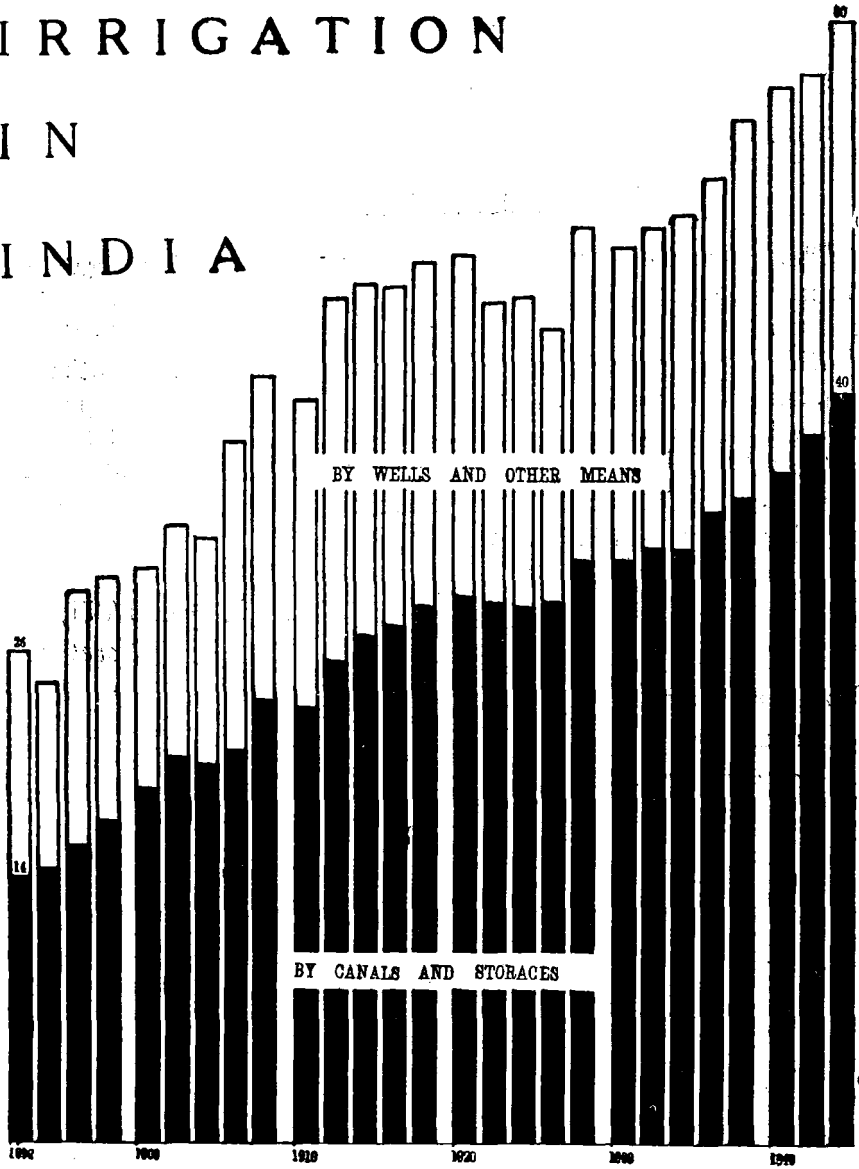


# IRRIGATION IN INDIA



AREA IRRIGATED IN PROVINCES

CENTRAL BOARD OF IRRIGATION

Popular Series

Leaflet No. 1

## FOREWORD

The great achievements in India, in respect of irrigation, have never been realised fully by the world, perhaps not even by the Indian people themselves. The bright facts relating to these activities are known only to engineers and perhaps to a few others. The people at large do not even know the facts. To create public interest in and understanding of facts and problems vital to the country this new series is being inaugurated by this leaflet which describes very briefly the great achievements of our country in Irrigation Science and Practice.

N. D. GULHATI,  
*Secretary.*

KENNEDY HOUSE,  
SIMLA,  
1st January 1947.

# IRRIGATION IN INDIA

## A LEADING ROLE

**F**OUR hundred thousand cubic feet per second, or 400,000 cusecs, represent a volume of water which, flowing continuously, would cover the whole of Delhi Province with a depth of over two feet in a day and a night. This is the capacity of the canals of India which have given her, in respect of irrigation, the leading place among all countries of the world. The total length of these canals is eighty thousand miles, more than three times the circumference of the Earth.



The Sukkur barrage.

The world's biggest barrage and the biggest irrigation venture

India irrigates every year over seventy million acres of land. This is the largest area which is irrigated in any country of the world. It is more than three times that irrigated in the United States of America, the next most irrigated country and one twice as large as India. The area irrigated in India is more than the whole combined total of any other ten countries of the world. How has she come to occupy this leading role? It is a long and fascinating story, of bold enterprise, of magnificent skill and courage, of innumerable difficulties overcome, of endless worry and loyal and selfless service. It will take volumes to narrate this story adequately, but here it is in brief outline.

### THE NEED FOR IRRIGATION

It has been estimated that situated as India is geographically and with the rainfall conditions as given to her by Nature, for successful cultivation, irrigation is necessary in one form or the other in all parts of the country where the mean annual rainfall is less than 50". This is so in the whole of Baluchistan, Sind and Rajputana where the rainfall is less than 5 inches in a year, in the best part of North West Frontier Province, the Punjab and the United Provinces, in parts of Central Provinces, Bihar and Orissa and over the whole of the Deccan plateau except a fringe along the western coast.

The quantity of water and the frequency of irrigation required to mature the same crop in different parts of the country varies very considerably. In some places not a blade of grass would grow without the artificial application of water. At others no irrigation is necessary; rain-fall is plentiful and at times the problem is to get rid of surplus rain water to drain the land for cropping. In between these two limits there is a wide range of the quantity of water required to mature crops. At some places irrigation works are required, as a standby plant, to be used once in a few years during a drought, at others, for some of the more valuable crops, only in the period just before the rains set in and during the dry season. There are many large tracts, however, where irrigation is a necessary complement of cultivation and is required all the year round. The statement opposite illustrates the varying requirements of irrigation as well as the extent of irrigation practised in different parts of the country.

Name of Unit	Total area of unit	Area cultivated annually	Percentage of cultivated area to total area	Area irrigated annually	Percentage of irrigated area to cultivated area	Percentage of irrigated area to total area
1. Sind .. ..	30	6	19	6	100	19
2. Bahawalpur ..	13	2	16	2	99	15
3. Punjab ..	61	32	52	19	60	31
4. N. W. F. P. ...	23	3	11	1	43	5
5. Patiala ..	4	3	84	1	38	32
6. United Provinces	68	45	68	12	27	18
7. Madras ..	80	37	46	10	26	12
8. Orissa ..	21	7	34	2	22	8
9. Bihar ..	44	24	52	5	22	12
10. Mysore ..	19	7	35	1	16	6
11. Bengal ..	49	30	60	2	6	4
12. C. P. and Berar	63	27	43	2	6	3
13. Hyderabad ..	53	29	31	1	5	1
14. Bombay ..	49	30	61	1	4	2

*Areas in million acres correct to the nearest million*

In Sind and Bahawalpur, the area cultivated is a small proportion of the total but it has to be entirely irrigated; in the Punjab the bulk of the area cultivated receives irrigation. On the other hand, in Bengal and Bombay the area irrigated is only a small fraction of the cultivated area which in itself is a fairly large proportion of the total.

### SOURCES OF IRRIGATION SUPPLIES

Supplies for irrigation are obtained from three sources :

- (1) directly from the waters flowing in natural streams,
- (2) from the storage of flood waters of these streams or directly of rain-water in small tanks, and
- (3) from the under ground sub-soil reservoir.

In different parts of the country the extent to which supplies are available from the three sources mentioned above varies ; so also does the extent to which the available sources can be utilised economically. Of these sources the first is generally the most economic, the easiest to exploit and the most important for the extensive irrigation works of the country.

### IRRIGATION AN OLD ART

There are large areas in the country where the annual rainfall varies from nothing to about 20 inches. It is easy to appreciate therefore that, in these arid tracts, irrigation must have been contemporary to agriculture itself. The knowledge of the country and the habits of the people lead one to believe that well irrigation and inundation from the swollen rivers during the monsoon must have been practised since the earliest times. In fact, frequent references to the practice of irrigation have been traced in the records dating back to many centuries before the commencement of the Christian Era. Wells have been in use from time immemorial and of the large number of tanks which are found in the Deccan many have been in existence for centuries. But the works which have made India famous for her irrigation practice have been constructed mainly during the last hundred years.

### ✓ A HUNDRED YEARS AGO

Early in the nineteenth century schemes were taken in hand for the improvement of some of the indigenous irrigation works in the country. Three of the most important of these were the remodelling of the two canals from the river Jumna which were constructed originally about the fourteenth century and the Cauvery Delta System in Madras, the original work on which is generally ascribed to about the second century. The three systems as then reconstructed were much smaller in magnitude and primitive in form, than they are to-day. These three systems and a number of inundation canals mostly on the river Indus irrigated, about 1850, two to three million acres per year. About twice as much area must have been under well irrigation at that time.

### ✓ NEW VENTURES

The experience gained on the two canal systems on the Jumna and one on the Cauvery led directly to investigations regarding possibilities of extending river irrigation to other parts of the country. The first of these and, one, which will be regarded, for all times, as a great feat of irrigation engineering, was the Ganges Canal in the United Provinces, work on which had been started in 1842 and which was opened for irrigation in

1854. It is a large canal, 200 feet wide at the head with a water depth of 11 feet. This canal made an enormous advance in Hydraulic Engineering. It was followed by the Upper Bari Doab Canal in the Punjab which was opened for irrigation in 1859 and the Gudavari Delta system in Madras. It was on the last system that, for the first time, a permanent head-works was built in the river ; the other canals then existing had only temporary expedients at their heads, built every year.

Among other schemes undertaken, during the period the three classic works described above were built, may be mentioned the improvements made to the inundation canals in Sind and the Punjab and to other small irrigation works existing in Bombay and other parts of India. The most important of these is the Kistna Delta system which was completed and opened in 1855. It was about the same time that two private companies the Madras and East India Irrigation Companies were formed and undertook the construction and operation of the Kurnool Cuddapah canal in Madras and the Orissa canals, respectively and these works represent the only great failures in the history of Irrigation in India.

### ✓ A NEW POLICY AND AN IMPORTANT PRINCIPLE

The failure of private companies and the success made on the works undertaken by Government led to the acceptance in 1866 of the policy of supplementing the ordinary resources of government by means of public loans for the construction of productive public works. Looking back, it can be stated that it was the adoption of this policy which rendered possible the very great development of irrigation works in India, that followed.

It was a year later in 1867, that the Government of India laid down a basic principle in connection with the then projected Sirhind Canal in the Punjab which has been the guiding light of irrigation projects ever since. It was laid down that the waters of a river should be utilised to the best possible advantage in the tracts commanded, irrespective of territorial boundaries.

### ✓ LOAN WORKS

The new policy of financing productive irrigation works from public loans led to the inauguration of several new works, large and small, the most important of which were the Sirhind Canal in the Punjab, the Lower Ganges Canal and the Agra Canal in the United Provinces, the Lower Swat Canal in the North-West Frontier Province and the Mutha Canals in Bombay. The first four of these canal systems were similar to those which had been constructed before and were therefore designed with more confidence than in the past.

✓ The last of these, however, the Mutha Canals in Bombay, marked yet another stage in the history of irrigation in India. "India was already well ahead of other countries both in the size of her canals and in the magnitude of the river works from which their supplies were drawn; with the construction of the Mutha Project she entered upon a new field, the building of great masonry dams". The Khadakvasla dam near Poona was started in 1869 and completed in ten years. This dam is almost a mile in length and about a hundred feet high.

Among other works carried out towards the close of the nineteenth century, the Lower Chanab Canal in the Punjab can rightly claim to be the most extensive and successful irrigation system in the world. This canal carries at its head a supply of water almost equal to that in the river Thames in flood, at London.

✓ The Periyar system in the South, also completed about the same time, had as its novel feature, the diversion across the peninsula, into the Bay of Bengal, of a large river which for centuries past had flown into the Arabian Sea. The Periyar has its source in the Western Ghats from where it flowed through uninhabited jungle towards the west. The change in its course was affected by the construction of a large dam in almost impenetrable and malaria ridden jungle and by carrying the river from the lake so formed through a tunnel bored through the main watershed of the country. The difficulties surmounted in the execution of this project were perhaps the greatest ever met with.

✓ Other works of the last century which may be mentioned in passing are the Nira Canals taking off the Bhatghar Dam in Bombay, the Jamrao Canal in Sind the Kabul River Canal in the North West Frontier Province, and the Lower Jhelum Canal in the Punjab. The last named was actually opened for irrigation in 1901.

### ✓ THE INDIAN IRRIGATION COMMISSION

The beginning of the twentieth century was marked by the convening of the Indian Irrigation Commission 1901-1903 as a result of whose recommendations, a large number of new works were under-taken and the construction of new canals in the country was accelerated.

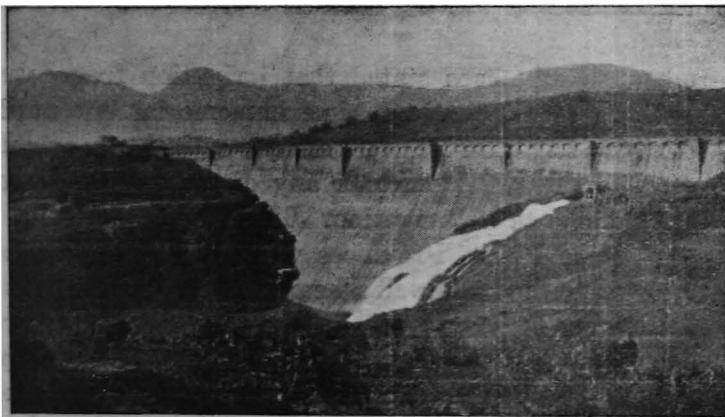
The first important work of the present century is the Triple Canals Project in the Punjab, the largest irrigation work executed upto the date of its commencement. As a peculiar feature of this project, the surplus water of the Jhelum was transferred across the Chenab and the Ravi into the Lower Bari Doab Canal. Three canal systems were constructed and this enabled the waters of



the Jhelum, the Chenab and the Ravi to be utilised to the best advantage of the province, irrespective of watershed boundaries. The new canals brought under command an area of four million acres. The work on the Triple Canals Project had hardly been completed when World War I placed a check on future progress.

### BETWEEN THE TWO WARS

With the end of World War I, a number of new large irrigation projects in different parts of the country were pursued with vigour. The Sutlej Valley Project, comprising four headworks on the river Sutlej and eleven canals, now irrigates an area of about two million acres in the Punjab in addition to vast areas in Bahawalpur and Bikāner. The Lloyd Barrage Project, with the largest barrage in the world at Sukkar and seven canals with an aggregate capacity of over forty thousand cubic feet per second, was brought into operation in 1932. The barrage has a length of just under a mile and was built at a cost of rupees four crores, the canals costing another sixteen crores. Other projects taken up after World War I were the Sarda Canal Project in the United Provinces, the Damodar Canal Project in Bengal, and the Divi Island Project in Madras which is the first attempt made in India for irrigation by pumping on a large scale. The Cauvery Metur Dam in Madras was constructed in 1925-34. In addition to irrigating an area of well over a million acres, it also provides for hydroelectric generation. About the same period, two important dams were also constructed in Bombay, the Bhatgar Dam for the old Nira Canals and the Wilson Dam for the Pravara Canals. The latter dam is 270 feet high and the highest in India to date.



**Wilson Dam**  
India's highest dam 270 ft. high

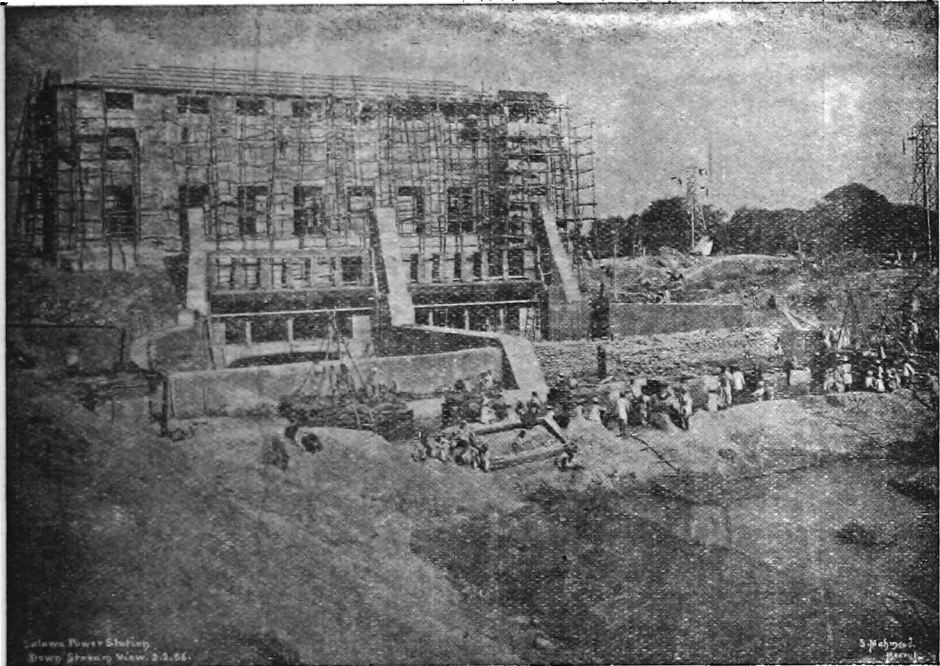
The last of the big projects to be under-taken before World War II were the Haveli and the Thal Projects in the Punjab. The latter had hardly been commenced when the war broke out and the completion of the project had to be postponed. The Thal Canal is being opened formally in a few days.

## WORLD WAR II

During the years of World War II, no new projects could be taken up. Some of the smaller projects in hand were however, brought to completion. The Bengal Famine of 1943 and the subsequent acute food shortage throughout the country brought home to all—government and people alike—that in spite of the extensive irrigation works already constructed, India was not yet self-sufficient for feeding her growing population. Since new construction could not be taken in hand immediately, opportunity was taken to investigate new schemes of development and many projects, were prepared, which could be taken up after the world war ended. A large number of small irrigation schemes and improvements in many more were however carried out to provide immediate relief in the food situation.

## IRRIGATION FROM THE SUB-SOIL RESERVOIR

It has already been stated that irrigation from wells has been practiced in India from time immemorial but until lately this form of irrigation was left almost entirely to private enterprise. Government seldom took any direct interest in an extension of this system of irrigation. The first in the field in this respect was the United Provinces which in 1933 laid the foundation of a state owned tubewell scheme. From 71 tubewells brought into operation in that province in the year 1933-34, their number has increased steadily to 1,649 in 1943-44, involving a capital outlay of about two crores of rupees. Other provinces and States are now initiating numerous similar projects of varying magnitude, and are also assisting the cultivators in the construction of new wells.

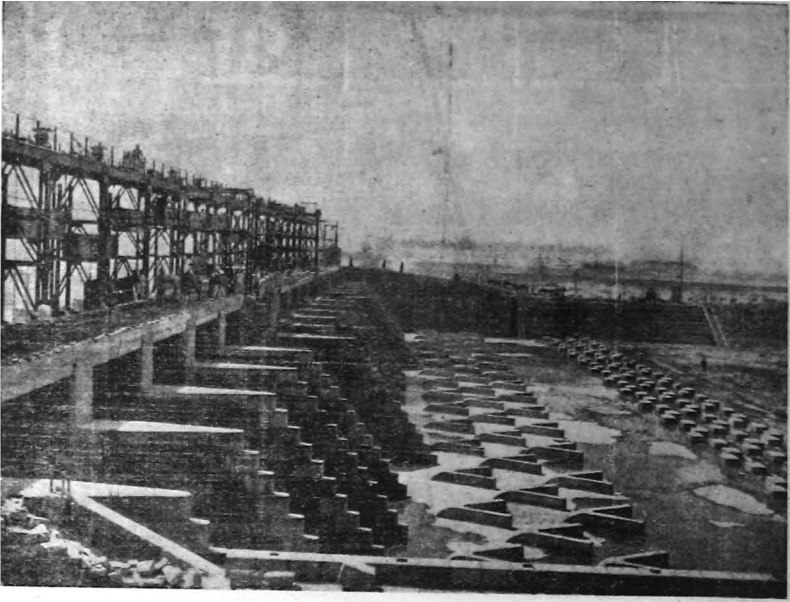


**Salawa Power Station (under construction)**  
**Supplies energy for working tube wells**

### IN RETROSPECT

The steady development of Irrigation works in India has been traced in the preceding paragraphs. It is however, necessary to state that only the more important schemes have been mentioned; there are many more comparatively small in magnitude, but equally important to the areas they serve. Another fact which deserves special mention here is that almost every project undertaken in the last century has since then been increased considerably in scope and enlarged in size. Another peculiar feature of these projects is that, unlike many other undertakings, there is no depreciation. The efficiency of the works has been maintained as originally designed, nay, in most cases as better knowledge of Hydraulics and canal engineering becomes available, the efficiency and utility of the works are increasing in a remarkable manner.

The result of all these endeavours is reflected in the steady increase in the area irrigated year by year. It will be seen from



**A view of the Khanki Headworks on the river Chenab  
after reconstruction in 1934**

**Showing downstream protection**

the diagram on the title page of this leaflet, that from 14 million acres irrigated by canals and tanks in the year 1892 in the provinces of India, the irrigated area from the same sources has increased to 40 million acres in 1945, the total irrigation from all sources having increased from 26 million acres to 60 million acres in the same period.

### ✓ **FINANCE**

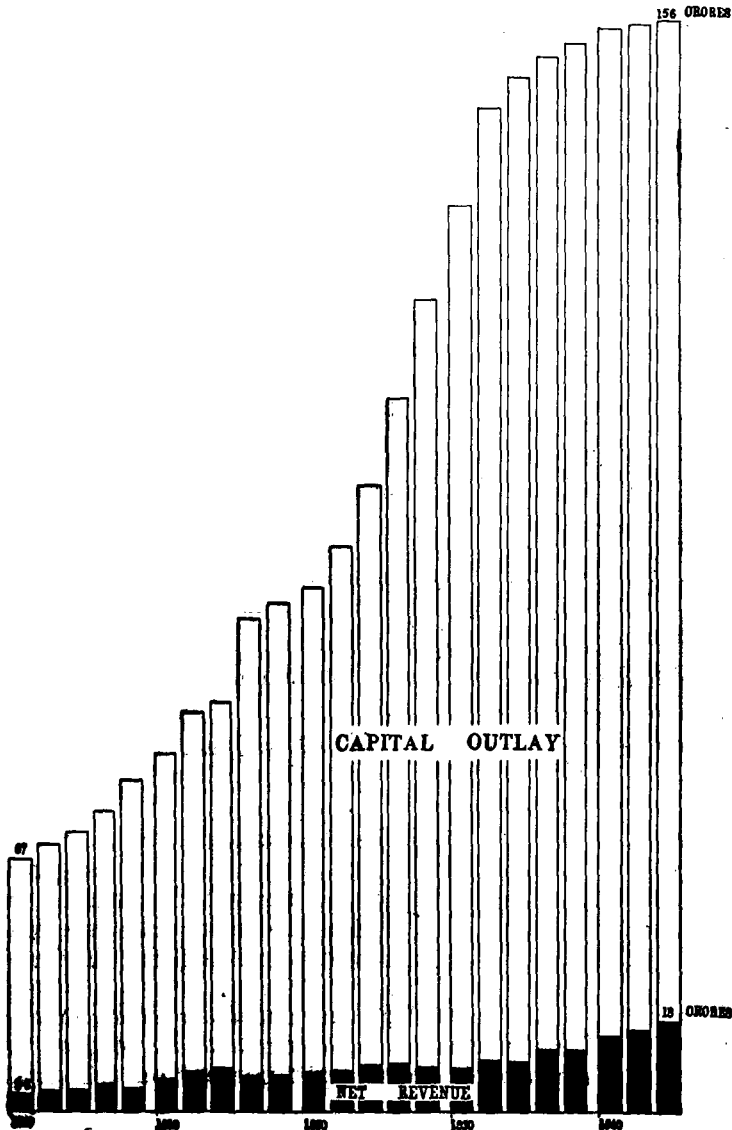
Irrigation works are divided into two classes :

- (1) Productive, the revenue from which is sufficient to meet interest charges on the capital outlay,
- (2) Protective, the revenue from which is not sufficient to pay interest charges on capital.

Projects of the first type can be financed from public loans but under the existing rules, protective works can be constructed only from the general revenues of the administration concerned. The diagram opposite shows the rapid increase since 1900

in the capital outlay on irrigation works both productive and protective, from twentyseven crores of rupees to one hundred and fiftysix crores.

This sum of rupees one hundred and fiftysix crores is not however a correct estimate of the present value of irrigation works in India. If these works were to be constructed to-day they would cost about two to three times as much.



## REVENUE

Charges for water supplied for irrigation from government canals, *etc.*, are levied differently in different provinces. In some, the ordinary land revenue assessment for irrigated areas includes charges for the supply of water, the latter amounting to as much as 9/10th of the total. In most areas, however, water is paid for separately according to the area actually irrigated and matured, the rate varying with the crop sown. Other methods of assessment, based mostly on the quantity of water supplied, have been tried but the average cultivator in the country fully understands the principle of 'No crops, no charge' and has little confidence in any system in which the liability of water charges is independent of the area and the quality of the crop sown.

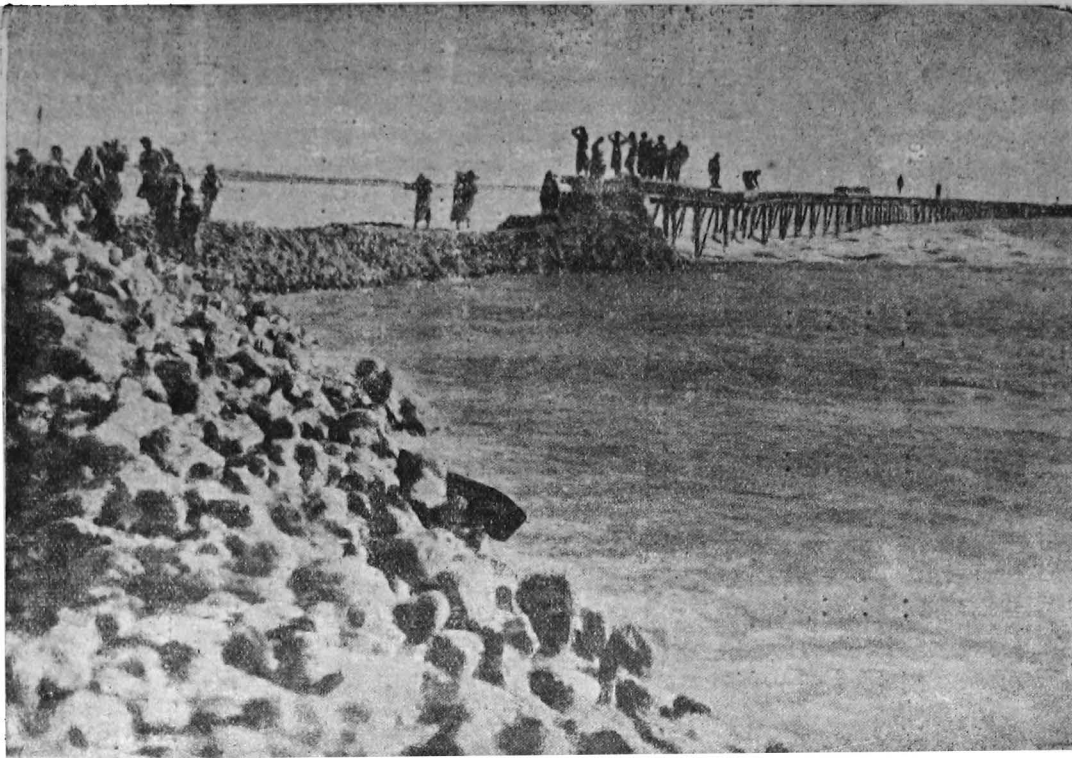
A different system of assessment is in force in parts of Bengal and the Central Provinces, where the cultivator pays a small rate for a term of years whether he takes water or not. In these areas the normal rainfall is high and irrigation is required only occasionally, when the rains fail or are delayed. Here the cultivator really pays a small annual premium to ensure that he can get water whenever he may want it.

The following considerations generally guide the fixing of water charges for different crops:

- (1) The amount of water used by the crop,
- (2) The scarcity or plentifulness of the water at the time, *e.g.*, water in the dry weather is less plentiful than during rains,
- (3) The value of the individual crop obtained from irrigation, and
- (4) The comparative cost of irrigation by other means, such as open wells.

The most important of these considerations is the value of the crop to the cultivator. Thus the rate for sugar-cane is higher than the rate for wheat and the rate for wheat is more than that of fodder. In each case the water rate is a small percentage of the benefit the cultivator derives from the water.

The net revenue earned by the canals in India, after deducting the cost of maintenance and operation, is rupees thirteen crores, which represents about eight percent on the capital outlay.



**Diversion of the river Indus at Kalabagh Headworks  
A trestle bridge has been constructed to block the right channel of the river**

## OTHER BENEFITS

The net revenue earned by Irrigation projects in India is however, not a correct measure of the benefits derived from them by the country and the people. The total value of crops raised with the water supplied by these works is a better indication. The following figures speak for themselves :

Year				Value of crops raised by water supplied from canals and tanks
1910-11	..	..	..	58 crores
1919-20	..	..	..	168 crores
1929-30	..	..	..	119 crores
1938-39	..	..	..	109 crores

With the rise in prices since 1938-39 and the increase in area irrigated, the value of crops raised in a single year must now be at least 300 crores or twice the total capital outlay on the irrigation works in the country. This is an achievement to be proud of.

This large production of the value of rupees 300 crores brings to the country increased prosperity. It provides increased employment to the people in transport and in industries where the raw-material is utilised. It saves in famine expenditure and brings additional income to local governments from excise, sales tax and registration, *etc.* The Central Government obtains large sums in the form of income-tax from factories utilizing agricultural produce, from railway transport, from increase in excise and customs and in many other ways. The value of the land to which irrigation water is supplied is raised manifold.

The existing rules for determining the productivity of irrigation projects do not take into account the numerous indirect benefits described above and it appears imperative that in the general interest of the country, the policy of government requires some modification in this respect.

### (1) ADMINISTRATION

Water flowing in natural streams and rivers is the wealth of the Nation and the duty of governments is to arrange and control the utilisation of this public property for the public good. Axiomatically the distribution of water should be for the greatest good of the greatest number. Although as stated before a charge



is made for the supply of irrigation water, it is not open for one to get more than a fixed quantity of water, no matter what he is prepared to pay for it. The quantity of water to be given to an individual depends on the area of the land on which it is to be utilised. The Canal and Drainage Acts in force in different parts of India have laid down as a principle that water is allotted to the land and not to an individual, whether landowner, lessee, or cultivator.

Until the Government of India Act (1935) came into operation, irrigation was a reserved provincial subject over which the Central Government exercised the usual powers of superintendence, direction and control. In addition to these powers, a further responsibility was imposed on the Government of India by the provision of the Audit Resolution which required the sanction of the Secretary of State to the construction of any new irrigation work, exceeding in cost rupees fifty lakhs. In deciding whether to grant or withhold such sanction the Secretary of State no doubt, acted upon the advice tendered to him by the Government of India who consequently assumed some responsibility for the soundness of the scheme and estimate.

With the measure of provincial autonomy granted by the Government of India Act (1935) provinces are now free to sanction all projects of irrigation development. But no satisfactory provision was made in the Act to ensure reconciliation between the interests of different units where these are in conflict and settlement of disputes between such units. It is hoped that the new constitution which emerges from the labours of the Constituent Assembly will not be wanting in this respect and suitable machinery will be set up to implement the very sound and well tried principle laid down in 1867, which has been referred to already, that the waters of rivers should be utilised in the area commanded to the best possible advantage, irrespective of territorial boundaries. Thus only can be ensured rapid and optimum development of the water resources of the country.

### THE INDIAN STATES

All that has been said in the preceding paragraphs referred to the development and progress made in the provinces of India. It is not to be understood however, that the Indian States have been mere spectators in the years past. Some of the projects undertaken in the provinces included in their scope lands in the adjoining Indian States. But apart from this, some of the Indian States have themselves been as active, in respect of irrigation works, as some of the most advanced Indian provinces. Among others the Governments of Mysore and Hyderabad and

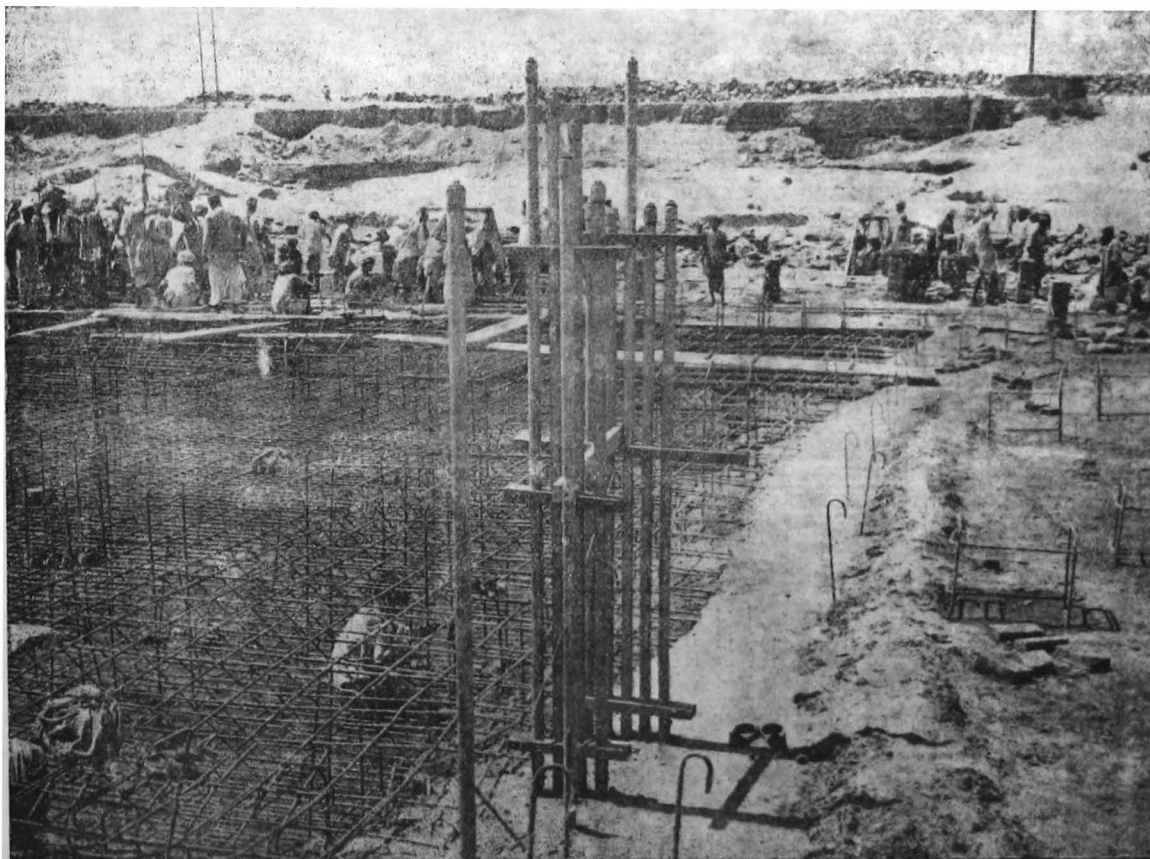
the Rajputana states have during the past fifty years or more constructed a large number of important irrigation works. The area under irrigation in the Indian States is increasing rapidly and in 1945, over ten million acres were under irrigation.

### ✓ THE FUTURE

Great as have been the achievements in the past, there are immense possibilities for the future. The recent food shortage in the country has stressed the need for immediate developments for new irrigation facilities. During the last few years a large number of projects, some of them sufficiently lucrative have been prepared for the further utilisation of the water resources of the country. It has been estimated that the existing irrigation works utilize less than a quarter of the utilisable resources that exist in India. Naturally the new schemes cannot be as profitable as those of the past, but if the water resources are utilised in multi-purpose projects on a regional basis, most of them will be self-supporting. There is no doubt therefore that the leading role which India occupies today, in respect of irrigation acreage, works and practice will be maintained for all time to come.

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**Trimmu Headworks (under construction)**  
**Showing heavy reinforcement in the floor of the barrage**