rice. Irrigation is done from field to field and generally no field channels have been constructed by the cultivators. No water rate is charged from the cultivators and therefore the Irrigation Department has never tried to assess the area actually irrigated by the canal. The members of the field staff do not possess village-wise *shajra* maps of the area on which they could even mark the boundary up to which canal water reaches in a particular irrigation season. For statistical purposes the total area commanded by the project is taken as the area irrigated. The discharge flowing in the stream

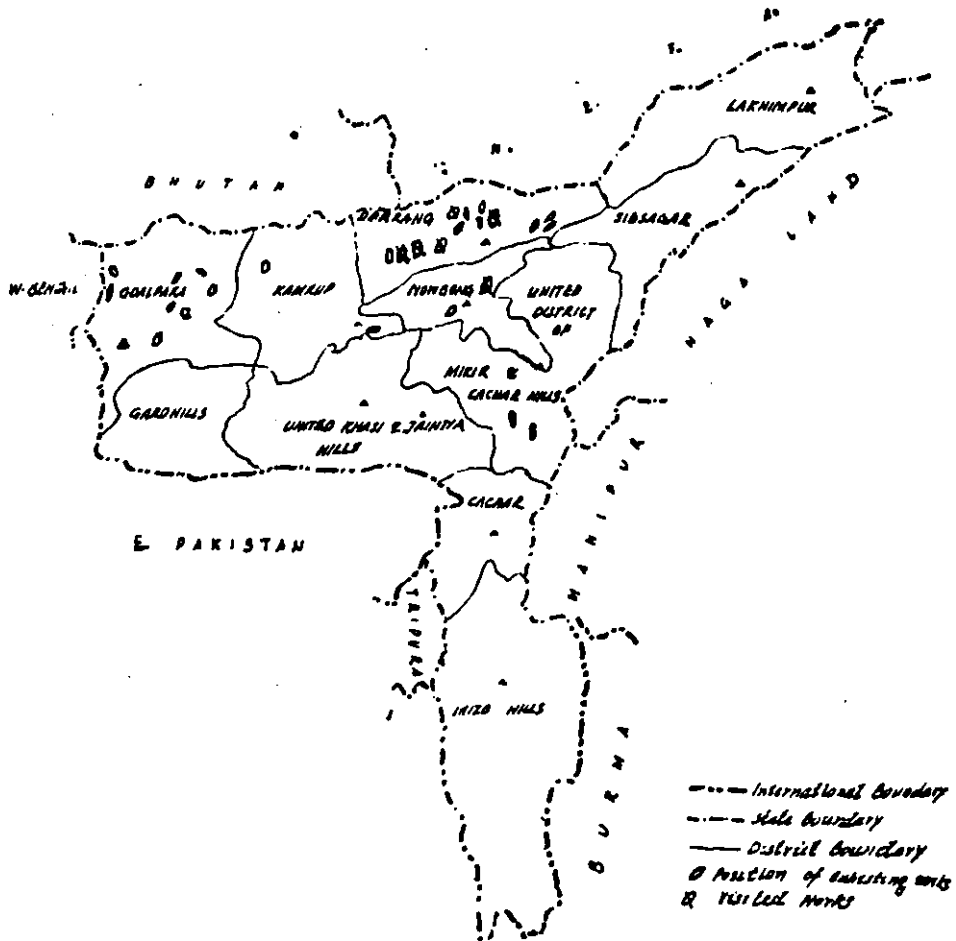


FIG. 2.1. Map showing Diversion Schemes.

during *rabi* and hot weather is not being utilised. The canal remains closed from 15th October to 15th May. It is felt that cultivators could be encouraged to bring some area under sugarcane and some other such crops which require water during non-monsoon period.

2.6. Steps should also be taken to see that water diverted at government cost is actually used by cultivators. Water rate should also be imposed to cover the maintenance expenditure to some extent. This will make the cultivators realise the value of water.

2.7. One agriculture farm in the command of this scheme was also visited by the team. There were no water channels in the farm and it appeared that field to field irrigation was practised. The fields were not properly levelled. There was no crop during that period. These farms could be utilised as research-*cum*-demonstration farms for working out the crops which could produce best results with assured irrigation, various crop rotations possible and for demonstration of increased yields with better farming methods.

Noanadi Extension Scheme

2.8. This scheme also lies in Kamrup district. The construction of this canal was started in the III Plan (1961). This canal takes off about half a mile upstream of the headworks of C. M. Dutta canal from the right bank of the river. Thus no separate cross-regulator is provided. An index map showing the layout is shown at figure 2.2. The head discharge of the canal is 90 cusecs and out of the total proposed length of 45,800 ft. The canal has been excavated from head to 16,000 R.D. and 24,000 R.D. to tail. The portion from 16,000 to 24,000 R.D. is held up on account of difficulty in acquisition of land and objections to alignment. It was reported that the land would now soon be acquired.

2.9. The area commanded is 9,500 acres and is all under paddy. The irrigation from the head reach up to 16,000 R.D. was started in May 1962. The figures of actual irrigation since 1962 to date were not available. There being no charge for water. The irrigation staff therefore does not consider it necessary to measure the area actually irrigated. The Revenue Department presumably takes the entire area as irrigated.

Sukhajani Irrigation Scheme

2.10. This scheme is situated in Darrang district. The parent stream from which the canal has been taken out is Sukhajani with a flood discharge of 363 cusecs and the minimum discharge of 20 cusecs in March. The project was completed in 1959. The head works consists of a cross-regulator with 3 bays of 10 ft. each and the head regulators on each side have one bay 5 ft. wide each. All the bays are fitted with vertical lift steel gates.

2.11. The left bank canal has the full supply discharge of 20 cusecs and the right bank canal is designed for 25 cusecs. Their lengths are 12,400 ft. and 14,200 ft. respectively. The two canals command a total area of 3,600 acres which is all under paddy. The figures of the area actually irrigated were not available. The canal is run only between middle of May to middle of October.

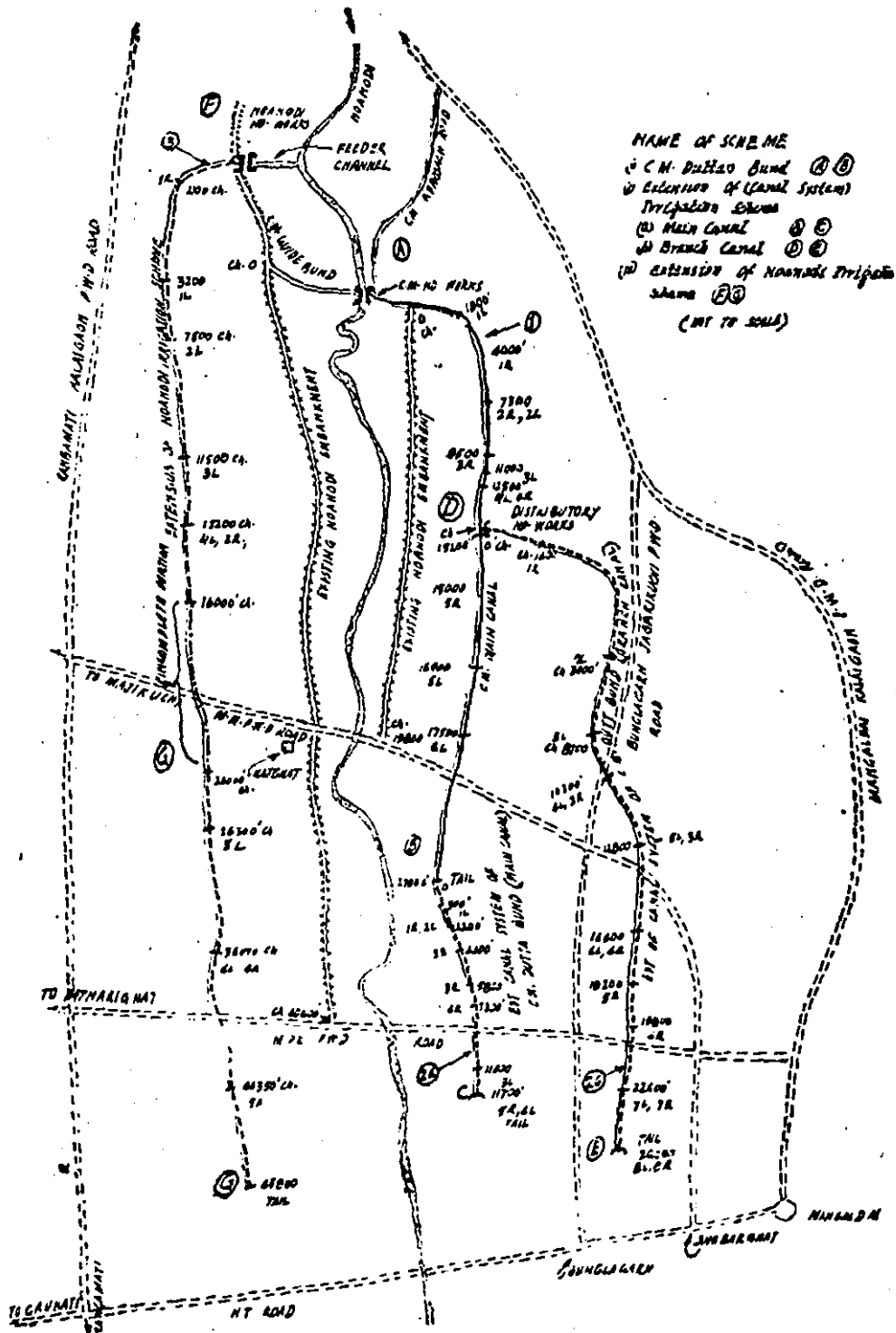


FIG. 2.2. Index Map of C. M. Dutta Canal of Noanadi Extension Scheme.

2.12. The perennial discharge of 20 cusecs in this case also could be utilised if the canal was run and cultivators were encouraged to raise cash or other *rabi* crops requiring water in non-monsoon months.

Panchnai Irrigation Scheme

2.13. This scheme is situated in the Darrang district and has been taken out from a small stream called Panchnai. A feeder canal about two miles long has been taken out from the nala and a masonry crest has been provided across this feeder for diverting water into the canal. Down stream of this diversion weir, the supply channel again joins the main nala. The canal has a head regulator with vertical lift type steel gates.

2.14. The head discharge of the canal is 65 cusecs and the length is 14,000 feet. There are 8 outlets and 7 falls. The layout of the scheme would be clear from the index map given at figure 2.3. The cost of the scheme is Rs. 1,24,554 and the area to be irrigated is 5,083 acres of paddy. Thus the cost per acre is about Rs. 24.

2.15. At the time of the teams visit, the canal was closed. The works appeared to be in good order. As the river has got practically no discharge during the non-monsoon months, only *kharif* irrigation is possible. The work was completed in 1953.

2.16. Figures of area irrigated annually are not available as they have never been measured and P.W.D. has not employed any staff for this purpose. The extent of actual benefits of the scheme have, therefore, remained unassessed.

Kolony Irrigation Scheme

2.17. This canal is in Darrang district near Tezpur and has been tapped from a stream known as Jorasar. The canal takes off from a 3,000 ft. long supply channel on the right bank of this stream. The highest flood discharge in the supply channel is 790 cusecs and the normal discharge is 190 cusecs. The supply channel has 20 ft. bed-width and 1:1 side slopes.

2.18. The full supply discharge in the canal is 57 cs. There are 16 outlets. The headworks consist of a cross-regulator across the diversion channel having two bays of seven feet width with vertical lift type steel gates. The head regulator of the canal has got one steel gate 7.5 feet wide. The length of the canal is 47,000' and there are five falls. Figure 2.4 gives the layout of this scheme.

2.19. The scheme was completed in March 1955 at a cost of Rs. 2.47 lacs. The area to be irrigated is 4,078 acres of paddy. The cost per acre works out to Rs. 60. At the time of the Teams visit the canal was closed. It was stated that the canal is usually run from about middle of May to middle of October. Field to field irrigation is practised. There are no field channels except in small lengths constructed departmentally. No recording of area actually irrigated annually is made.

Chapanala Irrigation Scheme

2.20. This scheme is in the Nowgong district. The canal is near the foot slopes of Mikir Hill and runs parallel to the hills. Along its alignment this canal has to cross several nalas flowing down from the hill slopes. On each of these nalas cross-drainage works combined with arrangement for diverting water of the nala into canal have been provided.

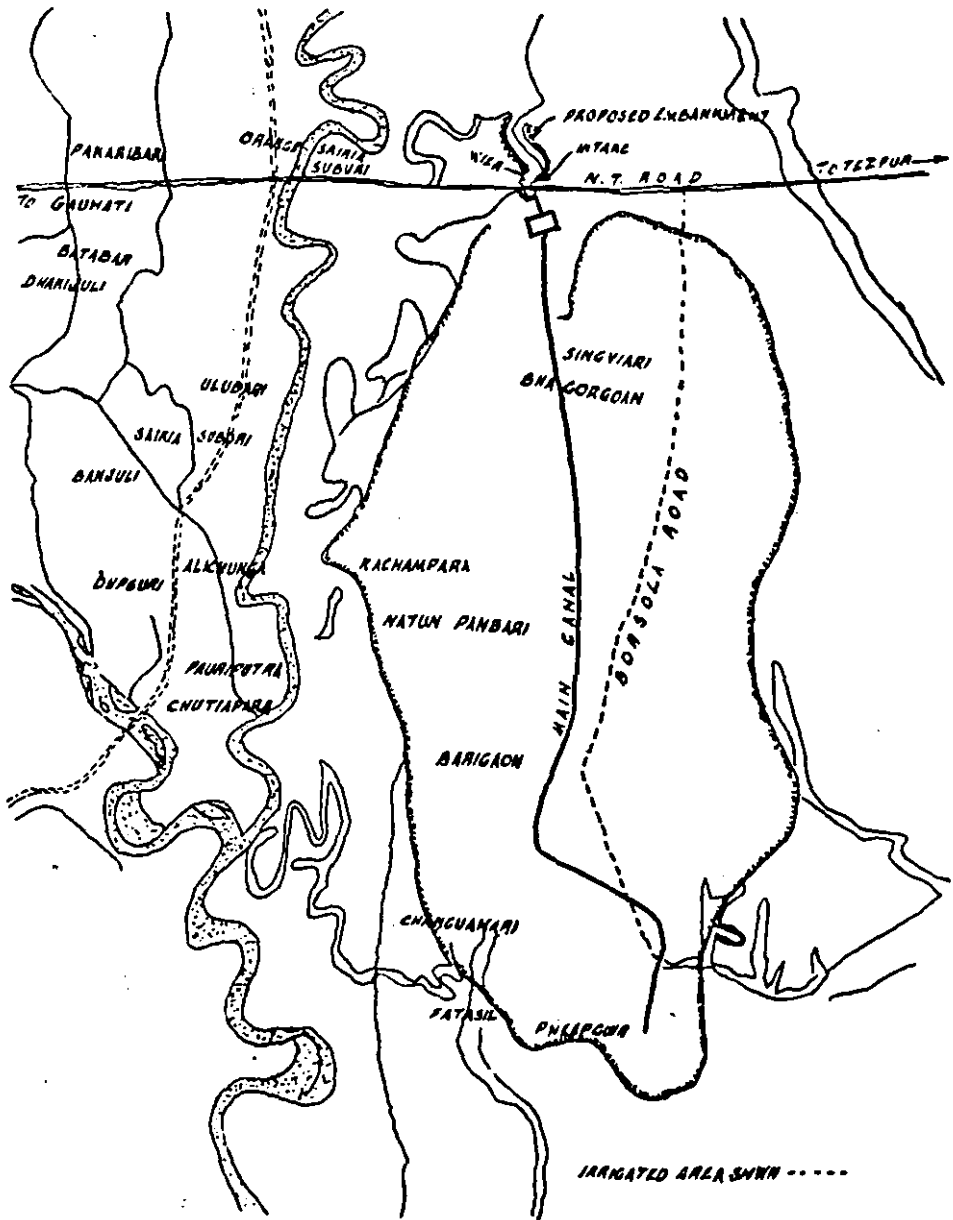


FIG. 2.3. Index Map showing Panchnai Irrigation Scheme.

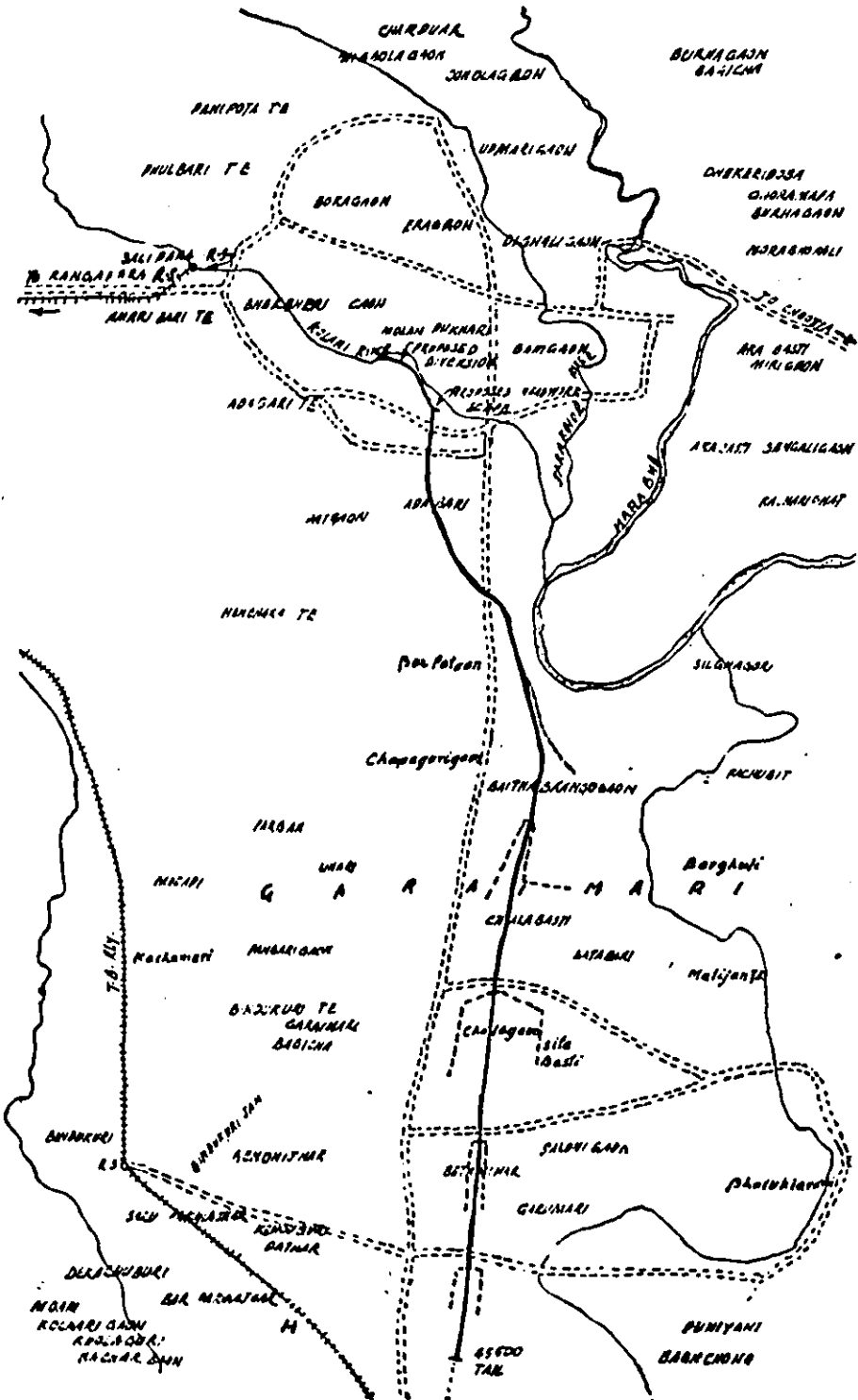
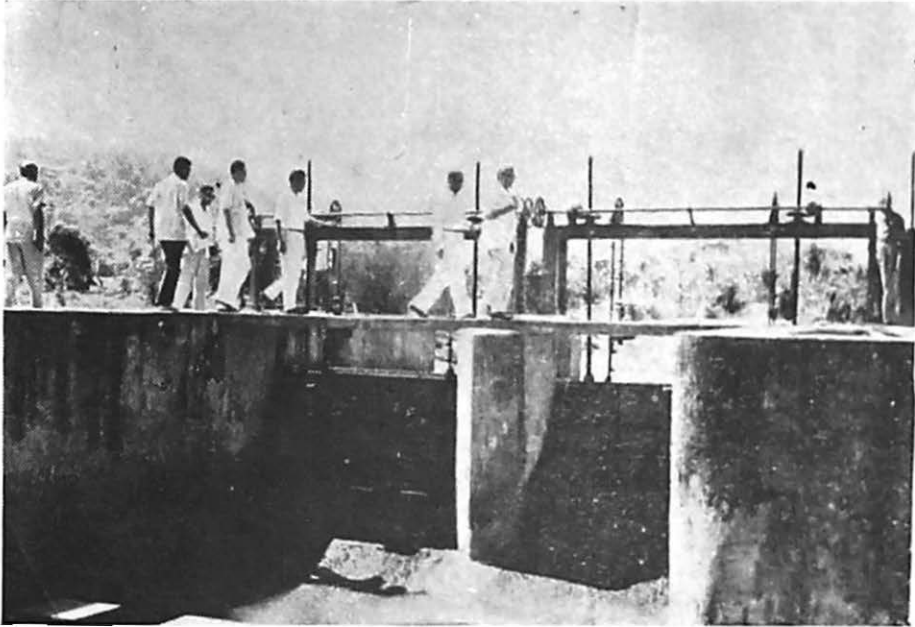


FIG. 2.4. Index Map of Kolony Irrigation Scheme.

2.21. The areas lying between these nalas have been proposed to be irrigated from this canal. The names of various nalas tapped in this manner are Jiajuri, Tholajuri or Baliadia Juri and Bamuni juri. Jiajuri has a maximum flood discharge of 800 cusecs and minimum discharge of 2 cusecs. Canals take off from east and west bank by providing a cross regulator across the nala and canal head regulators on both banks with vertical lift type steel gates as shown in the photograph below.



Photograph of Head-work on Chapanela Scheme

The east canal is 4,500 ft. long with a head discharge of 6.5 cusecs. There are 4 outlets in the east canal and it is proposed to irrigate 520 acres of paddy.

2.22. The west canal is 6,300 ft. long with a head discharge of 13 cusecs. Number of outlets is 6 and the area to be irrigated is 1,040 acres.

2.23. Tholajuri or Baliadiajuri has a maximum flood discharge of 800 cusecs and a minimum discharge of 4 cusecs. Two canals have been taken out from east and west banks by providing a cross-regulator and head regulators with vertical lift type steel gates.

2.24. The eastern canal is 1,600 feet long having a head discharge of 4.38 cusecs. There are 2 outlets and 350 acres of paddy is proposed to be irrigated. The canal crosses a number of streamlets locally known as *juris*. At 3,200 RD it crosses Homapa juri by means of a

level crossing. The maximum and minimum discharge is 200 and 1 cusec respectively. Water is taken from this stream into the canal as much as required.

2.25. At R.D. 7,800 the canal crosses Barbari village juri by syphon. There is a cross-regulator across the nala with a feeder channel to feed the canal when required. The maximum discharge of this stream is 200 cusecs.

2.26. At R.D. 13,000 the canal crosses Sukan juri stream by syphon and there is also cross regulator and feeder channel. The flood discharge of this stream is also 200 cusecs.

2.27. At 15,000 R.D. the canal crosses Baliadia juri by a syphon and here also cross regulator and feeder channel has been provided. The flood discharge of nala is again 200 cusecs.

2.28. At R.D. 21,000 the canal crosses Bamunijuri which has a flood discharge of 100 cusecs. There is similar arrangement at this crossing. The total discharge utilised for irrigation along this length of 26,300 feet is 245 cusecs.

2.29. Seven villages are served by this scheme. The outlets are generally of 1.25 feet diameter hume pipes. The bed width of the canal varies from 7 feet to 1.75 feet and water depth from 3 feet to 1 foot. Side slopes provided are 1:1; free board has been provided as 2 feet. At the time of visit of the Team the canal was closed. One cultivator was seen taking water for his paddy nursery by putting a bund across the canal and diverting the small quantity of water available. The canal irrigates only paddy and is run between middle of May and middle of October. During the rest of the season there is practically no water in the streams. Area annually irrigated has never been recorded and the water is given free.

2.30. From the above observations it will be seen that inspite of adequate rainfall, need for irrigation is occasionally felt. The reason is simple. In Brahmaputra valley the country slopes from North to South on the right bank and South to North on the left bank. Land is generally porous with the result that rain water drains off and gets absorbed quickly. Need for artificial irrigation is felt whenever there is a gap in the monsoons for more than ten days. However the canals do not seem to be serving the areas to the extent they are supposed to.

2.31. So far it has been assumed that the entire commanded area has been benefited. In the absence of any field verification, there is no way to discover the actual shortfalls.

2.32. In fact, irrigation schemes should be built only after a proper plan for fullest possible use of irrigation facilities is worked out. Thereafter, a co-ordinated effort need be mobilised to take advantage of the facilities created.

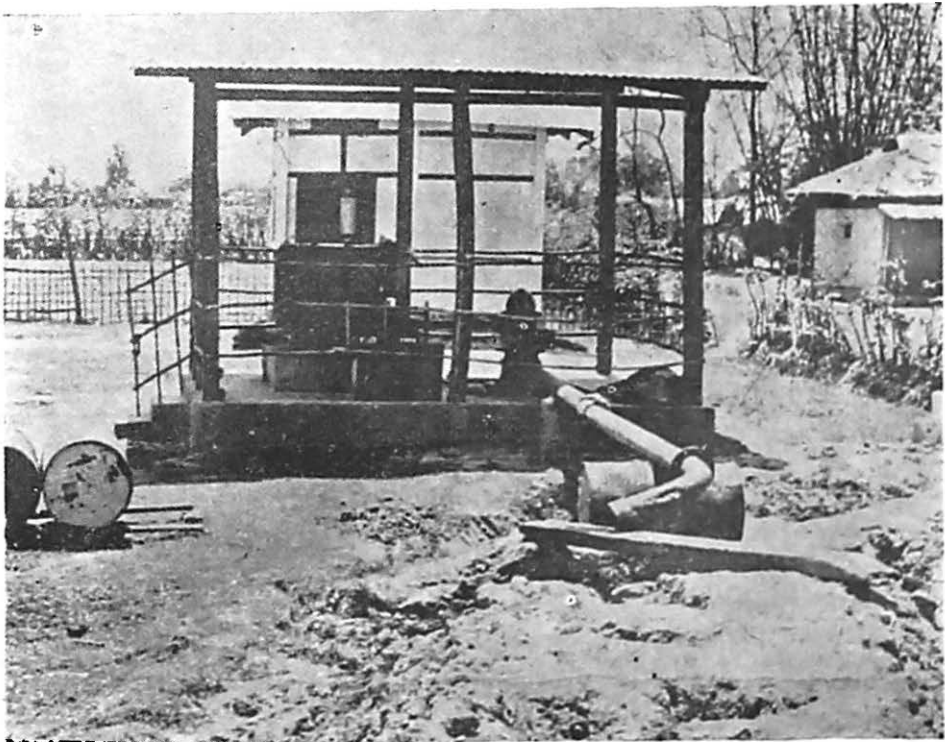
CHAPTER III
GROUND WATER RESOURCES

3.1. In the Brahmaputra valley there are possibilities of utilisation of ground water resources for the purposes of irrigation. This source is more dependable than diversion works built on small streams. Its exploitation is, however, comparatively costly and use can be made of ground water only when economic return from crops raised justifies it.

3.2. With a view to ascertain the feasibility of having deep tubewells in this area the Exploratory Tubewell Organisation took up experimental drilling in 1960 in four districts of Kamrup, Nowgong, Sibsagar and Darrang. Twenty-two successful deep tubewells as shown in fig. 3.1 have been bored by this organisation—four in Kamrup, five in Nowgong, six in Sibsagar and seven in Darrang districts. Particulars about these tubewells are given in *Appendix V*.

3.3. After testing, these tubewells were handed over to the State Agriculture Department as production works. The prime movers at present are Diesel engines. The pumps are of vertical bore-hole type. One operator has been posted on each tubewell where a residential quarter has also been built for him. The pump house and sump tanks still remain to be built.

3.4. The Team visited one such deep tubewell in the Nowgong district at Bhalukmari. This tubewell was completed by the Exploratory Tubewell Organisation on 19-1-61 and was handed over to the State Agriculture Department on 28-8-62. A Photograph of the Tube well is given below.



4
Photograph of the Bhalukmari Tube-well

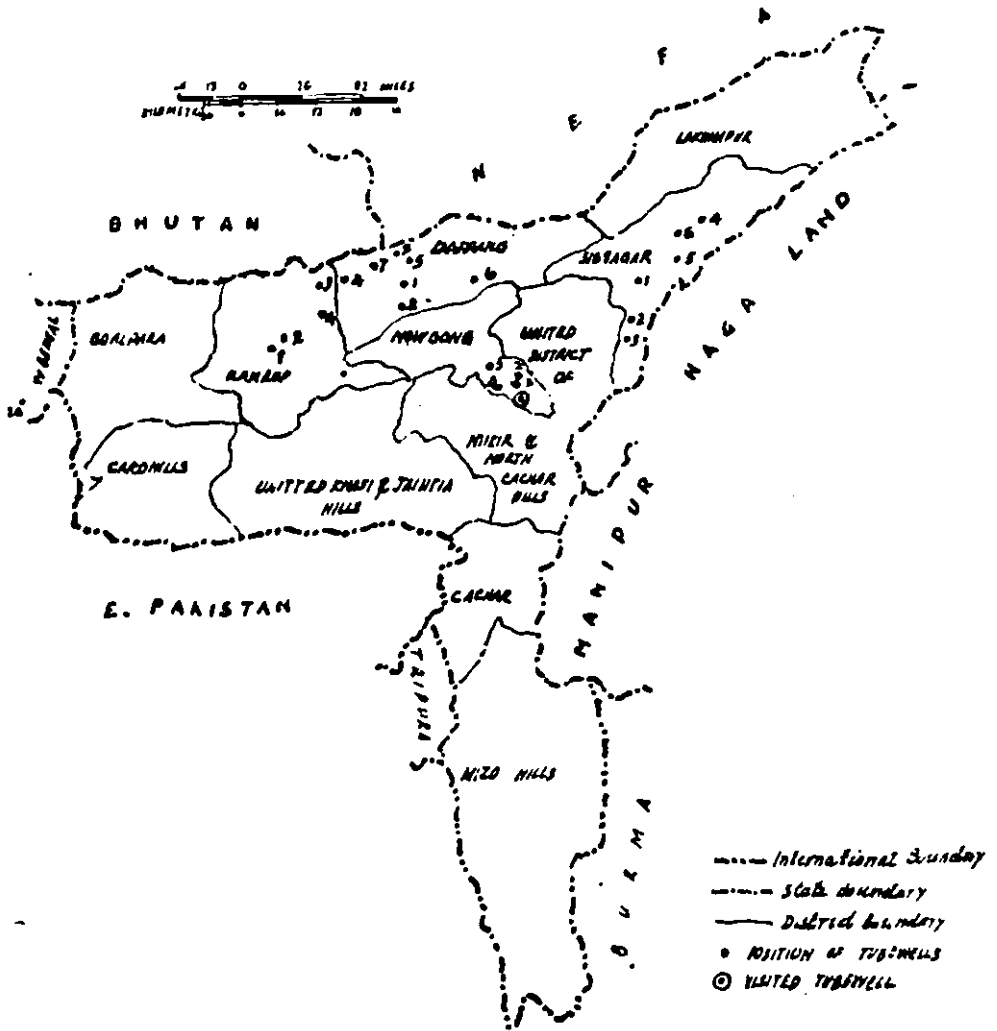


Fig. 3.1. Map showing Location of Tube-wells in Assam

3.5. The depth of boring is 475 feet and the discharge is 28,320 gallons per hour. It has a Jyoti turbine pump driven by a 30 H.P. Oliver diesel engine. The irrigation potential created has been assumed as 160 acres. The crop to be irrigated is paddy. The rate fixed for the irrigation from tubewells as mentioned in the "Master Plan for Irrigation, Assam" (Oct. 1963) is Rs. 15 per acre and this rate is mentioned to be the reason for non-utilisation of the potential. However at the site the impression given was that water is supplied free as on other irrigation works. Even so development is lagging.

3.6. The details of monthly hours run as copied out from the log book at site is given below:—

Statement of Bhalukmari Tubewell showing monthly hours run during 1963-64

| Month | HOURS RUN | |
|--------------|------------|------------|
| | Year 1963 | Year 1964 |
| April | 216 | 6 |
| May | 60 | 39 |
| June | — | 104 |
| July | 15 | 178 |
| August | 9 | 226 |
| September | 84 | 136 |
| October | 19 | 8 |
| November | 7 | — |
| TOTAL | 410 | 697 |

3.7. A perusal of this table would reveal that the tubewell has been run only during the monsoon season. Thus it has only provided supplemental irrigation for paddy. Out of 720 hours in a month the maximum figure of hours run is 226 which is low. The figures of actual area irrigated and hours run for all the 22 tubewells are given in *Appendix VI*.

3.8. There was no arrangement for measuring the discharge of the tubewell. Water channels have also not been constructed so far. The water is discharged over the ground and is made to flow in fields. Proper control and management of water is inescapable necessity for such water which has to be pumped out at so much cost. For keeping a watch on the performance a delivery tank with a V-notch should be provided on each tubewell. A well planned lined water channel system in the commanded area of the tubewell should also be provided.

3.9. To make the tubewells help in optimising agricultural production crops of perennial nature like sugarcane and *rabi* crops needing irrigation in the non-monsoon months need to be developed in the commanded area of these tubewells. Areas, where sugarcane can be developed in extensive belts, should be selected in these districts and installation of sugar mills may as well be planned. Then alone ground water resource can be usefully utilised.

3.10. The water rate of tubewells can be provided on volumetric basis. There is no difficulty in determining the volume of water supplied to a particular cultivator. By having a volumetric rate, the wastage of water is also checked. That will eventually lead to a scientific pattern of agriculture being developed in the area.

3.11. It may be advantageous if a few demonstration farms based on the use of ground water available through tubewells are organised by the State. That will go a long way in convincing people with regard to the year-round utility of tubewell irrigation.

3.12. The Team also feels that one or two Assam officers may be deputed to see and study tubewells under actually working conditions in Uttar Pradesh. They can then plan up maintenance and operation of tubewells in Assam on more concrete lines.

CHAPTER IV

OTHER SMALL IRRIGATION WORKS

4.1. Cultivators in some regions of the State have been using indigenous irrigation practices for a long time. Such irrigation was widely practised in the Northern belt of Darrang, Kamrup and Goalpara districts and also in the south bank of the Kamrup and Goalpara districts.

4.2. Enterprising villagers have tapped a number of rivers in their upper reaches near the foot hills to feed their 'dongs' (small irrigation channels) for irrigation in this area. The diversion works generally consist of small boulder weirs placed obliquely across the flow and diverting it along the 'dong' which runs down up to the fields.

4.3. In the central region in these three districts, the nature of these irrigation works takes the shape of earthen dams or composite dams of earth and brush wood across the streams. Each local scheme is executed and owned by a group of villagers and is looked upon more or less as a private possession. The same stream may be tapped at number of places in its course.

4.4. Some such indigenous irrigation schemes exist in the northern foot hills of the Mikir hills and Garo hills and also to a smaller measure in some parts of Khasi and Jaintia hills. In Khasi and Jaintia hills the water is tapped from a stream by putting boulders across it and leading it down the hill slopes.

4.5. These schemes, however, suffer from the following drawbacks:—

- (i) diversion works are temporary in construction and generally divert the entire flow of the channel into the dong,
- (ii) wherever spillways are provided, very often they are undermined and washed away,
- (iii) irrigation channels are not provided with proper slope and falls with the result that they get eroded and become useless after some time.

4.6. Under the programme for minor irrigation, some such schemes are also being constructed with State assistance through the Community Development blocks. One scheme known as Bhalukmari embankment was visited by the team.

Bhalukmari Embankment

4.7. This scheme lies in the Darrang district towards north of Tezpur. It comprises (i) a masonry sluice with a plate steel gate, (ii) earthen embankments with, about eight feet maximum height near the sluice, extending on either side. The length of the embankments is about three to four furlongs.

4.8. The cost incurred in the construction of the sluice which was provided by the government is reported to be Rs. 7,500. The equivalent participation by the villagers is in the form of labour provided for the construction of the embankment. The area benefited by this scheme was reported to be 280 acres.

4.9. The villagers were said to be responsible for the maintenance and repairs of the work but it did not appear to be receiving sufficient attention. The embankment had settled at several places. The sluice gate has not been painted and is liable to get rusted and deteriorate. In the case of such works panchayats could be entrusted to look after their maintenance properly.

Lift Irrigation

4.10. For irrigation of 'Ahu' and 'Boro' paddy which are sown in high fields and also for irrigation of vegetables some cultivators lift water from nearby pools etc. Agriculture department have arrangements for supply of pumping sets to the cultivators either on outright purchase basis at a subsidised cost or even on hourly rental.

4.11. The extent of execution of such schemes through the agency of Community Development block, is indicated from the following figures for 'Kathiatoli Development Block, Anchlik Panchayat' in the Nowgong district, which was visited by the Team:—

| Year | No. of small irrigation schemes executed | Govt. contribution in Rupees | Area benefited in acres |
|-------|--|------------------------------|-------------------------|
| 58-59 | 63 | 34,000 | 2,500 |
| 59-60 | — | — | — |
| 60-61 | — | — | — |
| 61-62 | 35 | 18,000 | 2,500 |
| 62-63 | 32 | 16,000 | 3,550 |
| 63-64 | 68 | N.A. | 11,954 |
| 64-65 | 24 | 25,000 | N.A. |

The block has also purchased two pumping sets which are operated by the cinema operator of the block. Some cultivators have also purchased pumps from the Agriculture department.

4.12. The cultivators of this block appear to be progressive. However, it was pointed out by the *sarpanch* that the main drawback was that in most cases the tillers were not the actual owner of the land and for this reason they could not come forward to provide labour and capital for execution of such schemes. The real owners living in cities did not show much interest. This problem appears to be common everywhere in the State and needs to be given some serious thought.

4.13. In Assam, where rainfall is generally good, investment on large scheme or even on medium sized schemes may not seem justified. Such indigenous systems of irrigation can provide the necessary protection in case of any drought. They also provide supplemental irrigation as needed.

4.14. It would seem advisable to let the Panchayat develop a system of self managed small irrigation societies or small co-operative lift irrigation schemes, which could provide the necessary irrigation. For this purpose people will need to be prepared and apprised of the benefits of irrigation.

CHAPTER V

PROSPECTS FOR DEVELOPING IRRIGATION

5.1. Assam is one of the wettest States of the Indian Union. The soils are fertile and capable of yielding good production if properly attended to. So far not much attention has been paid to irrigated agriculture. A beginning has been made with a few minor irrigation schemes for providing supplemental irrigation for *kharif* crops, mainly paddy. Irrigation may be needed at the time of prolonged gaps in rainfall during *kharif*, and also for *rabi* crops, which at present, are rarely grown.

5.2. The resources and requirements of the three regions of the State attended by many a local problem are distinctly different from each other. They are discussed below:

Brahmaputra Valley

5.3. Both the banks of Brahmaputra river have got extensive plain areas, numerous streams providing surface water resources and suitable conditions for boring tubewells. On the north bank the soil is mostly acidic. It does not retain waters due to porosity. The soil on the south bank is less acidic and even neutral at places. It is loamy and capable of retaining moisture. The ground water-table ranges between 10 feet to 25 feet during winter. The land near the river banks gets flooded almost every year and needs protection from floods.

5.4. Schemes recommended for this valley in the master plan for irrigation are minor irrigation schemes which are mostly diversion canals. Most of the sources are small streams which are not perennial. These schemes are, therefore, proposed to irrigate paddy and jute only. One medium irrigation scheme known as Jamuna Projects is also under construction in Nowgong district on the south bank of Brahmaputra. The river Jamuna is perennial. The maximum flood discharge and minimum discharge are 7500 and 150 respectively. In this project some area under *rabi* crop is also proposed to be irrigated.

5.5. Deep tubewells have been found successful as a result of exploratory borings conducted by the Exploratory Tubewell Organisation. The utilisation of this perennial resource would depend on the possibilities of introducing perennial crops or *rabi* crops in addition to jute and paddy. Tubewells should be developed in clusters in the areas where perennial crops can be developed and where perennial surface water resources are not available.

5.6. Areas near the river banks can be protected from floods by providing marginal embankments along the rivers. For flush irrigation of the fields falling behind these embankments regulators can be provided in the embankments.

5.7. The diversion canals, which cost between Rs. 100 to Rs. 150 per acre of the benefited area, are best suited for this valley. Storage works on these streams can also be planned for storing water for meeting irrigation demand during non-monsoon months. This can be done subsequently if such demand is created.

5.8. The irrigation works can be successful in increasing production only if efforts are made to modify the pattern of agriculture. It is necessary to introduce double cropping and utilise the small quantities of water at present available during the non-monsoon months for *rabi* irrigation.

Cachar Valley

5.9. In the Cachar valley the lands along river banks are much lower than the flood levels and are therefore liable to regular flooding and there are also water logging conditions. The rainfall is heavy. There are large number of water pockets locally known as "Haors". Boro paddy, which is sown in the month of November to December, and harvested in March to April stands in need of irrigation.

5.10. In the master plan, there is mention of the possibilities of storing water in these "Haors" by constructing embankments along their periphery and filling them during monsoons and using this water for Boro paddy irrigation. These schemes may be tried in this area, which has no irrigation resources till now.

The Hills

5.11. In the hills, there are small narrow valleys with patches of plain ground here and there, which are generally used for cultivation. Shifting cultivation on slope locally known as "Jhooming" is also widely practised. Irrigation is needed only during *rabi* crops and possibilities of constructing contour channels taken out from perennial sources may be explored.

5.12. Jhoom cultivation, in which every alternate year fresh hill slopes are cleared by burning of forest growth and cultivated till the soil becomes useless by erosion of top soil, is obviously a very harmful practice. The fertile top soil, which could be utilised for purposes of production is lost and then the same soil causes silting and raising of river bed and becomes one of the causes for floods in plains. The slopes can be better utilised by introducing fruit trees in the area on a commercial scale.

Distribution of water

5.13. It is generally not possible for cultivators to manage a field channel of more than 2 cusecs. On the diversion canals outlets having up to 5 to 6 cusecs discharge have been provided. For discharges more than 2 cusecs minors may be constructed for exercising better control on water. Field to field irrigation should also be discouraged and field channels constructed.

Demonstration-cum-Research Farms

5.14. Success of irrigation in Assam depends largely on the change in cropping ideas. It is, therefore, very necessary that Demonstration-cum-research Farms are located in the areas under the commands of irrigation schemes. In these farms research may be conducted for finding out the crops for type of soils found in the vicinity which could provide maximum yields with the help of irrigation.

5.15. Suitable rotation of crop may also be worked out. The results could serve as illustrative examples for the cultivators of the area, who could be taught the use of better farming methods and use of implements and insecticides by demonstration. It is, however, very important that there is a close liaison between the staff of Irrigation and Agriculture departments.

Assessment of results

5.16. There should be arrangement for measuring the areas actually irrigated by various irrigation schemes every year. With this, it would be possible to watch the progress of utilisation of potential. In case the progress is slow, measures to accelerate the same can also be devised.

5.17. Data regarding improvement in the yield may also be collected at the time of crop cutting from time to time and place to place. This would help in devising measures such as alteration of variety, change in cropping pattern, determination of dose of fertilisers etc. for obtaining optimum production.

Water Rates

5.18. Whenever large sums of money are invested, it is necessary to look for the return, direct or indirect. The investment on a minor irrigation scheme can be justified only when it shows indirect benefits in the shape of increased production. However, if there are definite gains to the cultivators, there is no reason why a small fraction of the increased gains may not be charged as water rates.

5.19. When cultivators start realising the benefits of irrigation and become irrigation minded, the water which may seem to be unwanted in the beginning, suddenly becomes in great demand. If the cultivators are not trained to use the water carefully, it may not be possible to satisfy the demand of the entire command. Imposition of water rates would also make the cultivator realise the value of water. Remission could, however, be given in the early stages, say full in the first year, 3/4th in the second, half in the third, 1/4th in the fourth and no remission in the fifth year.

5.20. There are, in some areas, clusters of fields in small holdings which if consolidated may form compact blocks convertible into tea gardens because of soil and climatic suitability. These could be managed either on a cooperative basis or on a quasi cooperative basis involving supply of pickings to central processing plants owned and operated by the State. Possibilities of irrigation exist in Assam and such tea gardens could be located with advantage where irrigation facilities could be mobilised.

5.21. Possibilities also exist in Assam for developing horticulture with the available irrigation resources. Where irrigation works do not already exist, irrigation facilities could be provided with a view to develop horticulture on a commercial scale. This may eventually lead to establishment of fruit canning centres either on a co-operative basis or as a State venture.

Irrigation Code

5.22. It is necessary for the State to have an irrigation code giving legal powers to the staff employed on the management of irrigation schemes, so that they may not find difficulty in enforcing proper water utilisation discipline and management on the State schemes.

SUMMARY OF RECOMMENDATIONS

Assam as its name suggests has only a little level land, where irrigation in its conventional form could be practised. Rainfall being heavy and spread over a period of almost 6 months in the year, need for artificial irrigation is not keenly felt except in Tea Estates, which have evolved their own equipment and plant for providing artificial irrigation when necessary. Even in the limited scope of its irrigational needs, the State has not made much progress. Whatever irrigation works have been built need to be organised so as to help optimising production from irrigated lands. Recommendations listed below have resulted from the field studies made by the Team and some of them have already been discussed with the State authorities, who may have already taken steps to implement them.

I. Before taking up irrigation schemes proper planning with regard to full utilisation of the irrigation potential needs to be done. Coordinated efforts need to be mobilised at the field level to take advantage of the irrigation facilities being created. (Paras 2.6, 2.32).

II. Where possibilities of installing tubewells exist sugarcane could be developed extensively, for which sugar mills could be planned. (Para 3.9).

III. Depending upon the nature of the soil, other perennial sources of irrigation could also be utilised for raising sugarcane crops. (Para 2.5, 2.12, 3.9, 5.5).

IV. Recording of areas actually irrigated by various schemes needs to be done so as to indicate the extent to which actual irrigation takes place as also the increase in production on account of irrigation that accrues to those areas. (Paras 5.16, 5.17).

V. Tubewells should be furnished with delivery sumps, V-notch etc. along with properly built water channels so that water pumped at considerable cost does not get wasted. One or two officers could be deputed to visit Uttar Pradesh and study the working of tubewells there. (Paras 3.8, 3.12).

VI. Wherever storage works are feasible on non-perennial schemes and wherever irrigation demand is likely to arise in non-monsoon period, they should be planned and executed. Suitable water rates should be imposed wherever State irrigation works are provided. Remission could, however, be given in the early stages, say full in the first year, 3/4th in the second, half in the third, 1/4th in the fourth and no remission in the fifth year. (Paras 2.6, 4.7, 4.18, 5.19).

VII. Existing agriculture seed multiplication farms as well as additional ones wherever required may be utilised as research-cum-demonstration farms for working out the crop rotation and their specific varieties best suited to the local soil-climatic and rainfall and irrigation water supply conditions. (Paras 2.7, 3.11, 5.15, 5.16).

VIII. *Panchayats* could be entrusted to look after the proper maintenance of works constructed by cultivators with N.E.S. block funds. (Para 4.9).

IX. *Panchayats* could also develop a system of self-managed small irrigation societies or small cooperative lift irrigation schemes. (Para 4.14).

X. The centuries old Jhoom cultivation system is very harmful. The slopes could be better utilised by growing fruit trees on commercial basis, which will help soil conservation.

(Para 5.12).

XI. The State should have a proper irrigation code, like those operating in other States, to control the construction, maintenance and utilisation of irrigation and other allied waters.

(Para 5.22).

XII. With the natural water resources of Assam being ample and soil and climate being suitable for tea gardens and horticulture, it will be advantageous to develop irrigation schemes for promotion of tea gardens and horticulture on a cooperative basis.

(Paras 5.20, 5.21).

APPENDICES

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APPENDIX I

Terms of Reference

The minor irrigation projects may be divided for study into two parts:—

- (a) Works already in existence.
- (b) Works which are now being constructed.

2. Case studies should be made of a number of projects of each type under the above headings with a view to judging their efficiency having regard to the objectives with which such works were carried out.

3. The following points should be especially borne in mind:—

Existing Projects

- (i) The present state of repair and maintenance.
- (ii) The system of keeping works in proper maintenance with particular reference to the customary obligations of villagers for keeping such works in a sound condition from year to year, the team should also examine the extent to which these obligations are enforced, the reasons for the failure to do so and the steps that should be taken to carry out such obligations efficiently.
- (iii) Reasons, if any for non-utilisation of water by cultivators.
- (iv) Improvements necessary to make the projects more efficient either in the matter of better agricultural planning and practices or in respect of engineering works.
- (v) Cost of restoration if the project is in a state of disrepair and whether it has been included in the Plan.

New Projects

- (i) Method of selection—procedure and principles on which priorities were based.
- (ii) Flow Chart of the construction Project should be prepared to examine whether any avoidable delay has occurred in its completion.
- (iii) Whether fullest use is made of catchment capacity in preparing designs.
- (iv) Economics of design.
- (v) State of agricultural planning with a view to optimum utilisation of benefits.
- (vi) Institutional arrangements provided for the proper maintenance of new works with special reference to the customary obligation of villagers in this regard.
- (vii) Cost of actual construction compared to estimated costs the reasons for increase if any and the care with which the initial estimates were framed.

4. Any other matter which the Team considers necessary to report upon having a bearing on economy and efficiency of such projects.

5. The following information should be gathered by the Team for each State, taken as a whole in regard to existing minor irrigation works:—

- (i) The Total area irrigated from them according to Settlement registers.
- (ii) The area actually irrigated from year to year beginning from 1947.
- (iii) The reason for the reduction, if any in the area irrigated.

6. In addition, the Team will carry out a study of the tubewell schemes of the Punjab and the U.P. with reference to the fact whether optimum use has been made of the facilities available by ensuring scientific crop planning and by improving agricultural practices. The study should be based on an examination of individual tubewells, which may be divided into most successful, successful and least successful varieties for the purpose of study. The Team should also select a few tubewells for which alternative crop planning and practices may be recommended that are being carried out at present in order to make them more successful. The consideration mentioned regarding minor irrigation works in paragraph 3 *mutatis mutandis* be taken into consideration for the study of tubewells also.

APPENDIX II

Minutes of the meeting of Irrigation Team, Committee on Plan Projects, Planning Commission, Government of India with the officers of Assam Government held on 24-4-65 at 11.00 a.m. at Sachivalaya, Shillong

PRESENT

Government of Assam

- | | |
|--|---|
| 1. Shri D. Das, I.A.S., Commissioner, Agricultural Production. | 1. Shri M. Thirumala Rao, M.P., Leader. |
| 2. Shri B. C. Datta, Sr. Financial Adviser, Agricultural Production. | 2. Shri Baleshwar Nath, Member. |
| 3. Shri S. Chowdhury, Addl. Director, Agriculture. | 3. Shri B. S. Mal, Superintending Engineer. |
| 4. Shri H. Gogoi, Jt. Director, Agriculture. | 4. Shri P. C. Gupta, Executive Engineer. |
| 5. Shri C. Thomas, Dy. Secretary, irrigation. | 5. Shri P. Chadha, Research Officer. |
| 6. Shri U. K. Burman, Under Secretary, Irrigation. | |

1. Initiating the meeting the Leader of the Team, Shri M. Thirumala Rao explained the purpose of the study to be conducted by the Team and enquired what part minor irrigation works played in the agricultural economy of the State.

2. The Commissioner, Agriculture Production, Shri Das stated that there were no existing major and medium irrigation schemes in the State. Minor Irrigation works comprised some diversion schemes 4 lift irrigation schemes and 22 deep tube-wells. Schemes costing more than Rs. 50,000 were constructed and maintained by the Irrigation Department, while those costing less than Rs. 50,000 were under the jurisdiction of Agriculture Department. These schemes since the past one year, have been transferred to the Anchal Panchayats.

3. Shri Das also stated that the soil was fertile and rainfall was enough and a reasonable crop was obtained even without irrigation. As much as 80 maunds of paddy per acre on an average was obtained without much effort. In view of the fact that more agricultural production should be sought from land and water resources, it was intended to increase the productivity per acre. To attain this objective, irrigation seemed necessary, because sometimes a prolonged gap in monsoon or erratic rainfall caused diminution in agricultural production. The average holding was reported to be 6 local bighas equivalent to 2 acres.

4. The bigger problem in the State as explained by Shri Das was of getting excess water out in many cases than of bringing more water to the land. Shri Baleshwar Nath pointed out that the purpose of artificial irrigation would primarily be to make up the deficiency of moisture in the soil whenever it fell below the level necessary to keep the plant growth in the healthy state. Also the cropping should be planned such as to yield maximum possible agricultural production as well as economic return with a moisture naturally available in soil and artificially applied through irrigation, if needed, to maximise production. For that purpose, irrigation becomes necessary for optimum production of agricultural commodities. Sometimes it is not possible to use other inputs like fertilisers etc. without proper and timely application of irrigation. Since the surface resources of water in the State are apparently good and even ground water resources may be possible, such irrigation would be arranged without much difficulty. As an example, he suggested that areas which are capable of supporting sugarcane crops should be localised. Sugar cropping would be planned on such areas on a scientific basis. In the sugarcane zones, sugar factories could be planned and the land and water resources of such areas could be subjected to optimum use for maximising sugar production in the State. This applies to other crops also which may be of the high water-consuming type. Shri Das pointed out that their approach to the problem of irrigation in the State was in fact exactly the same.

5. Shri Das also stated that their irrigation has, upto now, been primarily production oriented, and no irrigation charges have been levied. There is no law in the State governing irrigation specifically and exclusively as obtained in western States.

6. Shri Baleshwar Nath member of the Team pointed out that in the absence of any assessment, it was not possible to find out the actual benefit derived from the introduction of irrigation. He suggested that the evaluation of benefits of irrigation should be conducted by an independent agency so that the actual advantage, that accrues from the various crops, is assessed scientifically. That will enable a proper appraisal as to how far investment on irrigation works will lead to increase in agricultural production as well as economic returns to the beneficiaries and to the State. Such statistics are regularly collected in States like Punjab.

7. It was enquired by the leader of the Team if steps were being taken to develop horticulture, as the terrain and climate seemed suitable for such development. It was intimated that although bananas were grown in abundance but the plantation had not been done generally on a commercial scale. Oranges and Pine-apple were also grown extensively. Cultivation of ginger was also being extended.

8. A Master Plan of irrigation, primarily concerned with major and medium schemes was also shown by Shri Burman Under Secretary. It was requested that a copy of the same be provided to the Team.

9. The leader of the Team thanked the State authorities for their cooperation and expressed the hope that the Team's study will be able to make some contribution in the evolution of a plan for augmenting agricultural production in the State.

APPENDIX III

Statement of month-wise rainfall in millimeters in various districts of Assam in the year 1960.

| Sl. No. | Station | District | Total rainfall (in mm) in the month | | | | | | | | | | | | Total rain fall (m.m.) in the year |
|---------|-----------|-------------------|-------------------------------------|------|-------|-------|-------|-------|---------|-------|-------|-------|-------|------|------------------------------------|
| | | | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | |
| 1. | Golpara | Golpara | — | — | 35.8 | 15.2 | 516.2 | 295.0 | 701.6 | 209.9 | 634.0 | 95.0 | — | 4.4 | 2,507.1 |
| 2. | Gauhati | Kamrup | — | — | 30.4 | 15.6 | 317.3 | 224.2 | 303.6 | 595.1 | 222.3 | 46.7 | 10.2 | 3.0 | 1,768.4 |
| 3. | Tezpur | Darrang | — | 10.1 | 5.1 | 4.9 | 277.4 | 342.7 | 393.9 | 297.9 | 279.6 | 16.2 | 42.3 | — | 1,670.1 |
| 4. | Lumding | Nowgong | — | — | 12.4 | 35.0 | 188.4 | 218.5 | 90.4 | 250.0 | 131.8 | 36.8 | 33.4 | — | 997.0 |
| 5. | Jorhat | Sibsagar | — | 25.2 | 31.4 | 15.4 | 180.8 | 457.4 | 342.6 | 248.5 | 236.2 | 26.1 | 28.5 | — | 1,592.1 |
| 6. | Dibrugarh | Lakhimpur | — | 28.5 | 24.8 | 130.6 | 290.3 | 419.8 | 675.3 | 497.8 | 296.5 | 7.4 | 12.0 | 22.1 | 2,405.1 |
| 7. | Silchar | Cachar | — | 1.2 | 25.8 | 113.5 | 320.4 | 536.4 | 459.0 | 556.0 | 221.0 | 136.9 | — | — | 2,370.2 |
| 8. | Tura | Garohills | — | — | 107.4 | — | 443.5 | 522.2 | 1,044.4 | 254.8 | 199.8 | 95.7 | — | — | 2,667.8 |
| 9. | Shillong | K. J. Hills | — | — | 12.3 | 64.4 | 1.8 | 233.6 | 395.0 | 316.1 | 218.1 | 760.2 | 136.9 | 0.6 | 2,139.0 |
| 10. | Hablong | U. M. N. C. Hills | — | 1.2 | 16.2 | 54.3 | 277.5 | 622.5 | 410.8 | 354.7 | 237.7 | 161.2 | 96.5 | — | 2,232.6 |
| 11. | Aijal | Mizo Hills | — | 2.5 | 25.4 | 52.2 | 387.4 | 525.6 | 869.5 | 230.4 | 263.5 | 161.8 | 87.4 | 1.0 | 2,606.7 |

APPENDIX IV

Monthly Discharge of Noanadi River at Headworks of C.M. Datta's Canal for 1964.

| Month | Maximum discharge | Minimum discharge | Average discharge |
|-----------|-------------------|-------------------|-------------------|
| January | 171 cusecs | 108 cusecs | 124 cusecs |
| February | 107 .. | 65 .. | 84 .. |
| March | 152 .. | 57 .. | 65 .. |
| April | 234 .. | 45 .. | 95 .. |
| May | 401 .. | 57 .. | 102 .. |
| June | 1915 .. | 56 .. | 450 .. |
| July | 2077 .. | 112 .. | 492 .. |
| August | 1828 .. | 171 .. | 772 .. |
| September | 2310 .. | 270 .. | 828 .. |
| October | 1862 .. | 233 .. | 477 .. |
| November | 504 .. | 230 .. | 282 .. |
| December | 251 .. | 186 .. | 211 .. |

APPENDIX V

Statement showing particulars of the Twenty-two Deep Tubewells in Assam

| Name of district | Sl. No. | Name of scheme | Name of civil sub-div. | Estimated value of scheme | Year of completion | Depth of boring in feet | Discharge in G.P.H. | Draw down in feet/SWL | Gross command area in acres |
|------------------|----------|---------------------|------------------------|---------------------------------|--------------------|-------------------------|---------------------|-----------------------|-----------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Kamrup | 1 | Tulsibari | Gauhati | Bored by E.T.O. value not known | 23-3-60 | 1000 | 38000 | 6.7 7.5 | 250 |
| | 2 | Barama | " | Do. | 1-4-60 | 761 | 38200 | 17.2 7.8 | 225 |
| | 3 | Haripur | " | Do. | 29-3-60 | 760 | 38000 | 10.2 7.4 | 235 |
| | 4 | Tamulpur | " | Do. | 23-3-60 | 1016 | 38000 | 6.7 7.3 | 275 |
| Darrang | 5 | Natun Sarajuli | Tezpur | Do. | 28-4-60 | 750 | 38000 | 29.5 7.5 | 150 |
| | 6 | Sialmari Pathar | " | Do. | 3-5-60 | 1016 | 38000 | 8.4 7.6 | 270 |
| | 7 | Habigaon | " | Do. | 23-3-60 | 299 | 30000 | 18.35 14.55 | 155 |
| | 8 | Bhargaon | " | Do. | 22-2-60 | 461 | 37800 | 20.77 7.47 | 190 |
| | 9 | Dhekeajuli | " | 55426 | 20-5-59 | 454 | 20000 | Not known | 100 |
| | 10 | Bagmari | " | 57298 | — | 455 | 20000 | Do. | 100 |
| Mikir Hills | 11 | Sunpara | Mikir Hills | Do. | 3-64 | — | 22400 | — | 112 |
| Nowgong | 12 | Kaki No. 2 | Nowgong | Bored by E.T.O. value not known | — | 500 | 10000 | — | 30 |
| | 13 | Kaki No. 3 | " | Do. | — | 500 | 10000 | — | 100 |
| | 14 | Bhalukmari | " | Do. | 19-1-61 | 474 | 28320 | — | 150 |
| | 15 | Hojai | " | Do. | 16-1-61 | 560 | 39920 | — | 200 |
| | 16 | Dobaka | " | Do. | 4-12-61 | 440 | 37920 | — | 190 |
| | Sibsagar | 17 | Fallanguri | Golaghat | Do. | 8-59 | — | 20000 | — |
| 18 | | Barapathar | " | Do. | 4-59 | — | 20000 | — | 50 |
| 19 | | Sarupathar | " | Do. | 11-62 | — | 27780 | — | 138 |
| 20 | | Lodoigarh | Jorhat | Do. | 2-64 | — | 30000 | — | 150 |
| 21 | | Titabar | " | Do. | 1-64 | — | 19000 | — | 95 |
| 22 | | Johrat Agr. College | " | Do. | 2-62 | — | 26900 | — | 135 |

APPENDIX VI

Statement showing area irrigated and hours run of 22 deep tubewells in Assam

| Sl. No. | District | Name of Tubewell | No. of Hours run | | | C.C.A. (Acres) | Area irrigated (Acres) | | |
|---------|-------------|------------------|------------------|-------|-------|-------------------|------------------------|-------|-------|
| | | | 62-63 | 63-64 | 64-65 | | 62-63 | 63-64 | 64-65 |
| 1 | Kamrup | Tulsibari | 792 | 988 | 906 | 250 | 19 | 32 | 34 |
| 2 | | Barama | 219 | .. | 165 | 235 | .. | 48 | 33 |
| 3 | | Haripur | 115 | 172 | 175 | 225 | .. | 11 | 4 |
| 4 | | Tamulpur | 647 | 1,905 | 2,246 | 275 | Drinking water supply | | |
| 5 | Darrang | Natun Sarajuli | 76 | 91 | 123 | 150 | 14 | 17 | 24 |
| 6 | | Sialmaripathar | 123 | .. | 154 | 270 | .. | .. | 6 |
| 7 | | Habigaon | 118 | 89 | 132 | 155 | .. | .. | 5 |
| 8 | | Bhargaon | 207 | 105 | 283 | 190 | .. | .. | 38 |
| 9 | | Dhekiajuli | 130 | 137 | 29 | 100 | 16 | .. | .. |
| 10 | | Baghmari | 1,106 | 1,079 | 495 | 100 | 12 | 25 | 1 |
| 11 | Nowgong | Kaki No. 2 | .. | 547 | 176 | 30 | .. | 15 | 12 |
| 12 | | Kaki No. 3 | .. | 662 | 317 | 100 | .. | 17 | 22 |
| 13 | | Bhalukmari | .. | 637 | 536 | 160 | .. | 18 | 84 |
| 14 | | Hojai | .. | 544 | 844 | 200 | .. | 28 | 96 |
| 15 | | Dobaka | .. | 472 | 224 | 190 | .. | 27 | 10 |
| 16 | Sibsagar | Fallangari | .. | 141 | 184 | 100 | .. | 3 | 3 |
| 17 | | Barpathar | .. | .. | 134 | 100 | .. | .. | 6 |
| 18 | | Sarupathar | .. | .. | 178 | 140 | .. | .. | 22 |
| 19 | | Ladoigarh | .. | .. | .. | 150 | .. | .. | .. |
| 20 | | Titabar | .. | .. | .. | 95 | .. | .. | .. |
| 21 | | Agr. College | .. | .. | .. | 135 | .. | .. | .. |
| 22 | Mikir Hills | Sunpara | .. | .. | .. | 112 | .. | .. | .. |

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