

# Sind and the Lloyd Barrage

(As revised up to September 1933)

November 1933

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Administration and

a Note on Statistics.

sition.

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# REVIEWS OF ADMINISTRATION IN BOMBAY PRESIDENCY

No. II

## SIND AND THE LLOYD BARRAGE

### INTRODUCTION

This Review was originally compiled under instructions of His Excellency the Governor, Sir Frederick Sykes, issued in 1929 in consonance with the intention of having the whole administrative machinery of Government examined and ensuring efficient working in accordance with present and future economic and progressive requirements. It now includes all the important changes effected during the last five years including a summary of reforms, developments, economies carried out and proposals which Government have considered and rejected. The position disclosed has been examined by the Reorganization Committee, and the subject matter, including the recommendations of that committee, brought up-to-date for future reference and assistance.



# REVIEW of SIND AND THE LLOYD BARRAGE

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# REVIEWS OF ADMINISTRATION IN THE BOMBAY PRESIDENCY

## No. II

### SIND AND THE LLOYD BARRAGE

#### GENERAL.

Sind being situated beyond the reach of the south-west and the north-east monsoons with a slight and fitful rainfall, the area of cultivation depending upon rainfall is insignificant. The river Indus, however, flows through its entire length and for many generations water brought by a system of canals and by branches of the river on to the land, has rendered cultivable a certain area. The supply of water, being dependent upon the rise and fall of the Indus, fluctuates, however, and whilst most of the large canals are regulated and the supply is reasonably assured, there can be no guarantee that water will be available at the season when the cultivator requires it.

2. The British occupation of Sind took place in 1843. In 1855 Lieutenant Fife reported on the irrigation of Sind and proposed a complete revision of the existing canal systems and the construction of new canals to supply almost the whole cultivable area. His scheme practically corresponded to the right and left bank areas of the present Sukkur Barrage project.

3. With his scheme Fife submitted a rough estimate of only one area—the Rohri-Hyderabad area. The authorities in England returned this in 1857 because it was not based on accurate surveys, and authorized a minute survey of the whole of Sind. The Rohri-Hyderabad canal was then surveyed and the project resubmitted in 1859, but remained in abeyance till 1867, when it was taken up again by Colonel Strachey, Inspector General of Irrigation.

4. The scheme for a Rohri-Hyderabad canal was at length submitted to a committee which was appointed in 1892. This committee recommended that the proposals for

the perennial canals should be abandoned, that the existing canals should be improved, and that the Jamrao weir and Jamrao canal should be constructed. They did not take the right bank of the river into consideration. The Bombay Government accepted the last two recommendations but were not prepared to abandon entirely the principle of high level perennial canals. As a result of the committee's report large sums were expended on improving the existing canals.

5. Sind irrigation was next studied by the Irrigation Commission of 1901-03, but no practical proposals resulted. Shortly afterwards, however, Dr. Summers, the Superintending Engineer, Indus Left Bank Division, surveyed a feeder to the Dad Canal from Rohri and recognized that eventually a weir would be needed at Sukkur to supply his feeders as well as a similar canal on the right bank. This survey was subsequently extended to the whole of the present Rohri-Hyderabad canal area. In forwarding preliminary plans and estimate to the Government of India the Bombay Government asked for sanction to prepare a scheme to comprise:—

- (1) A barrage at Sukkur.
- (2) A right bank canal.
- (3) A Rohri-Hyderabad canal.
- (4) An Eastern Nara canal.

This proposal was generally approved by the Government of India and orders were issued in 1907. The complete scheme for a barrage and canals was forwarded to the Government of India with a recommendation to the Secretary of State that only the Barrage and Rohri canal should be constructed, the proposal for the Eastern Nara and the right bank canals being held back for further consideration. The Secretary of State placed the proposals in 1912 before a committee of engineers in London consisting of Sir J. Ottley and Messrs. Jacob, Cameron and Webb.

6. This committee was of opinion that such a project was not justified as a protective work for Sind and that it was not shown to be a productive work and acting on this advice the Secretary of State declined to sanction its execution. The Government of Bombay did not, however, let the matter drop. Fresh investigations were undertaken and the conclusion was reached that, although it was difficult to prove any direct effect of the Punjab withdrawals on the river at Sukkur, there was reason to believe that these might have a prejudicial effect at the beginning and end of the kharif irrigation season, and that Sind ought to be



protected from such a contingency by the construction of a Barrage. The Bombay Government was convinced that the existing conditions of cultivation and irrigation were not suited to the special circumstances of the country and that Sind needed improvements and benefits of the kind which the Punjab and the United Provinces had long enjoyed. It therefore put forward a rough outline of a revised scheme with the following changes from the one previously submitted, viz. :—

- (1) The inclusion of the right bank canal.
- (2) A new site for the Barrage below the gorge.
- (3) Possibly a new head to the Eastern Nara supply channel from the Barrage.

It submitted a rough forecast of the cost of the scheme as Rs. 1,120 lakhs and revenue as Rs. 63.5 lakhs with a net return of approximately 5.7 per cent. on the capital cost, and asked for the sanction of the Government of India to the preparation of detailed plans and estimates for a scheme on these lines. This sanction was accorded.

7. In October, 1915, an Executive Engineer was placed on special duty to revise the project, and in May, 1916, he submitted a report and outline for the whole scheme. These proposals were approved, but owing to the War nothing could be done until 1918 when Messrs. Baker and Lane were placed on special duty to investigate the nature of the lands commanded and to make recommendations as to the intensive cultivation, the nature of crops and the duties to be adopted in designing the canals. The report was submitted to Government in March, 1919. Another Executive Engineer, Mr. (now Sir) Musto, was simultaneously placed on special duty to design and estimate the cost of a complete scheme for a barrage and canals. He submitted his scheme to Government in July, 1920. This project provided for a Barrage at a new site below the gorge at Sukkur (instead of above it, as in the original project) and for a system of perennial canals on both banks of the river. The estimate of the total cost was approximately  $18\frac{1}{3}$  crores of rupees. The Government of Bombay submitted the scheme to the Government of India in July, 1920, strongly recommending it for the sanction of the Secretary of State who intimated his sanction to the technical and administrative sides of the project and the estimates for works in the House of Commons on the 2nd and 3rd August and in the House of Lords on 9th August, 1921. The approval of the Secretary of State to the

proposals of the Government of Bombay for financing the work was given in 1923, and approval to the project and permission to start construction were given by the Bombay Legislative Council in June, 1923.

8. It is unnecessary at this point to describe the project in detail. The Barrage has been constructed three miles below the gorge at Sukkur with three canals on the right and four on the left bank taking off from the river each with a separate head regulator. The head regulators of all the canals are immediately above the Barrage which can completely control the river-level and keep the approach channel to the canals clear of silt. The canals are divided into two systems. The right bank system comprises the North-Western, Rice and Dadu canals. The left bank comprises the perennial Rohri canal; a perennial supply channel to feed the Eastern Nara river and the canals dependent thereon and two feeder canals for irrigating land in the Khairpur State. The bulk of the work was completed by December 1931 and the canals were opened by His Excellency the Viceroy on the 13th January 1932. Irrigation commenced in June 1932.

9. The Government of India agreed to lend the necessary funds year by year to the Bombay Government for the purpose of financing the project. They did not, however, undertake to bear any part of the cost of the scheme. But it is evident that the success or failure of so large a project must be of great importance not merely to Sind and the entire Presidency, but indeed to the whole of India. More particularly its full success will have a considerable effect upon the central revenues. The supply of perennial irrigation to three and a half millions of acres of land, which were previously unirrigated and mostly uncultivated, must very greatly increase the export and import trade of the area. It is unfortunate that the large indirect return which it will produce in the form of income-tax and customs revenue will not at present be available for use either in repayment of its debt or to defray any of the cost of development of the area which is necessary for the production of that revenue. In this connection Sir M. Visvesvaraya and Nawab Ali Nawaz Jung Bahadur in their report on the construction of the Barrage and Canals wrote as follows:—

“ The cost of the project compared to the yearly revenues of the Bombay Government is abnormally high and the



finances of this Government have been none too prosperous since the close of the War. This work is without question an all-India responsibility and its burden should be borne by the broader shoulders of the Central Government. To construct one of the world's greatest schemes in a detached sub-province containing a population of a little more than 1 per cent. and to make a Presidency with 6 per cent. of that total population, the bulk of which does not share in its benefits, responsible for the whole cost seems hard on the latter. The Government of India recommended the scheme at a time of transition when the hardships it would entail were not fully realised, and it is but fair that they should now come to the rescue."

10. The progress of the work of construction has been closely followed by the Government of Bombay. In January 1929 the Bombay Government arranged for the members of the Legislative Council to visit Sukkur, and 42 members availed themselves of the invitation. His Excellency Sir Frederick Sykes visited Sukkur in November 1929 and in November 1930. In March 1929 His Excellency convened a conference of officials to consider every aspect of the development of Sind, and more especially its agricultural development, which was inevitable when the Barrage and the canals were completed and perennial irrigation was thus made available for the whole country. As a result in July 1929 this Government published a memorandum which took stock of the situation as it stood then and indicated the lines, which were suggested either at this conference or from other sources, upon which the Government was dealing with it, and the outstanding points for decision and furtherance. This memorandum has been revised at intervals and the present edition brings it up to 30th September 1933 under the following heads :—

- I—Irrigation.
- II—Communications.
- III—Land Policy and Revenue.
- IV—Agriculture.
- V—Forests.
- VI—Administration.
- VII—Finance.
- VIII—Development of Sind under the Barrage conditions.

### I. Irrigation.

11. From the point of view of irrigation Sind may be conveniently divided into three parts :—

- (A) The area which falls under command of the Lloyd Barrage and Canals.
- (B) Upper Sind.
- (C) Lower Sind.

#### (A) THE LLOYD BARRAGE AND CANALS.

12. (i) This vast project is designed to secure irrigation to the area comprising parts of the Shikarpur Canals in the Sukkur District and Begari Canals, the Ghar Canals, the Western Nara Canals Divisions and the Nasirabad tehsil on the right bank of the Indus, to Khairpur State, the Nasrat Canals, Hyderabad Canals, Jamrao Canals, the Eastern Nara Canals and a small part of the Fuleli Canals Division on the left bank of the Indus. The whole area under command excluding Khairpur State and Nasirabad tehsil amounts to 7,406,000 acres, of which 5,013,000 acres will be cultivated annually on attainment of full development. The irrigation in this area prior to the opening of the Lloyd Barrage Canals amounted to 1,830,000 acres and the increased irrigation provided for will therefore amount to 3,183,000 acres. Including Khairpur State and Nasirabad, the annual cultivation when full development is reached will be 5,453,000 acres.

13. (ii) *The Barrage.*—The Lloyd Barrage consists of 66 spans of 60 feet each, separated by 58 ordinary piers, each 10 feet wide, and 7 abutment piers each 25 feet wide. The total width of waterway provided is 3,960 feet and the over-all length of the Barrage between abutments is 4,715 feet. The structure has been designed to pass a maximum river flood of  $1\frac{1}{2}$  million cusecs, or about 50 per cent. more than the highest flood hitherto recorded. Each span of the Barrage is fitted with electrically operated single steel gates, designed to maintain a level  $18\frac{1}{2}$  feet above the Barrage sill. A road bridge is provided on the downstream side as an integral part of the Barrage at a lower level than the upstream arches carrying the operating gear of the regulating gates.

14. (iii) *The Canals.*—Three canals take off on the right bank and four canals on the left bank of the river



immediately above the Barrage. The principal features of these are tabulated below :—

Canal.	No. of spans of 25 ft. each in the head regulator.	Designed discharge cusecs at head.	Length in canal miles.	Bed width at head. Ft.	F. S. depth at head. Ft.
<i>Right Bank.</i>					
North-Western ...	6	5,152	36	165	10.2
Rice ...	13	10,215	82	243	11.75
Dadu ...	4	2,837	131	92.5	9.6
<i>Left Bank.</i>					
Eastern Nara ...	16	13,649	226	346	11.5
Khairpur Feeder, East .	2	2,094	13	82	8.5
Rohri ...	12	10,883	208	247	12.0
Khairpur Feeder, West...	2	1,936	45	79	8.8
Total ...		46,766	741		

The total length of the canals including existing channels is 6,816\* miles, of which

	Canal miles.	
*Main Canals ...	741	1,647 miles of existing
Branches, new ...	561	channels have been
Existing Channels ...	1,647	remodelled and utilised.
Escapes ...	167	The total quantity
Distributaries and minors, new ...	3,655	of excavation involved
Nara Valley Drain ...	45	including work in the
	6,816	

Manchar Drainage Scheme is about 610 crores cubic feet. This work has been and is being done partly by manual labour and partly by dragline machines. In all 46 dragline machines have been employed on the scheme. Of these only six are still working. Three of those at present laid up will also again be requisitioned for work on the Flood Protective Bund. Two 6-Ruston Machines have been sold. The total capacity of all the 46 machines put together was about 74 tons of earthwork per minute on the basis of  $5\frac{1}{2}$  days of 24 hours per week, equivalent to the labour of 32,000 coolies employed the whole year round or of nearly 77,000 coolies employed for the normal working season in Sind, consisting of five months.

15. In case manual labour had been relied on for all earthwork of the canals, the cost would certainly have been 50 per cent. higher than actual cost by use of mechanical excavators. Even at an increase of 25 per cent. the extra

cost would have amounted to Rs. 1.65 crores. It may also be stated that it would have been quite impracticable to obtain 77,000 labourers even if the greater part of the agricultural labour of Sind had been drawn on, and such a step would have resulted in serious difficulty, if not disaster, to the zamindars whose agricultural operations would have been brought to a standstill in consequence.

16. (iv) *Cost of project and progress of work.*—The project is estimated to cost Rs. 20.03 crores or £15,022,500 sterling. Work was commenced in July 1923. The whole of the Barrage has been completed including the divide walls and all the head regulators. Of the total amount of earth-work, viz., 610 crores cubic feet, 608 crores cubic feet have been completed. All the channels have been completed except a few of small section which have subsequently been found necessary. The necessary canal structures, viz., regulators, falls and bridges, have also been completed.

17. (v) *Rectangulation survey and provision of water-courses.*—The original project, as sanctioned by the Secretary of State, did not provide for the rectangulation or square survey of the area, but in May 1926 Government decided, as the result of a conference of irrigation and revenue officials held by the Commissioner in Sind, that in order to secure the proper distribution of water and facilitate the alignment of water-courses, it was necessary to have the area rectangulated as far as possible, and arrangements were made for the rectangulation work to be commenced by the Survey of India Department in the ensuing cold weather. It was intended that the whole area should be rectangulated down to 64 acre blocks by the Survey of India, the cost being roughly estimated at Rs. 18.75 lakhs spread over a four years' programme. At the same time the cost of further sub-division of the 64 acre blocks, which was proposed to be done by the Barrage administration, was roughly estimated at Rs. 4.44 lakhs. Both these items, it was considered, might legitimately be regarded as a necessary part of the cost of construction of water-courses, which should be recovered from the occupants of land. A further expenditure for levelling and level charts, amounting to Rs. 8.88 lakhs, was contemplated in connection with this survey, and this was considered to be debitable to the project and not recoverable from the occupants of land.

18. In May 1927, the Revenue Officer submitted proposals, which were approved by Government, for restricting



rectangulation by the Survey of India to blocks of half a square mile instead of carrying it down to 64 acre blocks. A reduction in the cost of the Survey of India's rectangulation operations from Rs. 18.75 lakhs to Rs. 9.5 lakhs was thus secured. The sub-division below half square mile (320 acres) blocks was to be done under the control of the Revenue Officer, and a programme for the sub-rectangulation to 4 acre blocks of 15 lakh acres of unoccupied land, at a total cost of Rs. 7.5 lakhs or 8 annas per acre, was approved. While these operations were in progress, the Revenue Officer submitted proposals for extending sub-rectangulation to occupied land in certain areas, and a further programme for sub-rectangling 8 lakh acres of occupied land was also approved. Of the total of 23 lakh acres, 19.25 lakh acres have been sub-rectangled up to now at a cost of Rs. 6.75 lakhs, and it is hoped that the remaining area of 3.75 lakhs will be sub-rectangled in the ensuing field season at a cost of Rs. 1.27 lakhs. The actual cost of sub-rectangling 23 lakh acres will thus come to Rs. 8.02 lakhs, against an estimated cost, for 15 lakh acres, of Rs. 7.5 lakhs. The considerable saving secured over the estimated cost has been largely due to the greater output of the staff, rigid economy, and careful organisation.

19. In order to select occupied land for sub-rectangulation, the entire Barrage area has been classified as under :—

*Class I.*—Villages which present no physical difficulty, e.g., where holdings are fairly large and where the necessary readjustment of areas is conveniently possible ;

*Class III.*—Villages where, owing to the existence of numerous small holdings or other physical difficulties, sub-rectangulation within a reasonable period and at a reasonable cost is rendered impossible ;

*Class II.*—Villages which are intermediate in point of difficulty between classes I and III.

The 8 lakh acres of occupied land, referred to above, in which sub-rectangulation has so far been undertaken, form the entire area of class I villages. The Revenue Officer has now submitted proposals for sub-rectangling class II villages, comprising an area of about 4 lakh acres, and these are under the consideration of Government.

20. In extending sub-rectangulation operations to occupied lands much difficulty is encountered. Such rectangulation is to the mutual advantage of Government and the zamindars : it renders the system of distribution of water more efficient, and, by reducing the unit of assessment to one acre blocks, enables zamindars to cultivate small portions of land according to their convenience without the liability to pay assessment for entire survey numbers of which only parts are cultivated. But these advantages are realised only by a few progressive and enlightened zamindars : and the majority would let things go on as they are according to the old unscientific system with all its inconveniences and wastage. To begin with, therefore, persuasion by concessions has been necessary. Rectangulation could not be carried out without slight variations being made, not only in the position but also in the size of holdings ; and, as no one would agree to receive back less area than he surrendered, this meant in practice that certain additions had to be made to holdings in order to rectangulate them. These additions, which came to about 4.1 per cent. over the area of the holdings, were given free, subject to the condition that land required for water courses, which comes to about 2 per cent. of the area rectangulated, would be given by the owners free of charge. The cost of 2.1 per cent. of land sacrificed would come to Rs. 15 per acre, the rate fixed for " mohag " land. Further, the recovery of the cost of rectangulation for these lands was also foregone. The total area for which these concessions were granted in the beginning was 23,555 acres.

21. As experience was gained, the concessions have been reduced. The concession waiving the recovery of the cost of survey is now withdrawn ; and it has been announced that, in class I villages—i.e., villages in which rectangulation can be carried out without difficulty—no land will be given in recognition of " mohag " claims until the village is rectangulated. Additions to holdings due to readjustment are allowed free up to 6 per cent., any excess over this area being charged for at the mohag rate of Rs. 15 per acre. It is hoped that these terms will prove fairly liberal to enable rectangulation of occupied lands to proceed at a fair rate. The sub-rectangulation so far completed is a practical demonstration of its advantages ; and requests for sub-rectangulation are pouring in even from class II villages. The demand is keenest in Dero Mohbat, Tando Allahyar, Sinjhor and Mirpurkhas talukas.



22. (vi) *Application of the Bombay Irrigation Act, 1879.*—It has been recognised for a long time that the existing Bombay Irrigation Act is defective and unsuitable in its application to the general administration and control of irrigation in Sind. The approaching transformation of the greater part of Sind from the old conditions of haphazard irrigation to modernized methods of distribution and use of water, which must inevitably take effect with the advent of the Barrage, emphasizes the urgent necessity for provision by the earliest possible date of suitable machinery to deal with the new conditions. The Commissioner in Sind appointed a committee of revenue and irrigation officials in 1926 to consider and report on the question of revision of the Sind canal rules and to prepare a draft of amendments considered necessary to adapt the Bombay Irrigation Act to the requirements of Sind. The report and draft amendments were submitted to Government by the Commissioner in Sind in August 1927, together with his comments and the opinions of the Chief Engineer in Sind, the Chief Engineer of the Barrage, and several experienced revenue officials. Such of the proposed revised rules as are compatible with the existing Irrigation Act have already been sanctioned. An amending Act to the Irrigation Act giving powers to irrigation officers to change a zamindar's source of water-supply where necessary in the interests of proper distribution and use of water and to effect recovery of cost of new water courses from the holders of the land in the Barrage area has been passed into law. The opinions of the Lloyd Barrage Advisory and Standing Committees on the proposed other amendments to the Irrigation Act are now under consideration.

(B) UPPER SIND.

23. The probable approximate costs for the remodelling of the three large canal systems in the Begari Canals division, the Desert canal, the Unharwah and the Begari canal, on the right bank of the Indus have been reported as :—

	Rs.
Desert canal ... ..	5 lakhs.
Unharwah ... ..	14 „
Begari canal ... ..	49 „
Total ...	68 lakhs.

As regards the Begari canal, a branch from the Rice canal was originally proposed to take over the “Dhoro” or concentrated rice area of the Begari below its 52nd mile, for which

provision of Rs. 48.7 lakhs was made. This proposal was abandoned, as it was found that by remodelling the Begari canal this rice area could be provided for adequately at less cost. The estimate of Rs. 49 lakhs for remodelling the whole Begari canal system covers provision of some Rs. 12 lakhs for the area originally intended to be served by the branch from the Rice canal. These projects, which provide for the complete remodelling of the three canal systems, would fully command irrigable lands under each. The preparation of the detailed projects for these canals has, however, been held in abeyance as there is no immediate prospect of the schemes being undertaken on account of the prevailing financial stringency. On the left bank of the Indus the area north of Sukkur, bounded on the east by the Jessalmir desert and on the north by Bahawalpur State, depends for its irrigation on the Mahi Canal system and on a series of small canals with direct heads from the river. A preliminary project report, comprising proposals roughly estimated to cost Rs. 56 lakhs, providing for the improvement of distribution of supplies and the extension of irrigation to parts of the area not at present under command, has been received. If this project, known as the Ghotki Canal project, is to be proceeded with, it will involve a preliminary expenditure of Rs. 40,000 on detailed surveys and preparation of the project. It is not likely, however, that any further progress with the execution of the project will be made in the near future in view of the present financial stringency. As has been stated, Upper Sind will remain unaffected by the operation of the Barrage, and any projects for the improvement or extension of irrigational facilities in this area will require to be considered on their individual merits and in no way as arising out of or resulting from the Barrage Scheme. The total cost of improvements to existing inundation canals and extension of irrigation to areas which at present have no such facility would amount, according to present information, approximately to Rs. 124½ lakhs for that part of Upper Sind which lies north of the sphere of the Lloyd Barrage and Canals. It is not possible at this stage to lay down any programme for the progress of these works, nor to forecast expenditure on them year by year.

#### (C) LOWER SIND.

24. (i) It is the third section of Sind, comprising the larger part of the Fuleli Canals division and the whole of the Karachi Canals division, situated to the south of the limit of



command of the Barrage, which stands in danger of being adversely affected at the critical periods of the kharif season under future conditions. In recognition of this danger Government, in 1923 gave assurances to the zamindars of Lower Sind that systematic improvements to canals in this area would be undertaken, and in pursuance of these assurances projects have been prepared and are in process of preparation for the complete remodelling of the canals irrigating Lower Sind. The projects will provide for straightening the old tortuous inundation canals, for taking out new branches and distributaries, where required, and for control of draw-off to equalise distribution of available supplies at a higher level of command. As the result of the adoption of these measures not only would Lower Sind be safeguarded from possible lowering of the river levels at critical periods, due to withdrawals of the Barrage Canals; but the more equitable distribution of supplies would benefit considerable areas now precariously commanded.

25. The principle of the proper control and distribution of water is involved in this scheme. It is of paramount importance in dealing with any large volume of irrigation water and the land affected thereby to ensure the most equitable distribution of water possible. On this depends the prosperity of all the irrigators on the system and the value of their holdings. If water is not equitably distributed, no individual cultivator can have any security as regards the value of his land. If the unsystematic distribution of water hitherto obtaining is allowed to continue, the zamindar with a fortuitously good supply will have the value of his land greatly enhanced, whereas a zamindar not so fortunately situated will find his landed estate of little or no value.

This principle is of fundamental importance to the Lloyd Barrage scheme and its financial stability. A good deal of the land under the Fuleli canal will be transferred to the Rohri canal setting free water which will be used for extensions of cultivation on the Fuleli.

26. In view of the fact that the success of the Barrage scheme is entirely bound up with the equitable distribution of water, it will be fatal to the Barrage itself to allow of any extension of the haphazard methods at present prevailing in the Fuleli area and indeed through the whole of Sind. Sales of land under the Barrage are an integral part of the financial scheme, and it will be impossible to persuade buyers that water will be equitably distributed on the Barrage canals

if they see Government, from year to year, not only allowing the present inequitable system to continue but extending it.

27. (ii) *Fuleli Canals Division*.—A project has been prepared for the remodelling of the Fuleli Canal system. The project is divided into five sections in each of which the necessary widening, regrading, provision of new distributaries and control of draw-off to secure equitable distribution is provided for at an estimated cost of Rs. 49,97,694 as under :—

	Estimated cost (including all charges).
	Rs.
Section 1—From head to mile 30, where a new cross regulator will be provided .	2,21,412
Section 2—From mile 30 to mile 46 (existing Alipur regulator) ...	6,70,248
Section 3—From mile 46 to mile 62, where a new cross regulator is under construction ...	13,56,581
Section 4—From mile 62 to mile 70/3, where a new cross regulator has been constructed ...	4,22,698
Section 5—From mile 70/3 to tail (mile 81/3) .	23,26,755
Total ...	49,97,694

The works in all the five sections with the exception of modules and remodelling of Mirwah Talhar have practically been completed. The expenditure under "Works" in 1932-33 was Rs. 4,09,276, whereas the provision in the budget for 1933-34 is Rs. 2,79,000. The whole remodelling scheme is expected to be completed by the year 1935-36.

28. (iii) *Other Canals in the Fuleli Canals Division*.—A project is under preparation for affording assured irrigational command to the area situated to the west of the Fuleli and bordered by the Indus and by the Karachi Canals Division. This area now depends for irrigation on the Hasanaliwah, Khairwah and Mulchandwah. The approximate estimated cost of the project is reported as Rs. 9.3 lakhs.

29. (iv) *Cost of immediately necessary improvements in the Fuleli Canals Division*.—The probable cost of remodelling the existing irrigation system in the Fuleli Canals



Division to safeguard this area from possible adverse effects at critical periods of withdrawals of the Barrage canals and to afford improved distribution of available supplies will therefore amount to approximately Rs. 59 $\frac{1}{4}$  lakhs.

30. (v) *Mehrani Canal Project*.—This project in the Fuleli Canals Division of the Hyderabad District cannot be said to come within the scope of the assurances of Government as communicated to the Lower Sind zamindars at the time of the inauguration of the Barrage scheme. The project contemplates the extension of irrigation to 61,607 acres of good culturable land to the south of Guni Taluka which at present lie uncommanded. The total culturable area to be brought under command will be 156,043 acres for which 1,510 cusecs full supply discharge is provided at the head of the canal. The project is estimated to cost Rs. 26,10,105 and the estimated return on capital expenditure is 10.68 per cent. It provides largely for extension of irrigation to new areas and will accordingly be considered on its merits after the immediate commitments of Government have been given effect to.

31. (vi) *Karachi Canals Division*.—Plans and estimates have been prepared for the projects for remodelling all the canal systems in this Division at a total cost of Rs. 72 lakhs. Out of these, the project for remodelling the Kalri and Narichach canal system was sanctioned for Rs. 10,70,949 in 1929 and another for remodelling the Sattah canal system was sanctioned for Rs. 2,81,377 in 1932. The work on the former system was started in 1930-31 and has now been practically completed. The commencement of the work on the latter system has been postponed pending experience of two or three post-Barrage abkalanis. The remaining projects are under scrutiny. The cost of works necessary to secure the irrigation in this Division against the adverse effects of Barrage withdrawals had previously been estimated as approximately Rs 54 lakhs on a preliminary survey of the data available.

32. (vii) *Conclusion*.—The liability in sight to which Government are committed by the assurances given to the zamindars of Lower Sind in 1923 and 1925, that their interests would not be allowed to suffer as the result of the withdrawals of the Barrage canals, may therefore be said approximately to amount to Rs. 1.31 $\frac{1}{4}$  crores (Fuleli Canals Division Rs. 59 $\frac{1}{4}$  lakhs and Karachi Canals Division Rs. 72 lakhs) and, considering the outlay as a whole the expenditure

will be unproductive. The Fuleli and Kalri Remodelling Schemes are already in progress. The probable expenditure to end of the current financial year on these Projects is estimated at Rs. 42.42 lakhs (including all charges) and about Rs. 18.26 lakhs will be required till their completion in 1935-36. The commencement of the remaining projects in these divisions will depend on the financial situation. The question of the provision of a second barrage for Lower Sind, to be situated at Kotri or Jherruck, has been mooted, but the cost would be prohibitive considering the comparatively small area and unproductiveness of the country which could be brought under command of irrigation from above such a barrage, if built. This suggestion is therefore beyond the bounds of practical politics.

## II. Communications.

### (A) ROADS.

33. (i) In August 1919, the late Mr. R. J. Kent wrote a note regarding improvements to road communications in Sind. As a result plans and estimates for metalling the following roads were submitted by the Chief Engineer and were sanctioned by Government:—

	Cost. Rs.
(1) Road from the Cemetery at Karachi to Drigh Road Station ... ..	94,833
(2) Road from Karachi Jail to Drigh Road ... ..	96,311
(3) Road from Drigh Road to Malir ... ..	1,60,433
(4) Road from Karachi to Hub River ... ..	2,12,634
(5) Tatta-Jungshahi Road ... ..	3,79,046

These works were carried out at the cost shown against each. Further expenditure of Rs. 19,519 was incurred during 1928-29 on providing a bituminous seal coat of Spramex in miles 4/6 to 9/0 of the Karachi Cemetery-Drigh Road.

34. (ii) The Finance Committee (appointed to discuss the draft financial statement of the Government of Bombay for the year 1919-20) recommended that, in the event of savings becoming available for expenditure, the provincialization of seven roads in Sind mentioned in their report should be taken into consideration as a first instalment. The Chief Engineer thereupon suggested 24 roads for provincialization, but the Commissioner in Sind selected only 16 of these in order of urgency. Government accepted this proposal and ordered these 16 roads to be provincialized.



- |   |                      |
|---|----------------------|
| 1. Sukkur-Shikarpur Road.                       | } Right Bank Circle. |
| 2. Shikarpur-Jacobabad Road.                    |                      |
| 3. Naushahro-Pad-Idan Road.                     | } Left Bank Circle.  |
| 4. Mirpurkhas-Umar-kot Road (first six miles).  |                      |
| 5. Katcha portion of Hyderabad-Mirpurkhas Road. |                      |
| 6. Hyderabad-Badin Road.                        |                      |

35. (iii) In April 1924 the Chief Engineer in Sind was requested to submit a report describing briefly the nature and condition of the roads provincialized in 1920 and 1921, indicating which of them stood in urgent need of improvements and were of sufficient importance to be taken in hand

immediately. The Superintending Engineers of the late Indus Right and Left Bank Circles reported that the six roads noted in the margin were in urgent need of improvement. Government, however, directed that improvements to the following roads should be taken in hand as early as possible, and the state which each has now reached is as shown below :—

*Northern Sind Circle—*

- (1) Sukkur-Shikarpur (21 miles). Plans and estimates for metalling the road sanctioned for Rs. 6,19,457. The work has been completed at a cost of Rs. 5,70,408. Estimates for asphaltting miles 0 to 6 and 6 to 20/3 amounting to Rs. 80,502 and Rs. 2,56,034 respectively, have been sanctioned but the work has not yet been taken in hand for lack of funds. Eight new road bridges estimated to cost Rs. 53,595 are proposed to be constructed on this road. Plans and estimates for the work have been sanctioned. Work not yet begun.
- (2) Shikarpur-Jacobabad Road (24½ miles). Plans and estimates, the latter amounting to Rs. 2,00,402 (revised), for brick paving 8 miles of the road (Shikarpur-Kot Sultan Section) with a 1½" carpet of sand and bitumen have been sanctioned. The work has been in execution since last year and is expected to be completed during the current financial year. The expenditure incurred to end of August 1933 was Rs. 1,22,376. Miles 15-16/5 and 17/6-18/0 are also proposed to be similarly treated and plans and estimates, the latter amounting to Rs. 42,234 have been sanctioned. The remaining length of the road is proposed to be maintained as a 'kachha' earth road.

*Western Sind Circle—*

- (1) Radhan-Mehar (9 miles). Preliminary improvements sanctioned for Rs. 31,073. Work not yet begun.
- (2) An estimate amounting to Rs. 96,607 has also been sanctioned for improvements to the Badah-Nasirabad Road (7½ miles) and this work is completed, the total expenditure being Rs. 96,175.

*Bohri Canal Circle.—*

- (1) Hyderabad-Hala via Matiari (33 miles). An estimate for improvements to this road was sanctioned for Rs. 93,265 in December 1931. It has since been revised to Rs. 1,19,200. A sum of Rs. 46,371 was spent last year and Rs. 50,200 have been allotted this year from petrol tax fund for further work.
- (2) Hala-Sakrand Road (24 miles). Plans and estimates for this road are under preparation.
- (3) Sakrand-Moro Road (42.5 miles). An estimate for improvements to this road has been sanctioned for Rs. 65,871. Rs. 40,600 have been spent last year and further work is in progress for which an allotment of Rs. 21,000 is granted during the current year.
- (4) Moro-Kandiaro (32 miles). An estimate for improvements to this road has been sanctioned for Rs. 30,104. Work not yet begun.
- (5) Kandiaro-Kotri Road (16 miles). Plans and estimates for the road are under preparation.
- (6) Naushahro-Pad-Idan (11 miles). Plans and estimates sanctioned for Rs. 33,127. Work completed.

An estimate for experimental road work for treating with oil emulsion amounting to Rs. 2,528 has been sanctioned for a length of 3 miles. The estimate is under revision.

*Eastern Sind Circle—*

- (1) Mirpurkhas-Umarkot (47 miles). Plans and estimates for the first 6 miles have been sanctioned for Rs. 49,100. Work not yet begun.

36. (iv) In 1925 the Chief Engineer in Sind reported that three roads required to be metalled, besides the six mentioned above. These are shown below, the present stage of progress on each being noted :—

- (1) Shahdadpur-Hala (13½ miles). Estimate has been sanctioned for Rs. 44,339 for brick-paving 4 miles only. Work has been completed. An estimate amounting to Rs. 1,26,317 for brick-paving the remaining portion of the road has not been sanctioned due to financial stringency.
- (2) Tando-Adam-Uderolal (7¼ miles). Plans and estimate sanctioned for Rs. 1,25,808 for metalling. A revised estimate amounting to Rs. 72,903 for brick-paving the road has not been sanctioned due to financial stringency.
- (3) Chhor-Umarkot (12 miles). Brick-paving sanctioned for Rs. 1,07,270. Work not yet begun.



*Southern Sind Circle—*

The Karachi-Kotri Road *via* Tatta was recommended by the Sind Roads Sub-Committee to be brought to the forefront at the earliest opportunity as it is a Class I interprovincial route to the Punjab. A project for reconstruction of the same was drawn up and submitted to Government. The plans and estimates therefor have been approved and technically sanctioned by Government at a cost of Rs. 4,92,581 and the road has been provincialised. The work was commenced and the sum of Rs. 75,000 spent in 1932-33. A further sum of Rs. 2,46,000 has been allotted in 1933-34. The work is in progress and is expected to be completed in 1934-35.

An estimate amounting to Rs. 7,51,300 representing the share of this Government to be paid to the North-Western Railway for the provision of a roadway in the Kotri bridge project was sanctioned in April 1931. The amount to be paid by Government has since been increased to Rs. 7,89,182. The increased liability has been accepted by Government, and the amount paid to the Railway authorities. The work has been completed.

An estimate amounting to Rs. 25,381 for reconstructing the edges of the Karachi-Malir Road, section I, mile 4/6 to 9/0, was sanctioned in August 1931. The work has been completed.

An estimate amounting to Rs. 21,783 for providing a 2" carpet of sand and bitumen over 6" brick-on-edge soling on Karachi-Malir Road  $\frac{1}{2}$  furlong in mile 7 ( $6\frac{1}{2}$ ) and  $3\frac{1}{2}$  furlongs in mile 11 (10/0 to 10/3 $\frac{1}{2}$ ) was sanctioned in March 1932. Half the cost is to be met from the reserve with the Government of India in the Road Development Account and the other half from the ordinary share of this Government from the Petrol Tax fund. The work has been completed at a cost of Rs. 19,311.

37. (v) In 1925 the necessity for providing better communications in the zone of the Barrage was brought to notice. The Commissioner in consultation with the Chief Engineer of the Barrage and the Chief Engineer in Sind stated that the question of improvements of communications had been discussed at a conference which unanimously agreed that—

- (1) the question should be investigated by a thoroughly competent Road Engineer ;

- (2) it would probably be advisable to create two Road Engineers Districts in Sind so as to relieve the Irrigation Engineers of this work; and
- (3) money must be made available for expenditure on roads.

The Commissioner suggested that in the first instance a competent officer should be placed on special duty to investigate the whole matter. This proposal was approved, and Government appointed Mr. H. B. Parikh, as Executive Engineer on Special Duty, to investigate and report on the question of improving communications in Sind and particularly in the Barrage Canals area. Mr. Parikh submitted his report in 1928 and gave preliminary estimates for the construction of the following mileage of Provincial and Local Board roads for the present:—

	Rs.
581 miles of trunk roads at Rs. 26,000 per mile ...	1,51,06,000
808 miles of feeder roads at Rs. 21,000 per mile ...	1,69,68,000
	3,20,74,000

and also the following further mileage of roads when funds become available:—

	Rs.
73 miles of trunk roads at Rs. 26,000 per mile ...	18,98,000
531 miles of feeder roads at Rs. 21,000 per mile...	1,11,51,000
Total ...	1,30,49,000

Grand Total ... 4,51,23,000

38. The report was referred to the Roads Sub-Committee of the Advisory Communications Board, Sind, for consideration and report. The Commissioner in Sind submitted to Government the minutes of the proceedings of the Committee in which it was *inter alia* stated that the Committee was of the opinion that a programme for spending ultimately as much as Rs. 4.51 crores in all was not a practical proposition in these days of financial stringency. The Road Sub-Committee, therefore, appointed a Sub-Committee to go into the question and to make proposals for urgent works to the extent of Rs. 50 lakhs only, the amount to be provided from funds outside the Petrol Tax funds. The report of the Sub-Committee has since been received. The Sub-Committee has prepared a ten-year programme and a list of road works arranged in order of urgency. The total cost of the programme does not reach the sum of Rs. 50 lakhs proposed and the Committee consider that if the sum is available it will be advisable to take up some of the interprovincial



roads. The following points may be noted. Such bridges, so far as crossings on existing road alignments over canals and irrigation channels are concerned, are being or will be provided as part of the work of construction of the irrigation systems concerned. With regard to the construction of roads themselves these will generally be on or close to the alignments of the existing unmetalled roads and tracks, and it appears that in many parts of the country, for some time to come at least, the immediate needs will best be met by providing improved and raised unmetalled roads, which can be done most economically by employing modern grader and tractor outfits. These earth roads can later, when the growth of traffic renders such action necessary, be provided with metalled or other suitable surfacing. It is recognised that the provision of surfaced roads proposed in Mr. Parikh's report represents the probable final requirements when the whole country is fully developed.

Since the scheme was submitted by the Road Sub-Committee the financial condition of this Presidency had become considerably worse and Government found themselves unable to finance even this small scheme. The position was brought to the notice of the Government of India who have since agreed to assist this Government and as a preliminary measure to bear the cost of a fresh enquiry which will embrace the survey of the funds now available and likely to be available in the near future from all sources, and the extent to which the resources of the local bodies will be adequate to discharge their responsibilities, whether for roads or for other matters. The enquiry will also include a complete classification of roads with respect to their form of construction and cost and with respect to the authority to be responsible for their maintenance. The Government of India have appointed with effect from November 1933 Mr. S. G. Stubbs, Officiating Road Engineer with the Government of India, with a small staff for a period of six months to conduct the enquiry.

39. (vi) The figures of Government expenditure on roads in Sind (on original works and repairs) from the years 1921-22 to 1932-33 are as follows:—

Year.			Works.	Repairs.	Total.
			Rs.	Rs.	Rs.
1921-22	...	...	42,740	1,28,920	1,71,660
1922-23	...	...	1,00,248	1,44,992	2,45,240
1923-24	...	...	73,472	1,44,764	2,18,236

Year.		Works.	Repairs.	Total.
		Rs.	Rs.	Rs.
1924-25	...	1,65,700	1,45,054	3,10,754
1925-26	...	42,918	1,56,720	1,99,638
1926-27	...	1,11,961	1,68,353	2,80,314
1927-28	...	2,69,033	2,09,520	4,78,553
1928-29	...	2,82,952	1,92,537	4,75,489
1929-30	...	1,03,320	2,54,482	3,57,802
1930-31	...	30,614	1,70,816	2,01,430
1931-32	...	87,390	1,43,428	2,30,818
1932-33	...	6,51,927	1,49,421	8,01,348

## (B) RAILWAYS.

40. The North-Western Railway main lines are already running in a north and south direction on each bank of the river in the Barrage area. The new feeder railways required may be grouped under two systems—viz. (1) the Sind Left Bank and (2) the Sind Right Bank Feeder Railways. These feeder railways are not necessitated solely by the advent of the Barrage scheme since there had already been a local demand for them independent of considerations connected with the execution of the Barrage project. The completion of the Barrage project has, however, made the improvement of communications in this area a matter of necessity and implies the construction of feeder railways and new roads and the improvement of existing roads.

41. *Sind Left Bank Feeder Railways.*—This system consists of the following broad-gauge lines, totalling about 164 miles in length which have been constructed and opened to traffic :—

- (1) a loop line from Mehrabpur to Pad-Idan *via* Tharushah, 44 miles ;
- (2) a loop line from Nawabshah to Tando Adam *via* Sakrand and Hala, 54 miles ; and
- (3) a chord line between Tharushah and Sakrand, 66 miles.

The North-Western Railway administration anticipated an annual loss of Rs. 6,43,685 on the working of these three sections of line estimated to cost Rs. 97.5 lakhs and towards meeting this loss this Government was asked to make an annual contribution of Rs. 4 lakhs for the first five years. During the second five-year period the annual loss on working was estimated at Rs. 2,63,170. A guarantee of payment by Government of the actual loss on working, limited to a maximum annual liability of Rs. 2 lakhs,



subsequent to the first five-year period was also asked for by the Railway administration. This guarantee was agreed to by the Legislative Council in March 1928.

The construction of these lines was sanctioned by the Railway Board in June-1928. The Section Mehrabpur-Pad-Idan was completed and opened to traffic on 20th May 1930. Work on Tando Adam-Nawabshah Loop and Tharushah-Sakrand Chord was also completed and both sections opened to traffic on 10th December 1931 from which date the guarantee period commences for the whole of this system.

42. *Sind Right Bank Feeder Railways.*—These are complementary to the Sind Left Bank Feeder lines. This system consists of two lines, viz., from Sita Road to Jacobabad and Larkana to Dost Ali, of an aggregate length of 135 miles.

The scheme provides for the dismantlement of the existing Larkana-Dodapur Narrow Gauge System and also for the purchase of this light railway.

At the time of submitting the project it was expected that this would be a profitable line but conditions have changed so much with the bad state of the grain and cotton markets, etc., that it is doubtful if such optimism is still justifiable. Further as the greater portion of the proposed alignment runs parallel or very close to existing roads, motor traffic is bound to materialise to the further detriment of the successful operation of this line. It is therefore probable that the Bombay Government would be required to give a financial guarantee before these railway lines could be constructed.

In the meantime the Railway Board have decided to postpone the consideration of this project for the present.

The Mitchell-Kirkness report recommends that the alternative of development by road should be considered in lieu of these feeders.

The construction of a link line between Jacobabad and Dodapur is also under consideration in case funds for the full Right Bank Feeder Scheme are not forthcoming.

The Larkana-Jacobabad (Sind) Light Railway Company has recently applied to the Railway Board for permission to construct the following railways but their final decision is awaited :—

- (a) an extension from Shahdadkote to Jacobabad via Ghari Khairo, Usta and Rojhan—a distance of  $49\frac{1}{2}$  miles.

- (b) a branch extension of about  $13\frac{1}{2}$  miles from Shahdadkote to Bagh Tail.

43. Besides the systems mentioned above, there are certain other proposed lines more or less connected with the Lloyd Barrage. These lines are dealt with briefly below:—

(1) *Khadro-Nawabshah Railway (Jodhpur Railway).*—The final location survey of this railway has been completed and the estimate has been forwarded to the Railway Board. No action has yet been taken regarding the acquisition of land, as this project, in common with all other metre-gauge projects in Sind, is held up pending a decision on the conversion to broad-gauge of the Hyderabad-Chhor section of the Jodhpur-Hyderabad Railway and of the two branch lines from Mirpurkhas. The Mitchell-Kirkness report however doubts the necessity of this project.

(2) *Jhol-Hiral (Jodhpur Railway).*—The survey of this project has been completed and the project estimate submitted to the Railway Board.

The Sind Light Railway Coy. Ltd. has asked the Railway Board for permission to construct a metre-gauge line from Jhol Station on the Khadro Branch to Hiral Station on the main line, a distance of about 66 miles, and their orders are awaited.

(3) *Jhudo-Hiral (Jodhpur Railway).*—The survey of this loop has been held in abeyance pending a decision on the conversion to broad-gauge of the Hyderabad-Chhor section of the Jodhpur-Hyderabad Railway.

(4) *Tando Adam-Palhal line (N.-W. Railway).*—The Railway Board has intimated that it is not proposed to investigate this further at present, as this project is considered unlikely to yield a remunerative return.

(5) *Tando Mahomedkhan-Sujawal and Badin-Jungshahi lines (N.-W. Railway).*—The reconnaissance surveys of these lines have been completed, and the Railway Board after considering the projects have come to the conclusion that a guarantee will be needed from the Bombay Government and that for the present the projects have been held in abeyance.

(6) *Shikarpur-Ratodero line (N.-W. Railway).*—It has been decided that the consideration of this line should be postponed.



(7) *Mirpurkhas-Nagar Parkar line (N.-W. Railway).*—The Railway Board has decided to drop this line in favour of the Viramgam-Radhanpur-Badin project for the Bombay-Karachi connection.

(8) *Bombay-Karachi Connection (N.-W. Railway).*—The Railway Board sanctioned an estimate for the final location and preparation of a detailed estimate for a broad gauge line on the Viramgam-Radhanpur-Suigam-Nagar Parkar-Badin route. The location was completed in December 1930 and the estimate submitted to the Board early in 1932. The detailed estimate contains an alternative route for the eastern portion Nagar Parkar-Suigam-Deesa-Palanpur-Sabarmati (near Ahmedabad). This alternative necessitates the conversion of the metre gauge (Deesa-Palanpur) to broad gauge and allows for broad gauge to run alongside the metre gauge from Palanpur to Sabarmati. This alternative is more attractive financially and has other considerations to recommend its adoption. Its chief disadvantage is the larger initial outlay of capital. A third proposal for running a metre gauge along the selected alignment from Deesa to Hyderabad has also been considered. This is considerably cheaper but has not been developed in detail.

After consideration of the report and detailed estimates of 1932, the Railway Board in April 1933 ordered the carrying out of a revised traffic survey which has since been completed and an advance copy thereof submitted to the Railway Board. This report is under scrutiny of the N.-W. Railway Administration.

With regard to this railway the Mitchell-Kirkness report remarks that this is an important through connection and the question of an alternative road does not arise.

(9) *A project for the conversion to broad-gauge of the line from Hyderabad to Chhor with two branches from Mirpurkhas to Khadro and from Mirpurkhas to Jhudo.*—The project was submitted to the Railway Board who, after consideration, postponed this for the present.

44. So far as the Sind Left and Right Bank Feeder Railways are concerned, the construction of which has become desirable owing to the advent of the Barrage scheme (*vide* paragraphs 41 and 42 above), it will be seen that liability on the part of the Bombay Government is confined to the Sind Left Bank Feeder Railways, and this is again limited to an annual guarantee against loss in



working of Rs. 4 lakhs a year for the first five years after the opening of the line for traffic and thereafter to the actual loss subject to a maximum of Rs. 2 lakhs a year, until the lines prove remunerative, when the amounts of the guarantees will be paid to this Government with simple interest out of profits.

### III. Land Policy and Revenue.

45. (A) *Problem of disposal of land.*—The essential difference between the resettlement of Sind and the colonization of the canal areas in the Punjab is that in Sind the new canals are to irrigate an already settled country, whereas in the Punjab for the most part the irrigable area was at the outset a desert. The zamindars of Sind have their established position in the country, and it is essential that their legitimate claims should be considered. On the other hand the success of the project cannot be jeopardized by yielding to a number of interests that may be incompatible with the general and financial stability of the Barrage scheme. Moreover demands of all kinds have been put forward for grants of land on concessionary terms which, if acceded to, would involve grave financial risks. The policy that the Government has set before itself is that in the first place the legitimate claims of the present zamindars should be satisfied, secondly adequate provision must be made for special classes, such as peasant cultivators, and thirdly land must be sold in the open market in order that part of the capital cost of the project may be met by the receipts from the land sales. The cardinal feature of the situation is the marked absence of the large areas of hitherto uncultivated waste which form a familiar feature of the Punjab irrigation scheme. Out of the gross area of  $7\frac{1}{2}$  million acres commanded by the scheme the greater part is not Government land, but is already in the occupation of private persons, and its value is being enhanced out of all proportion by bringing water to it. Some  $1\frac{1}{2}$  million acres, after uncultivable land and land to be reserved for public purposes have been deducted, are available for the purpose of distribution, and this vacant land is very much fragmented. The policy adopted is that the indigenous population should have first claim to the newly irrigated tracts at the disposal of Government.

The Barrage and all the canals have been completed and water was admitted into them for purpose of irrigation during the kharif season of 1932. The area irrigated



during the first kharif season was 1,368,524 acres and that irrigated up to the end of December in the first rabi season was 1,155,067 acres, or in all 2,523,591 for the full year.

46. These facts lead to certain conclusions. New colonists cannot be settled on the land long in advance of the date when water will be available. There is much preliminary work to be done in the larger unoccupied areas before these lands can be disposed of profitably to Government and to the purchasers. Since most of the area contains a considerable nucleus of zamindars and cultivating owners already depending on agriculture for their livelihood, it is necessary to aim at the orderly development, so far as possible, of the whole tract at one and the same time. It is not possible to deal with the Barrage area piecemeal, deferring the development of certain sections until that of others is practically complete. In March 1929, Government published their conclusions as to the policy which it is desirable to adopt in the disposal of waste lands, while reserving to themselves full liberty to change that policy in any directions which experience or changing circumstances may indicate. The various classes of grants to be made may be considered under the following heads:—

47. (i) *Fallow-forfeited and Mohag Grants*.—Government have already made clear their opinion that the indigenous population has the first claim to consideration in the development of the area, and the Royal Commission on Agriculture has expressed the same view. They have therefore set apart 3,50,000 acres to be granted to existing landholders at the nominal rate of Rs. 15 per acre. Since Government are undertaking a capital expenditure of over Rs. 30 per acre on this land and on every other acre already occupied, the magnitude of the financial concession being made to the existing landholders in the tract will be readily understood. Government consider that the resources of these landholders can best be employed, and will be fully employed, for many years to come in bringing their lands under the more intensive cultivation which will be possible under Barrage irrigation.

In order to enable the total liabilities on account of fallow-forfeited grants to be ascertained, Government issued in November 1929 an order prescribing 30th September 1930 as the latest date up to which applications for the return of fallow-forfeited land would be received. The total area applied for has been 1,55,500 acres, of which 1,09,000 acres



has been actually taken up. But at the end of June 1932, the first instalment of the purchase price, which is payable in two instalments, had only been made in respect of 50,000 acres. So long as Barrage water was not available and the land could not be cultivated it was undesirable to exercise any severity in the collection of these outstandings. But the position is entirely altered now that the Barrage canals are flowing, and Government had prescribed 15th February 1933 as the latest date by which at least the first instalment for these lands must be paid.

Government had also prescribed 31st December 1932 as the latest date by which all applications for "mohag" grants must be made in the Barrage area.

48. (ii) *Peasant Grants*.—Although it is not possible to settle peasants on the land before cultivation operations can be undertaken, the terms on which Government are prepared to grant land to peasants are described below. When the Jamrao was colonized thirty years ago, grants for both Sindhi and Punjabi peasants were given free of malkano. In the Punjab to-day fairly heavy recoveries are made from peasants. The Punjab peasant is required to pay Rs. 3 per annum per allotted acre for the first ten years, and thereafter has the option of paying Rs. 5 per acre in perpetuity, without acquiring proprietary rights, or of paying heavier annual payments over a period, which may extend to forty years for the purpose of acquiring proprietary rights, according to the prescribed scale.

Government clearly cannot afford, nor do they consider it necessary, to give land to peasants free. The hari, whose status is raised to that of a peasant proprietor, has his income largely increased, and there is no reason why he should not pay a reasonable share of that increase to Government by way of instalments for the purchase of his land. But in the present conditions of Sind agriculture Government do not think it desirable to attempt to levy the prices which the Punjabi peasant willingly pays, and they have therefore empowered the Revenue Officer to make grants to Sindhi peasants on the following conditions. The peasants will be tenants-at-will for the first five years, during which they will pay Rs. 3 per annum per allotted acre and will be required to comply with certain conditions framed with a view to ensuring that they actually live on or near their land and bring it under cultivation. Thereafter they will be required



to pay malkano equivalent to half the amount paid by peasants in the Punjab according to the following scale :—

Number of years.	Annual payment per acre.		
	Rs. a. p.		
15	...	...	...
or 20	...	...	...
or 25	...	...	...
or 30	...	...	...
or 40	...	...	...

The ordinary land revenue will be recovered in addition to these payments of malkano. The peasants will thus be able to complete payments for their holdings within a period ranging at their option from 20 to 45 years. It is not desirable to permit payment within a shorter period, since the object is to get the peasants settled on the land and not to encourage them in the speculative sellings of their holdings. The present value of these payments is about Rs. 50 per acre. Government consider that peasants should be settled only on land of good quality and that a grant should ordinarily be about 16 acres and never more than 24 acres. For the present, Government have authorized the Revenue Officer to set aside 50,000 acres for the purpose of peasant grants. This is enough for 3,000 peasants. Government, however, trust that, as time goes on, it may be possible to set aside a larger area for this purpose.

49. It is not proposed at present to give peasant grants at concession rates to other than Sindhis (including Tharis). The Punjabi peasant is sufficiently alive to the value of perennial irrigation and will be able to buy land in the ordinary way at full rates provided that he is given reasonable opportunities to purchase small holdings and pay for them by instalments. An exception will be made in the case of Punjabi *abadgars* already settled in Sind in respect of areas mainly colonized by Punjabis. It is improbable that any other class would be suitable for or be attracted by the conditions obtaining in Sind, but Government will consider sympathetically claims that may be advanced on behalf of any such classes. The Revenue Officer has also been authorized to consider applications from co-operative societies or other organized groups for grants on terms not more generous than those outlined above. A beginning has already been made with peasant grants, and by the end of September 1933 over 20,000 acres had been disposed

of under this head. It is expected that the bulk of the area reserved for this purpose will be distributed during the current year.

50. (iii) *Military Grants*.—After very careful consideration Government have come to the conclusion that no concessions of a financial kind can be made at their expense on the grounds of military service. Subject to the fulfilment of a few definite commitments made before the Barrage scheme was sanctioned, the Revenue Officer is authorized to make grants to military personnel, either retired or serving, on terms of full payment for the land either by themselves or by the Government of India in the Army Department on their behalf. The free leases which had been granted to ex-soldiers before the inception of the Barrage scheme, with a definite undertaking that they would be confirmed without payment of malkano when the grant of land was reopened have now all been converted into permanent grants. They amount to approximately 9,000 acres. Government have agreed to set aside a further 10,000 acres for grant to serving or time-barred soldiers, on condition of full payment for the land, and allotment in connection with this scheme is proceeding, but at the present time it seems unlikely that the whole of this area will be taken up on the terms offered.

51. (iv) *Sales at full rates*.—Having regard to the capital cost of the Barrage scheme, it is necessary to obtain for the bulk of the unoccupied lands the best prices that will be procurable from time to time. It was at one time intended that sales by auction would be the rule, and that these sales would be open to all bidders, whether from this or other provinces. It was also proposed that payment for the land should be by instalments, the general rule being 10 per cent. down and the balance in five equated instalments of principal with interest at  $6\frac{1}{2}$  per cent. In practice, it has been found that the period allowed for payment was too short, and the Revenue Officer, who was given authority to vary the number of instalments in cases where he considered it desirable to do so, has found it necessary to allow payment by ten instead of five annual instalments as a general rule. It has also been found that mainly owing to the great fragmentation of Government lands, it is generally more profitable to deal individually with applicants for land by offering them land at a fair price than to proceed by way of public auctions. Outside buyers from distant provinces will not come to Sind and wander about to see small scattered areas merely in the hope that they may be able to buy one



or other of them in an auction. Such buyers are interested only in the few large compact areas, and it is more practicable to set a fair price by treating with them individually after they have seen the land in which they are interested.

52. (v) *Limited auctions and sales at fixed prices.*—It was from the beginning recognised that there was in the aggregate a very large area for which sales by auction would not be advisable or even practicable. In these cases the Revenue Officer is authorized to sell lands at a fair price fixed by him, or to hold auctions confined to a limited class of bidders. Examples of the sort of cases referred to are lands which are equally in the *mohag* of several people and of which the sale to a stranger would consequently be inadvisable and lands in small scattered parcels to which no particular person has a valid claim, but which could not be expected to attract any considerable number of bidders at an auction. In such cases a standing offer to sell at a fixed price may be the better method.

53. (vi) *Short-term leases.*—At the inception of the Barrage scheme, over one hundred thousand acres in the Barrage area were held on temporary leases for five years and a considerable area was held on leases for one year which were regularly renewed from year to year. In some cases definite promises had been made that such lands would be permanently granted when the Barrage came into operation and in some cases lands were granted on the express understanding that no such claim would be considered valid. The circumstances of each lease have been examined in considering the terms on which such leases should be converted into permanent grants, and there have been some cases in which financial concessions have had to be made. Generally, however, it was considered equitable to fix a price approximating to the full value of the land and to recover it by an extended system of instalments. This conclusion is justified by the fact that few of these leases date back to the period anterior to 1910, when the Commissioner in Sind issued orders, in pursuance of a decision of Government, that no land commanded by the right and the left bank canals or by the remodelled Eastern Nara should be given out except on lease, the lessees to be subsequently given first claim to permanent occupancy on payment of suitable *mal-kano* fixed with regard to the enhanced value of the land due to an assured supply of water. Undoubtedly a large number of these lessees hoped to get their grants confirmed on



payment of a light malkano and the decision to fix a price approximating to the full value of the land has been most unpopular with them. This expectation is not, however, justified. These lands are often very valuable, and are already in regular cultivation, and Government do not think that the fact that tenants have had a free lease for several years can be admitted as a valid claim to further concessions in the matter of price. The leases are now being renewed only on the condition that the holders will agree to take the lands up permanently at the price fixed by the Revenue Officer when they are called on to do so. The land not so taken up will be available for disposal to others in the ordinary way. So far only about 13,000 acres of pansalo land has been taken up permanently by the old grantees.

The Revenue Officer has been authorized to lease for a period of years lands which are not yet ripe for sale. These leases may be for varying periods and may be sold either by auction or by tender or at rates fixed by the Revenue Officer. The sale of these leases, which are now a regular feature of colonization work in other provinces, will bring in considerable sums and will materially assist the general development of the area by admitting of the temporary cultivation of lands for which water will be available, but which in other respects are not ready for final disposal.

It has also become evident that during the earlier years of the flowing of the canals, considerable areas of Government land must be given out at once in order to secure the proper working of the canals by ensuring a sufficient take off of water from all channels. Such lands it is not profitable to sell yet, nor is it possible to secure high rentals, but they are being leased for short periods on the best terms available. The only alternative to this procedure would be to let water run to waste.

Before the introduction of the Barrage scheme, no lease holder in the Barrage area paid any lease money but only paid the ordinary assessment on such area as was cultivated. The grant of free leases has now been stopped, and lease money at least equivalent to the assessment is now usually charged in addition to the assessment.

54. (vii) *Long-term leases.*—The Revenue Officer is receiving a certain number of applications for large grants for special purposes such as cotton-growing, cattle-breeding, fruit-farming, etc., generally involving some concession in the matter of price. The history of such grants in other



provinces suggests that careful scrutiny of such proposals is necessary, if the public revenues are to be adequately safeguarded. Government have therefore passed orders that the Revenue Officer should not sanction any application which involves either the grant of more than 500 acres or any special concession in the matter of price without their consent.

It is vital to the success of the whole Barrage scheme that the general standard of agricultural production should be raised. This can best be achieved by a demonstration of what can be done by private individuals or companies working for their own profit land for cotton-growing, cattle-breeding, fruit-farming, seed farms, etc. A few large grants ranging from 2,000 to 20,000 acres on terminable leases to persons who will adopt progressive methods and contribute to the social advancement of their small neighbours will be of great value. Government have already sanctioned one grant of 20,000 acres in the Umarkot Taluka of the Thar Parkar District. The grant is in an area remote from railways and other communications, where a considerable area of Government land was available which in the ordinary way would have taken some years to develop. The grantee has started growing cotton on a commercial scale and is also bound to set aside an area of 300 acres to be run as an experimental farm under the instructions of the Agricultural Department. It has already had the effect of drawing attention to the possibilities of this area in a marked degree, with the result that a great deal of the waste land surrounding the grant has already been sold or let on short leases to other applicants.

55. (viii) *Grants to other departments.*—The Agricultural Department have intimated that they will require about 3,000 acres for seed farms. The grant of leases for special purposes mentioned in the preceding paragraph may, however, obviate the necessity of setting apart so large an area for a Government seed farm. The question of the land that will be required by the Forest Department has been discussed in Chapter V below.

There remains the area remaining for disposal at full rates. It would be premature to estimate what this area will be. Leases for long periods, which will be a new feature in Sind, will, for instance, have to be taken into consideration, and it is difficult to foresee with any accuracy the extent to which these leases will be taken up. The total

area for disposal will be very large, and the sales are likely to be spread over a period of not less than twenty years, during the course of which some of the proposals may undergo modification in the light of the changing financial situation and actual experience. The proposals must therefore be regarded rather as a general indication of the lines along which development can for the present proceed than as an irrevocable commitment to a particular policy. The great fall in agricultural prices and values which has just set in may last for some years, but unless it becomes clear that it is likely to be permanent, it would appear profitable to slacken off somewhat the programme of outright sales and concentrate rather on bringing the land under cultivation as quickly as possible by means of short leases.

56. (B) *Other problems*—(i) *Introduction of new settlements*.—The number of talukas wholly or partly affected by the Barrage canals is 38, and the introduction of new land revenue settlements in all of them was necessary. Regular settlement enquiries were instituted and were carried out by two officers during the four years ending 1930-31. The reports had been completed but had not yet reached Government before the world wide depression of prices made it clear that any rates of assessment based on enquiries held before that depression set in could not be satisfactory, and could hardly be considered by Government unless they were first reviewed in the light of the changed conditions. Government therefore directed that the proposals made by the settlement officers should first be revised with reference to the fall in agricultural prices before they were published in the ordinary course for the submission of representations and objections. This review inevitably resulted in the recommendation of much lower rates of assessment than had originally been proposed. The introduction of the new settlements was sanctioned by Government in July 1932, and the new rates were introduced with effect from the kharif crop of 1932, which was the first to be grown on the supply afforded by the new canals.

57. (ii) *Land Acquisition*.—The acquisition of land for canals, distributaries and minors has now been nearly finished, the total area acquired for these channels up to 30th September 1933 being 46,314 acres at a cost of 61.66 lakhs. The remaining area for acquisition is for water courses, and most of this is being acquired by private negotiations without recourse to the Land Acquisition Act.



58. (iii) *Rectangulation*.—Details have been given in paragraphs 17 to 21.

#### IV. Agriculture.

##### A—DEVELOPMENT OF THE AGRICULTURAL DEPARTMENT IN SIND, 1923-33.

59. *Advisory Committee, 1923*.—As soon as the Lloyd Barrage Project was sanctioned, an Advisory Committee was appointed by Government to consider the development of the Agricultural Department in Sind in order to enable it to deal effectively with the large series of new agricultural problems which would arise on the advent of perennial irrigation. This Advisory Committee was composed of both official and non-official gentlemen and was under the Chairmanship of the Commissioner in Sind. The Committee submitted numerous valuable recommendations many of which are alluded to in the course of this chapter.

60. *Recommendations of Advisory Committee, 1923*.—With regard to the administration of the Agricultural Department in Sind, the Committee urged the separation of the Department in Sind from that in the Presidency, the former to be placed under the sole control of a local Director who would deal directly with Government and also with the Commissioner in Sind and the Chief Engineer, Lloyd Barrage and Canals Construction. On the side of scientific research and investigation into agricultural problems, the Committee recommended strongly that experimental work should be undertaken at once *before* the opening of the Barrage. They emphasised the importance of research into soil and irrigation problems with special reference to *kalar* land formation and reclamation and urged the financing of such scientific investigations on a liberal scale so as to ensure that the maximum results should be obtained. In connection with agricultural propaganda and extension work, the Committee considered that a greatly extended programme of district propaganda and demonstration work was essential and recommended the early development of the staff and equipment of the Agricultural Department in Sind to enable such an increased programme to be carried out fully and effectively.

The recommendations of the Advisory Committee of 1923 and the action taken thereon, up to the present year, i.e., 1933, are tabulated in Appendix I.

61. *Central Agricultural Research Stations.*—The Advisory Committee recommended the establishment of three main agricultural research stations, viz. :—

- (1) At Larkana, for the area to be irrigated on the right bank of the Indus.
- (2) At Sakrand, for the area under the Rohri and other canals on the left bank.
- (3) At or near Shadipalli, for the area under the various canal systems dependent upon the Eastern Nara.

Government accepted these recommendations with certain reservations. The establishment of two main stations on the two banks of the Indus was admitted to be necessary but, as it was not then certain whether the problems of the Eastern Nara tract were so different in character from those of the rest of the Left Bank area as to require an independent station, this item was held over for further investigation. It was decided, however, to establish forthwith one central research station at Sakrand on the left bank of the Indus as the important problems of this large tract demanded immediate investigation. Suitable land was available and irrigation facilities were considered to be adequate. The scheme for starting this main research station at Sakrand was estimated to cost Rs. 3,02,432 during the year 1925-26 and this demand was finally passed by the Legislative Council in August 1925.

62. *The Agricultural Research Station, Sakrand.*—The Agricultural Research Station, Sakrand, is situated in Nawabshah District in the centre of the area which is commanded by the Rohri Canal and its dependent canal systems on the Left Bank of the Indus. Since the opening of the Station in 1925, the main research work of the Agricultural Department in Sind on post-Barrage problems of Agriculture has been centralized there. The scientific work of the station is organised in three sections, chemical, botanical and agricultural. In addition, a small physiological section, financed by grants from the Indian Central Cotton Committee, has been established at the station to carry on investigations into physiological problems of cotton cultivation in Sind. Within the past three years, minor organizations dealing with estate management and agricultural engineering have been established at the Station. In 1932-33, an oil-seed branch of the botanical section has been started for agricultural and economic research into the possibilities of the extension of the cultivation of improved



varieties of oil-seed and pulse crops in the Barrage areas. The work of this branch is financed by grants from the Sir Sassoon David Trust Fund.

63. *Direction and co-ordination of agricultural activities in Sind prior to 1930.*—The establishment of an Agricultural Department in Sind took place in 1904. During the period 1904–1930, the work of the Department was in charge of a Deputy Director of Agriculture and was under the general supervision and control of the Director of Agriculture, Bombay Presidency. The cadre of the department in Sind formed part of the general cadre of the Agricultural Department in the Presidency. After the organization of the Agricultural Research Station, Sakrand, in 1925, Dr. Mann, the then Director of Agriculture, held charge of the control and direction of the Station, in addition to his own duties until his retirement in 1927. Thereafter, temporary arrangements continued in force until June 1930. The Advisory Committee of 1923 had stressed the necessity for a separate Agricultural Department in Sind. The Royal Commission on Agriculture in India stated that :—

“The Agricultural problems of Sind will, in our opinion, assume such importance as a result of the construction of the Barrage that we consider the province should have its own Director of Agriculture with headquarters at Karachi. The work of the Sakrand Farm and its sub-stations will fully occupy the time of a Deputy Director of Agriculture.

We recognise that Sind under Barrage irrigation will contain as important and comprehensive a system of agriculture as Egypt has to-day and we consider that the welfare of the people demands a chain of experimental stations subsidiary to Sakrand and a full staff of competent officers. We are convinced that the financial returns to the State from expenditure on a far-sighted policy will be on the most generous scale.”

In accordance with these opinions, in June 1930 the post of Chief Agricultural Officer in Sind was created, combining the duties of the Director of the Research Station at Sakrand and of Deputy Director of Agriculture; and Mr. W. J. Jenkins was appointed to it.

64. *Establishment of a separate Agricultural Department in Sind.*—Subsequently, the Chief Agricultural Officer in Sind was made independent of the Director of Agriculture, Bombay Presidency, in financial and administrative

matters and subordinate only to the Commissioner in Sind. Steps were also taken to separate the cadres of the Provincial and subordinate agricultural services on the basis of the present distribution. The Chief Agricultural Officer is, however, able to obtain the advice of specialist officers under the Director of Agriculture such as the Agricultural Chemist, the Live Stock Expert, the Economic Botanist, the Plant Pathologist, etc. .

## B--AGRICULTURAL RESEARCH AND INVESTIGATION.

### (1) Organization of Research.

65. *Agricultural Research Stations.*—The main agricultural research work of the Agricultural Department is centred at the Agricultural Research Station, Sakrand, where scientific investigation into post-Barrage problems of agriculture is being carried on in the chemical, botanical, agricultural and physiological sections established at that station. Research work on the rice crop is in progress at the Government Farm, Larkana, in the centre of the rice-growing areas of North Sind. Botanical work on the "bosi" wheat crop was formerly conducted at the Government Wheat Farm, Jacobabad, but, as this institution was closed down in 1932-33, arrangements have been made to continue this work on a small leased area. Irrigated wheats are being dealt with at the Agricultural Research Station, Sakrand. Research work on fruit culture and horticultural problems is centred at the Government Fruit Farm, Mirpurkhas.

66. *The Sind Research Committee.*—During 1930-31, considerable impetus was given to agricultural and irrigational research in Sind by the formation of a Sind Research Committee to co-ordinate and control research work in Sind in all its branches as affecting irrigation and agriculture. The composition of the Committee is:—

- (i) The Commissioner in Sind (Chairman),
- (ii) The Chief Engineer in Sind,
- (iii) The Chief Agricultural Officer in Sind,
- (iv) The Executive Engineer, Development and Research Division in Sind,
- (v) An Agricultural Research Officer to be nominated by the Chief Agricultural Officer in Sind.



The main function of the Committee is to ensure the closest co-operation between the research work of the Agricultural and Irrigation Departments by consideration of the lines along which such work should proceed in future and by allotment of different items of research work among the various research organizations of both departments so as to avoid duplication and over-lapping of work.

## (2) *Improvement of Crops.*

67. *Introductory.*—The Advisory Committee of 1923 urged that careful experiments should be made to determine (a) the types of crops which would give the best results under Barrage conditions and (b) the best rotations of crops which would enable the maximum returns to be obtained from the land without damaging it, while at the same time maintaining its fertility. This work is being carried on intensively at the Agricultural Research Station, Sakrand, and at subsidiary research stations of the department. This section of the report deals primarily with botanical and agronomical improvement of crops both with regard to yield and quality and an attempt has been made to indicate the progress made in these directions and to describe the future lines of work which are being undertaken.

### (A) WHEAT.

68. *Present position with regard to wheat improvement.*—The importance of wheat as a crop to be grown in the Barrage areas has always been recognized both by Government and by responsible commercial bodies in Sind. It is anticipated that wheat will be by far the most extensively cultivated crop under Barrage irrigation and that the total area under this crop will rise from half a million to two million acres. On the botanical side the research work of the department has been directed towards (a) obtaining by selection among local Sind wheats, the highest yielding strains for extension as pure crops in the districts and (b) improving the quality of the Sind wheat crop by the extended introduction of superior "strong" wheats, with good milling characters, from other parts of India and from abroad.

With regard to (a) the Agricultural Department has succeeded in selecting high-yielding strains of wheat, viz., C. Ph. 47 (Phandani), A. T. 38 (Thoree) and H. S. W. III (Boojri) which give definitely superior outturns per acre than



the ordinary local crops in general cultivation. These selected strains are being multiplied up and extended in the wheat-growing tracts. Under (b) above, the most successful importations are the famous "Pusa" wheats produced at the Imperial Institute of Agricultural Research, Pusa, Bihar. The variety Pusa 12 is already well established in North Sind and other high quality Pusa wheats, notably Pusa 114, appear to be well suited for cultivation under Sind conditions. Other successful importations include Punjab 8-A and Punjab 11, two valuable wheats from the Punjab, Manitoba No. 1, the world famous "strong" wheat of Canada and Bina wheat from the North-West Frontier Province.

Experiments on wheat cultivation and agronomy have shown that, under post-Barrage conditions of irrigation, early irrigation water can be utilised for flooding wheat fields in October and early November and, provided that suitable tillage methods, designed to preserve the moisture in the land, are adopted, the crop can be sown on such fields in late November or December without affecting final yields.

69. *Recent progress with regard to Wheat improvement.*—The series of "Major Wheat varietal tests" carried out in the rabi seasons of 1930-31 and 1931-32 were repeated in the rabi season of 1932-33 and the results obtained largely confirmed the results of the previous years. These tests involved the design and execution of a series of scientifically designed field experiments on both Government farms and zamindari lands in all parts of Sind. As a result of these tests, the Agricultural Department is now in possession of full and reliable information with regard to the yielding capacity of improved wheat varieties in the different wheat-growing tracts and a scheme for seed multiplication and extension of improved wheats has been commenced on the basis of the information thus obtained.

The Karachi Chamber of Commerce drew the attention of Government to the importance of extending the cultivation of "strong" wheats with good milling characters in the Barrage areas. Samples of improved types of wheat grown in Sind, both indigenous and imported varieties, have been submitted for milling and baking tests in England, the United States of America, Holland and Scotland and considerable valuable information is now available with regard to the quality of these samples from the milling and baking point of view. The imported Pusa type, viz., Pusa 114, has been most favourably reported upon abroad and



efforts are now being made to cultivate this variety in commercial quantities in the Barrage areas.

A seed multiplication scheme for improved wheat varieties based on "units"—each "unit" representing a final area of 50,000 acres under one improved variety—has been drawn up and the third stage of multiplication is in progress. The programme of pure seed multiplication under this scheme consists of five stages for each "unit", viz., (1) seed patch—5 acres, (2) increase block—50 acres, (3) field scale plantings—500 acres, (4) village groups—5,000 acres and (5) district groups—50,000 acres. The first three stages are under careful departmental supervision; the fourth and fifth stages will be arranged through selected seed-growers and co-operative organizations. Seven and a half such "units" of multiplication have been started to supply different wheat-growing tracts. Arrangements have been made with the Sind Central Co-operative Bank whereby that organization will take a prominent part in the financing and distribution of the fourth stage under the seed multiplication scheme.

With regard to purely botanical work on the wheat crop, trials of different varieties of wheat obtained from other parts of India and from abroad were continued. In general, these newly imported varieties have been found to be decidedly inferior to the improved varieties now being handled by the Department in point of yield. Several, however, possess valuable characters and will be utilised in future hybridization work with Sind wheats. The F<sub>1</sub> generation of the new cross between C.Ph. 47 and Pusa 114 was grown in the rabi season, 1932-33.

70. *Future lines of work in wheat improvement.*—With regard to botanical investigations, it is unlikely that any material improvement in yield over the improved varieties now being handled by the department will result from further selection among indigenous Sind wheats. The possible exception is among the 'Ihoree' types of wheat and botanical selection in these varieties will be continued for a few more years. The most profitable and rapid method of improving the quality of the Sind wheat crop is by the continued introduction and acclimatisation of the improved Pusa selections. These selections are being tested further in the different wheat-growing tracts under replicated yield trials. Measures are also being taken to obtain from time to time analytical reports on the nitrogen and protein content and

on the milling and baking qualities of all improved wheats grown in Sind as an essential complement to botanical work.

Experiments are necessary to determine the best seed rate of the improved wheat varieties, under both irrigated and *bosi* conditions, in the main wheat-growing tracts of Sind and work in this connection has been started. The manuring of the wheat crop, both with artificial manures and green manure crops, is under investigation at the Agricultural Research Station, Sakrand. The possibility of altering the spacing between rows with the object of obtaining the maximum stand and final yield per acre will be tested.

In view of the very important place which the wheat crop will occupy in Sind under the Lloyd Barrage and Canal Systems, the detailed study of the world economics of the wheat crop and of internal and external market requirements must be continued. The types of wheat which are required in the world's markets, the economics of production, assembly and distribution and the changing requirements of consumers both in India and abroad are subjects upon which the fullest investigation is needed in the interests of the future of wheat growing in Sind. In addition, efforts are being made in the near future to place commercial quantities of pure superior quality wheats grown in Sind on the market in order that it may be possible to determine the economics of their production in the Barrage areas. These matters are at present receiving careful attention but if they are to be investigated in full detail might finally require the undivided attention of an expert marketing officer, as recommended by the Royal Commission on Agriculture in India (paragraph 348 of Report).

#### (B) COTTON.

71. *Present position with regard to cotton improvement.*— During the past ten years, the area under cotton cultivation in Sind has averaged slightly over 3,00,000 acres with an average annual outturn of about 1,00,000 bales. With the full development of perennial irrigation under the Lloyd Barrage and Canal Systems, it is anticipated that the cotton acreage will expand to 7,50,000 acres and may even reach 10,00,000 acres. Four main classes of cotton are being dealt with by the Agricultural Department in Sind, viz.,



(a) Sind *deshi*, (b) Punjab-American cottons, (c) imported American cottons and (d) imported Egyptian cottons. Among these four main classes of cottons—which include types suitable for all purposes—the Agricultural Department have evolved by botanical selection improved strains which, by reason of high outturn per acre, high ginning percentage or superior quality, appear suitable for extension in general cultivation in the Barrage areas. Among the *deshi* types, the improved variety 27W.N gives an early and abundant crop (about 16·20 per cent. higher outturn than ordinary *deshi*) and has a 4·5 per cent. higher ginning percentage. This variety is now the standard *deshi* cotton in Sind and is extending rapidly in the cotton-growing areas. Of the Punjab-American types, improved selections in the 285F and 289F varieties have been obtained with a staple length of 1" to 1-1/8" which grow well under Sind conditions and would be in great demand by Indian mills. The yield of the Punjab-American varieties is not so great as that of the improved *deshi* 27W.N. Among imported American and Egyptian types, improved selections have been made which are outstanding for staple length and high quality of lint. The yields of these imported varieties are, however, low—about half the yield of the improved *deshi* type. They are also more susceptible to unfavourable environmental or climatic conditions and require more care and attention in cultivation. Thus the Agricultural Department in Sind has already obtained a very wide range of improved cottons, suitable for all purposes, and available for extension under post-Barrage conditions.

72. *The Indian Central Cotton Committee, Bombay, and the extension of improved varieties of cotton in Sind.*—In December 1930, the Chief Agricultural Officer in Sind submitted a Note on the major problems connected with the development of cotton cultivation in Sind to the Indian Central Cotton Committee, Bombay. This note served as the basis for a discussion during which the advice of traders, growers and official representatives on the Committee was given freely. With regard to the problem of which variety or varieties of cotton should be extended under post-Barrage conditions, the general consensus of opinion was that cotton with a full 1" staple always had a good market and that it would therefore be desirable to go in for more of this type of cotton. It was also recommended that efforts should be



mixing and to obtain the best prices for the growers. The Committee made a strong recommendation that a system of licensing of gins and presses should be introduced into Sind as early as possible and that the construction of new gins and presses in the Barrage areas should be controlled to avoid the subsequent formation of "pools" which would operate against the best interests of the growers. Finally, the Indian Central Cotton Committee sanctioned a grant of Rs. 31,000 per annum for a period of three years in the first instance to be devoted to the extension of improved cotton varieties in the Barrage areas. This grant has been utilized for the establishment of a "Sind Cotton Extension Scheme". A cotton supervisor and staff being appointed in both the right and left bank areas to carry out district demonstrations and experiments on the cultivation of improved cottons and to supervise seed multiplication and distribution. In August, 1933, the Indian Central Cotton Committee considered reports on the progress of the work under the scheme and sanctioned a further grant of Rs. 2,96,540 to enable the scheme to be extended for a further period of five years, i.e., till 1939.

73. *The Sind Cotton Committee.*—The formation of a Sind Cotton Committee was approved by Government in March 1931. The committee has considered many matters relating to the welfare of the cotton-growers of Sind including schemes for the multiplication and extension of pure seed of improved varieties, improvements in cotton marketing, regulation of gins and presses, cotton standards, and measures for improving the yield and quality of the Sind cotton crop. The Sind Cotton Committee forms a common meeting ground where all sections of the cotton trade, growers and officials, can discuss matters, relating to the welfare of the cotton growing and trading industries in Sind.

74. *Trade exhibition of improved cottons in Karachi.*—An exhibition of the improved cottons, being handled by the Agricultural Department in Sind was held in Karachi in February 1932. This exhibition was organised in order to bring to the direct notice of the cotton trade the progress which has been made by the Department in cotton improvement work and to ascertain, as far as possible, the future trend of trade requirements in connection with the development of cotton growing in the Barrage areas. The exhibition was held in the hall of the Karachi Chamber of Commerce



and was largely attended by representatives of commercial bodies and of large cotton-growing firms and by prominent cotton growers. A similar cotton exhibition was organised in February, 1933, at the time of the meeting of the Indian Central Cotton Committee which, at the request of the Sind Cotton Committee, was held for the first time in Karachi. The members of the Central Cotton Committee and many other visitors took a keen interest in the exhibits and many valuable suggestions for future work were obtained. This was the third trade exhibition organised by the Department, —a wheat display having been held at Karachi in 1930-31— and the results fully justify the continuance of this valuable method of ensuring a liason between the commercial community and the scientific work of the Department.

75. *Recent progress with regard to cotton improvement, botanical and agronomical investigations.*—The main improved varieties of cotton, being handled by the department, were again tested in replicated series on Government farms and in the districts. The results obtained emphasized the high yielding capacity of the improved *deshi* variety, 27W.N. and the improved Punjab-American selections, viz. 285F-21, 285F-2 and 289F-1 also gave satisfactory results. Adverse climatic conditions which prevail during certain seasons bore severely upon the imported American and Egyptian types and botanical work is in progress to endeavour to obtain hardier and higher-yielding strains of these high quality cottons. Hybridization work was limited to continued study of the crosses already in hand and trials of the most promising of these are now being carried out on a field scale.

Agronomic experiments on sowing dates, distance of planting, interculturing and green manuring of the cotton crop were continued at the Agricultural Research Station, Sakrand.

76. *Physiological investigations on the cotton crop.*—The Cotton Physiological Research Scheme, financed by the Indian Central Cotton Committee, completed its sanctioned period of five years in 1932. A final report on the five years' working of the scheme was submitted to the Central Cotton Committee in August. The Committee approved the report and extended the scheme for a further period of five years at a total cost of Rs. 1,62,854. Valuable practical results have already been obtained from the work under this scheme with regard to the most suitable sowing dates of



different varieties of cotton under post-Barrage conditions of irrigation and in connection with the water requirements of the crop. Experimental work on the best methods of distributing irrigation supply, within a fixed "delta", to the cotton crop in order to increase final yields is in progress. Another major item in the extended research programme deals with the effect on cotton yields of applications of quick-acting nitrogenous manures at critical periods of crop growth. The factors, responsible for the appearance of "red leaf" in American and Egyptian cottons and the problems relating to sound seed development are also being studied.

77. *Cotton extension work in the Barrage areas.*—This work is financed by grants from the Indian Central Cotton Committee and has recently been extended until 1939 at a cost of Rs. 2,96,540. The work is organised in two sections, one in the left bank areas and one in the right bank areas. Each section is under the charge of a Cotton Supervisor with a small subordinate staff. These establishments are carrying out definite programmes of cotton extension and of propaganda and demonstration in connection with the growing of improved cotton varieties and better methods of cotton cultivation. During the year 1932, field trials of improved cottons were laid out at eighteen centres on the left bank and, on the right bank areas—where cotton cultivation was not practised hitherto—thirty demonstration plots of cotton cultivation were organised. In addition, the Cotton Supervisors conducted varietal tests of superior quality cottons, demonstrated improved methods of cotton cultivation, assisted zamindars in marketing their produce, organised seed multiplication and extension work in their respective areas. The development of cotton cultivation on the right bank of the Indus promises to become a feature of post-Barrage agriculture in Sind.

A seed multiplication scheme for improved varieties of cotton—based on "units" as in the case of wheat—has been organised and is now in force. The "unit" in the case of cotton is 25,000 acres finally developed under one variety of improved cotton. The stages of multiplication are the same as in the scheme for wheat seed multiplication. Nine "units" of multiplication—five for improved *deshi* cotton and four for improved Punjab-American varieties—have been commenced and the third stage of development, involving 2,500 acres under improved cottons on the lands of "A"



class registered seed-growers will be entered upon in the kharif season of 1934.

78. *Future lines of work on cotton improvement.*— Botanical research work on the cotton crop in Sind is being concentrated upon (a) Punjab-American types and (b) Imported American and Egyptian types. With regard to (a), botanical selection aims at obtaining higher yielding and hardier strains than at present available while maintaining a staple length of not less than 1". Improvement in the regularity and the "silkeness" of the staple of the Sind-American crop is also being kept in view. With regard to (b), the most important requirements are greater resistance to adverse environmental conditions and to white ant attack, earlier maturity and better yields per acre. It is unlikely that further selection work among Sind *deshi* cottons will result in obtaining a higher yielding strain than 27W.N. but it will be necessary to continue botanical work with this improved strain to ensure the maintenance of its high ginning percentage. Further breeding work on high quality cottons is being concentrated at Mirpurkhas with a view to their ultimate extension on the Jamrao Canal area where conditions appear to be most favourable for their successful and profitable cultivation. Work on the existing 4F × Meade, 285F × Sea Island and 285F × Pima hybrids will be continued but the prospects of any important advance by hybridization among improved cottons are not of much importance at present. Good varieties of African cottons have been obtained and tested under Sind conditions.

On the side of cotton agronomy and cultivation, further research work on the manuring of the cotton crop and the effect of manurial applications at critical periods of growth has been commenced in the physiological section, Sakrand. Attention can also be profitably given to investigations into the optimum seed rates of different cotton varieties, technique of sowing and interculturing and irrigational requirements in different cotton-growing tracts in the Barrage areas. Field trials of such agronomic improvements are in progress on Government auxiliary farms. The investigation of the various diseases of the cotton crop in Sind, e.g. wilt disease, "root rot", "red leaf" etc., and of the control of insect pests, e.g. bollworm, white ant, etc., must also be undertaken in the near future.

On the economic side of cotton production in Sind, the marketing of improved varieties of cotton, especially of low



yielding long stapled varieties requires detailed examination if the growers of such superior quality types are to receive an adequate return for their labours. The recommendations of the Indian Central Cotton Committee with regard to the licensing of gins and presses, the segregation of long stapled areas, i.e. "community" cotton growing and the avoidance of the evils resulting from "mixing" and "pooling" in ginning factories must be examined thoroughly. Certain of these problems have already been considered by the Sind Cotton Committee and there is every reason to believe that their solution will be reached with the fullest co-operation between the commercial community and the Agricultural Department in Sind.

### (C) OTHER CROPS.

79. *Rice*.—Work on rice crop improvement is being conducted at the Government Farm, Larkana, and three improved strains have been evolved which are much superior to the local varieties and which are rapidly extending in the rice-growing tracts of North Sind. During the past two years, a series of experiments were conducted in the district to ascertain whether the transplanting season of the rice crop could be profitably advanced in view of the fact that irrigation water under Barrage conditions will be available about two months earlier than formerly. The results indicate definitely that early transplanting is not only possible but gives higher yields per acre than by the old method of late transplantation. Similar experiments are being carried on in the present year.

The work of the Agricultural Department on the improvement of the rice crop has so far been entirely concentrated upon the rices of the Upper Sind tract. However there are approximately five lakhs of acres under rice cultivation in the districts of Hyderabad and Karachi and it is essential that scientific research on the improvement of the rice crop in this important area should also be undertaken. Accordingly, work on the botanical improvement of the rice crop of lower Sind and the testing of high quality and early maturing varieties from other rice-growing areas was carried out last year in the Guni taluka of Hyderabad district. The results obtained were promising and the investigations are being continued in the present year. The Botanist in Sind has carried out an extensive tour in Karachi district to study the existing conditions of rice cultivation there, and



has submitted a comprehensive report dealing with all the major problems of the tract and suggesting profitable measures to benefit the cultivators. Arising out of this report, large quantities of seed of early maturing rices have been distributed for extended cultivation in Karachi district. A promising hybrid Kangni 27 × Kolumba 184 appears to offer possibilities of giving a material increase in the yield of the rice crop in north Sind and is now being tested on a field scale. Investigations are being made with regard to the suitability of improved Sind rices for other markets in India and abroad and samples have been sent to trade authorities for opinion and valuation. During the present year, a consignment of five tons of dehusked Kangni rice from north Sind, was sent to a firm of rice millers in London, for valuation and milling tests. The report received from the firm indicated that Kangni rice is too small-grained to suit the European market which demands a bolder sample of the short and flat type. Similarly tests with other varieties of improved Sind rice will be arranged in future.

At Larkana, investigations into diseases of the rice crop are in progress. This work is under the charge of a Rice Mycologist and is financed by grants received from the Sir Sassoon David Trust Fund. Special research work on the control of the "ruro" or "mahlo" disease in the rice crop in lower Sind is most necessary as it has caused tremendous loss to the cultivators and Government in recent years.

*Jowar and bajri.*—Under perennial irrigations from the Lloyd Barrage and Canal Systems, a considerable increase in the areas under jowar and bajri must be anticipated in view of the increased demand for grain for human consumption and of fodder for work-animals. With regard to jowar, the department have obtained several improved high-yielding varieties which give 20-40 per cent. higher outturns per acre than the ordinary crops in cultivation in Sind. The seed of these improved varieties is being multiplied up and issued for extension in the districts. Hybridisation work on this crop is also in progress and promising material has been obtained. Preliminary work has been started on the botanical improvement of the bajri crop in the Barrage areas.

80. *Oilseeds and pulses.*—The Royal Commission on Agriculture in India raised the question whether it would be prudent, in the left bank area, to rely on cotton only as a main kharif crop or whether efforts should be made to find