

REPORT
OF THE
INDIAN IRRIGATION COMMISSION,
1901-03.

SUMMARY OF RECOMMENDATIONS,

PARTS I AND II.



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REPORT OF THE INDIAN IRRIGATION COMMISSION.

SUMMARY OF RECOMMENDATIONS.

PART I.—GENERAL.

1. (a) The unproductive share of the capital expenditure incurred in bringing an acre under cultivation should be limited, at any rate for some time to come, to three times the saving that will be effected thereby in the average annual cost of famine. This proportion will probably not be too high, provided that it is applied only to cases in which the water-supply is assured in a year of drought (92—109). Unproductive outlay on irrigation works.

(b) Protective works should be sanctioned without hesitation when the capital cost is not likely to exceed thirty times the net revenue, or whenever a return of more than 8 per cent. on the capital cost may be anticipated. When a lower return than this is anticipated, it will be necessary to pay closer attention to all the circumstances of the case (111).

2. The programmes of future expenditure on irrigation works should provide for the construction of as many productive works as can be proposed without reference to the urgency of protection in the tract to be commanded by them, and promising projects should be held in abeyance only under very exceptional circumstances (114). Productive works.

3. The Commission's provisional forecast for expenditure on State irrigation works, for which capital accounts will be maintained, involves a total outlay of 44 crores for the irrigation of 6½ million acres, and a net annual loss to the State of 73½ lakhs as a set-off against which the finances will be relieved by the reduction in the future cost of famine which will result from this expenditure. That reduction will certainly not be less than 31 lakhs, and it may be much more, if in sanctioning protective works the principle is adopted that the net burden which the expenditure would impose on the State should never exceed three times the saving in famine expenditure likely to be effected by the works (140). Forecast of expenditure.

4. Protective operations should be undertaken in all provinces in accordance with some definite scheme. Each Local Government and Administration should be invited to submit its own programme, so that a revised general programme can be prepared in accordance with which future financial arrangements will be framed. Local Governments should be held responsible for the finally accepted programmes being systematically carried out. The works should be completed as quickly as possible and should not be interrupted for want of funds (141). Provincial programmes.

5. In the repair and improvement of private tanks the assistance of Government can best be given by loans and grants-in-aid and by professional assistance. Where the tanks are out of repair endeavours for the present should be concentrated upon their repair and the provision of necessary subsidiary works (149). Private tanks.

6. There is in some provinces the need of a clearer definition of the customary obligations of the landowners and cultivators regarding the repairs of irrigation works and of stronger authority to enforce them. When the repairs required on any work are too expensive for the landowner, he should be granted loans and in some cases even free grants-in-aid (151). Maintenance of private irrigation works.

7. The construction of field embankments should be encouraged by liberal *sakavi* advances and by free grants in tracts exposed to famine; and that in districts, where their construction is likely to be of use, famine labour should be extensively employed on them (153). Field embankments.

Extension of wells.

8. (a) In the Punjab and United Provinces, except in some special tracts where wells are required for protection in famine, the people may be trusted to increase wells without any stimulus beyond the grant of *takavi* (166).

(b) In Central and Southern India there are many tracts in which it will be justifiable to make considerable financial sacrifices for stimulating well construction (167—168).

(c) Government should not itself undertake the construction of wells except where necessary for experimental and instructive purposes. In Government or managed estates Government might construct wells, but even here it will often be better to get the tenants to make them (169—171).

(d) Government must be prepared to share some of the risks of well-construction. Partial remission of advances should be made when the cultivator fails to find water through no fault of his own.

Trial borings.

9. Endeavour should be made to discover some simple and inexpensive method of boring, and where necessary assistance should be rendered in making trial borings by providing tools and expert workers at a small charge. In certain localities (South-East Punjab, South Jumna districts of the United Provinces, parts of Gujerat, area of Deccan tract) special experiments should be made in order to ascertain whether any deep source of supply (sub-artesian water) can be tapped (175—176).

Subsoil water survey.

10. Over the greater part of the alluvial tract those tracts should be mapped out in which the construction of temporary wells can be usefully pushed at an early stage of a famine. In the localities where special experiments are made in search of sub-artesian water a careful record should be kept of the results of all borings (175—176).

Regard to local conditions.

11. In stimulating improvements of all kinds, especially well-construction, minute regard should be paid to local circumstances. Reports and maps should be prepared in every district and circle similar to those compiled for the drought tracts in the United Provinces (177).

Exemption of improvements.

12. Where exemptions are temporary liberal advances may be given. Where they are perpetual the liberality must be measured solely by the needs of the tract and the saving which will accrue in famine expenditure and loss of revenue consequent upon famine: by the considerations, in short, which justify the construction of purely protective works. In provinces where exemption is at present only temporary a trial of perpetual exemption would be justified in tracts exposed to famine in which special encouragements are required. In Bombay the widest publicity should be given to the provisions of the law regarding perpetual exemption. In the Central Provinces and in the Punjab the rules might perhaps be modified so as to secure to approving landowners a period of exemption from enhancement of revenue which would not be less than that now given in the United Provinces (178—180).

Exemption of tenants' improvements.

13. In provinces other than Bombay and the *rayatwari* districts of Madras the tenancy law should be examined and amended so as to secure for the tenant a liberal period of exemption from enhancement of rent on account of his improvement. The period should be sufficient to recoup the tenant for any reasonable outlay incurred by him (181).

Takavi.

14. (a) For stimulating *takavi* the principal measure required is to quicken the interest of all revenue officers in *takavi* work; to place liberal allotments at their disposal; and to inquire strictly into the causes of failure to spend up to them (188).

(b) The loans should not be a source of profit to the State and the rate of interest might be reduced to 5 per cent. in all provinces (189).

(c) Suspension should be given without hesitation whenever from causes beyond the control of the borrower his crops fail to such an extent as to make payment of the year's instalment burdensome; whenever suspensions of revenue are granted, they should carry with them automatically suspensions of the year's *takavi* instalments. The officer who has authority to grant the loan should also have authority to grant suspension. The effect of suspension should be to

postpone by one year the payment of all remaining instalments. The head of the district should not have to report each case of suspension to superior authority (191).

(d) As regards period of repayment, it seems unnecessary to consider the question of the loan being paid by the generation benefited by it. The sole consideration in determining the period of repayment should be the "life" of the work. The full period so determined should be offered to the borrower and no pressure should be placed upon him to induce him to choose a shorter period. Either no maximum period should be prescribed by law or the maximum for the whole of India should be far lower than the existing maximum of 35 years; 50 years would seem to be a suitable term. Local Governments might be empowered to prescribe in the rules maximum periods for different tracts and classes of work. The officer empowered to grant loans should have full power to fix the period of repayment. In secure tracts a strict estimate should be made of the "life" of the improvement (192—194).

(e) In all precarious tracts where special stimulus is required and where the cultivator undertakes to build a thoroughly durable well the alternative should be offered of paying $5\frac{1}{2}$ per cent. so long as the well endures without any demand for repayment of capital, although he might repay at any moment any portion he wished so as to reduce the interest charges (195—196).

(f) Power should be given to sub-divisional officers and even to tahsildars to grant advances within certain limits (197).

(g) In districts where large advances are to be made the officer distributing *takavi* should take the money with him into camp, receive applications, inspect sites, settle terms and make advances on the spot (197).

(h) The doubt as to the exact legal effect of section 7 (1) (c) of the Land Improvement Loans Act should be set at rest under competent legal advice, or if need be, by one or two test cases; and if necessary the law should be amended, so that the land benefited should be saleable for the recovery of *takavi* arrears, just as it would be for recovery of arrears of land revenue, free of all encumbrance. The provision of section 5 might, if thought necessary, be fortified by making notice compulsory. Wherever records-of-rights have been prepared, it might be ruled that objections submitted by prior encumbrances will be recognised only if the encumbrance has been previously entered in the record. The existence of prior encumbrances should not, however, necessarily bar the grant of the loan (198—199).

(i) The expediency of making tenants' holdings saleable for the recovery of Government loans, as in the Central Provinces, should be considered in other provinces (200).

(j) The experiment should be freely tried of making advances to tenants upon their individual personal security (202).

(k) Separate accounts should not be maintained for principal and interest (203).

(l) Where land revenue is recovered by rates upon the area cultivated or matured, *takavi* might be recovered by a percentage surcharged on the amount of land revenue (204).

(m) With the increase of *takavi* advances there is certain to be a need for increase of establishment, and in certain tracts special officers and suitable establishments may have to be provided. It may be possible to utilize agricultural banks in distributing *takavi* (205).

(n) Great care should be taken in famine times to have the advances given out early. For each district a sum based upon experience of previous famines should be fixed beforehand and authority to disburse up to that sum should be given to heads of districts by the Local Governments as soon as they are satisfied that the necessary emergency has arisen. On the occurrence of famine all permanent allotments should be at once diverted to small and temporary irrigation works (206).

- Special concessions in famine tracts.** 15. In tracts exposed to famine greater concessions will have to be made which should generally take the form of grants of money up to a maximum of, say, one-half the total amount required. Such grants should only be made when they are justified by the poverty of the applicants, or where the margin of profit from irrigation is so close that the concession would make the difference between profit and loss to the irrigator (207—208).
- Disbursement of loans and grants.** 16. The money should be given out by instalments; the work inspected; and the second instalment not given until work to the value of the first has been executed. Where advances are large there should be a special agency for inspection. Subordinate's inspections should be checked by superior officers. The advance or grant should fully cover so much of the outlay as the borrower is unable to provide from his own resources (209).
- Forecast of outlay.** 17. At a rough estimate Government should treble the existing *takavi* grants and allot 17 lakhs annually for free grants-in-aid. The amounts to be provided will necessarily come under revision from time to time, but the revision should be made rather with reference to actual requirements than to budget exigencies (210).
- Financing of loans and grants.** 18. The policy advocated should not be liable to interruption in years of financial stress. Subject to the conditions that *takavi* transactions should be self-supporting and involve no loss to the State, the only limit to the *takavi* grants should be the amounts the people are willing to take and the officers of Government able to distribute with due regard to security. If the amounts required cannot be provided from general revenues, the money should be obtained from loan funds. Expenditure on grants made might be chargeable against the famine grant; or, in other words, be met from that portion of the grant which would otherwise be applied for the reduction or avoidance of debt. Local Governments should be invited to submit estimates of the amounts which they can distribute over a series of years not less than five, and be given regular annual instalments up to which they should be expected to work. Failure to do so should be explained, but should not be made the ground for diminution of allotments. Similarly, regular allotments should be given to the heads of districts and divisions. The free grants will be chargeable against some final head of expenditure such as 'minor works agricultural' (190—192—213).
- Artesian wells.** 19. Experimental borings for artesian water should be made in any famine tract in which the geologists may consider that the conditions are exceptionally favourable for artesian action (221).
- Classification and financing of State works.** 20. (a) (i) The present distinction between productive and protective works should be done away with, both being included in the class of major works; and all future capital outlay on major works should be met from loan funds.
- (ii) The net interest charges, *i.e.*, the excess of full interest charges over net revenue, on every major work hereafter sanctioned, should, until its interest account has been cleared, be shown against the famine grant.
- (iii) The excess of net revenue over full interest charges on every major work, hereafter sanctioned, should be credited to the famine grant until its arrears of interest have been cleared.
- (iv) The balance of the famine grant, remaining after the cost of famine relief, the grants-in-aid of private agricultural works, and the interest charges on major irrigation works and the two famine railways, have been deducted, should be shown as applied to the reduction or avoidance of debt.
- (v) The Government of India should be empowered to sanction all estimates for major works of which the amount for "works" does not exceed 10 lakhs of rupees; estimates above this amount only being forwarded to the Secretary of State for sanction. The powers of sanction of Local Governments and Administrations to be fixed hereafter.

(b) Transfer to major works all minor works for which both capital and revenue accounts are now kept, and the revenue accounts of which can be taken as indicating with reasonable accuracy the true return due to the capital expenditure (248).

(c) All new minor works which will form no integral part of existing minor works, and which are likely to cost more than Rs. 50,000, should be sanctioned as major works (248).

(d) No capital accounts should be maintained for those minor works which now have them, but which cannot be transferred to major works owing to the unreliability of the capital and revenue accounts, or to the difficulty of making them reliable (250).

(e) In future classify works as follows :—

I.—Major works; to include all works for which reliable capital and revenue accounts are kept, whether the capital cost has been met from loan funds or the famine grant, or from current revenues.

II.—Minor works; to include all works for which capital accounts are not kept, and to be sub-classed as follows :—

(a) Minor works for which continuous revenue accounts are kept.

(b) Minor works for which revenue accounts are not kept.

(f) When any considerable outlay for improving a minor work cannot be met from current revenues, the work should be transferred to the major class, its capital account being debited only with the outlay incurred on the improvement (252).

21. (a) The profits which may accrue under a provincial settlement should not be ear-marked for the construction of new works (254). Provincialization of works.

(b) There is no reason why protective works should remain Imperial in those provinces in which productive works have been provincialized (257).

(c) The proposals of the Finance Committee of 1878 (258) are inapplicable in their present form to works which are not likely to fulfil the conditions of a productive work. It would be advantageous to modify them so as to limit the liabilities of the Provincial Government in respect of interest. The amounts for which Local Governments may be asked to accept responsibility after works have come into operation should, in the first instance, be fixed as low as possible. In those provinces in which the irrigation revenue is wholly or mainly indirect, it will be necessary to provincialize the whole of the indirect revenue that may be due to the works or to make other arrangements for crediting the provincial account with the whole of the revenue actually created by the works. A scheme based on the principles proposed by the Finance Committee modified, as now proposed, may with advantage be applied in any province in which an extensive programme of irrigation works is contemplated (258—263).

22. The meter system is inapplicable to large irrigation works and the module is the only possible system of charging by volume; the function of a module being not to *measure* the volume passing through it, but to control it, so that when freely open the discharge will be constant. The first step to be taken towards introducing a volumetric system of charges is to establish a *volumetric system of distribution* in a canal or section of a canal, the present system of assessment remaining unaltered; the next to construct suitable modules at the head of the branches or minor distributaries; and the next to construct modules at the heads of all water-courses. After a time the cultivators might be allowed the option of contracting for the season or number of seasons, and finally the change might be made compulsory. It is only by proceeding gradually and enlisting public opinion in its favour that such a change can be introduced in India. In short, first *distribute* by modules, then in time *assessment* by modules may follow. On the Sone Canals the system cannot be introduced until the supplies to which the 'blocks' are entitled have been definitely fixed. So as to admit of the boundaries of the blocks being extended or removed, the Charging for water by volume.

system would be very suitable for some of the works in the Bombay Deccan, and Mr. Visvesvaraya's proposal should be given an early trial, but it would be unsuitable for Madras. Irrigation officers should be encouraged to design and experiment on modules (274—292).

Establishments.

23. For carrying out the programme of new works the staff of Engineers must be largely increased, and the increase must all be permanent. A corresponding increase will be required in most of the subordinate establishments and also some increase in revenue establishment. The distribution of supply in all large irrigation works should be closely controlled, and a strict account kept of the disposition of every cubic foot of water entering the canals. In Madras the establishments should, if necessary, be strengthened for this purpose, and the canal officer should be regularly apprised of all applications for remissions on account of flooding, etc. In Northern India and Bengal no change should be made in the existing system of management. The more closely the irrigation officers are connected with the work of assessment and remissions, etc., the more progressive and sympathetic will be the administration. The great importance of providing an adequate staff of Engineers for the maintenance and management of the larger irrigation works should therefore be steadily borne in mind when the revision of establishment is under consideration. Measures should be taken to prevent service on canals from becoming permanently and generally unpopular. It may suffice to grant local allowances on a liberal scale to incumbents of charges which involve much isolation or discomfort (293—307—377).

Hydraulic and agricultural experiments.

24. Expert inquiry should be directed to matters connected with the application of water to cultivated crops on the general lines suggested in Chapter XI under the supervision of a trained expert provincial officer working under the general guidance of the Director-General of Agriculture (308—322).

Completion of unfinished famine works.

25. The Commission's recommendations relating to completion of uncompleted famine works are confined in the Provincial Chapters to irrigation works. For railway works special report has, it is understood, been submitted to Government. In the case of other works Local Governments should decide and no delay should occur in the completion of those which can, at moderate expense, be made useful to the country. District Board should complete partially-made roads; being assisted, when necessary, by grants-in-aid. In deciding whether it is advisable to complete any revenue-earning work, the previous expenditure on relief labour should not be taken into account (330—331).

Relief work programmes.

26. (1) In any severe, extensive or long-continued famine reliance cannot be placed on village works alone; and in most districts public works must form the backbone of relief operations. The proportion which one class of works must bear to the other will depend on local conditions. For both classes of works there should be definite standards by which to appraise their utility, and future programmes should be prepared with reference to these standards (337).

(2) No attempt should be made to utilize large protective works, which are in progress when famine is declared, for the employment of any labour that is not moderately effective. The work should be carried out for as long as possible by the usual departmental system of petty contract. On these works good work and rapid progress should be the main consideration and not their usefulness as affording a means of employment to distressed labour. These remarks are also applicable to other public works in actual progress when famine occurs, but with less force. Also, but with still less force, to works for which regular estimates have been sanctioned on their merits, but on which work has not been actually commenced (339—340).

(3) Relief works should be arranged in the following order of eligibility in the programme of the Public Works Department:—

- A (a) Works under construction when famine is declared.
- (b) Works which have been sanctioned on their merits but not commenced.
- (c) Useful works reserved for famine and for which detailed estimates have been sanctioned.

- (d) Useful village works for which estimates have been sanctioned.
- B (e) Proposed works of class (c) or (d) for which detailed estimates have not been sanctioned.
- (f) Village works of little or no protective value.
- (g) All proposed Public Works, whether protective or not, which, although not altogether destitute of utility if completed, cannot possibly be completed by famine labour, or which cannot be rendered of any use without committing Government to very heavy additional expenditure.

Relief labour would not ordinarily be employed on Part B as long as employment could be afforded on works in Part A ; but works under heads, (e) and (g) in Part B would be transferred to Part A as soon as regular sanction had been obtained for them (343—344).

(4) A special establishment should be employed for compiling Part A which should, however, be limited to probable actual requirements (345—348).

(5) Separate programmes should be maintained for village works to be carried out by civil or local unofficial agency without assistance from the Public Works Department (349).

(6) Works in Part B should only be opened if requirements cannot be met from Part A, and it will probably be advisable that works in Part B should not be opened without the express sanction of the Local Government if their completion otherwise than by relief labour will involve a charge of more than five lakhs (350).

(7) In selecting works utility should be the main consideration. It is better to tolerate some laxity of supervision in procuring really useful village works than to acquiesce in the performance of useless work (351).

(8) In considering the prospective utility of any work regard should not be had solely to public utility. In preference to works of doubtful or of no public utility works likely to be useful to proprietors or cultivators of land should be freely undertaken (352).

(9) In districts where irrigation works are possible some authority should be made responsible for seeing that detailed proposals for possible irrigation works are worked out and brought on to the district programmes (370).

27. Tracts in which the need for protection is greatest should receive the first attention, but operation should be started in all provinces (371).

Order of execution of works.

28. The Public Works and Civil Officers should be closely associated in devising measures of protection and programmes of relief works (372).

Co-operation of Departments.

29. A Central Board or authority should be constituted to watch progress in carrying out the Commission's programme of State and private works (374).

Central Boards.

30. The Inspector-General of Irrigation should be free to spend a considerable portion of his time on tour. If necessary, arrangements should be made to relieve him of his duties as Secretary while he is on tour.

Inspector-General of Irrigation.

31. As soon as the people have learned to appreciate the advantages of irrigation, the water-rates should be gradually enhanced to the full value of the water ; that is, until the rates charged to an occupier are the maxima compatible with a full demand for water, and those paid by the owner are a fair share of the increase of his assets due to irrigation (378).

Water-rates.

PART II.—PROVINCIAL.

THE PUNJAB.

- Bannu and Rawalpindi. 1. In Bannu, with its increasing population, expert advice will be required to improve and develop irrigation; and in Rawalpindi the further extension of wells and the more efficient utilization of hill streams appears to be called for (8).
- Ferozpur and Delhi. 2. In both these districts some further protection is desirable. In Ferozpur some extensions of inundation canals are possible. In Delhi further protection can only be afforded by means of wells (9).
- Jhelum, Gujrat, Karnal, Umballa. 3. These districts will be practically dependent for their further protection on the extension of wells and the better utilization of hill streams (9).
- Gurgaon. 4. Gurgaon can be made more secure by the development of wells and bands (9).
- Lower Bari Doab Canal and Sutlej Valley scheme. 5. The opening of the Sirhind Canal has not affected the inundation canals on either banks of the Sutlej, whether in British territory or in the Bahawalpur State, in any other way than that of necessitating a greater expenditure on their maintenance and improvement. But it cannot therefore be concluded that a second perennial canal, like the proposed Lower Bari Doab Canal, can be opened without seriously affecting the efficiency of these canals. If, then, the proposed Lower Bari Doab Canal is to be supplied from the Sutlej, it will be necessary to construct weirs for the maintenance of the supply of the inundation canals lower down the river. But there is another proposal (Mr. Wilson's) which would render the construction of these weirs unnecessary, namely, that the surplus waters of the Indus and Jhelum should be diverted eastward; thus setting free the surplus and cold-weather supply of the Bias and Sutlej for irrigation on the left bank of the latter river. There are objections to this proposal, but they cannot be regarded as conclusive; and in an *ad interim* communication to the Government of India it was therefore recommended that the whole question should be more fully examined. Mr. Dane's proposal to utilize water stored in the Wular Lake for supplementing the supply of the Jhelum will also doubtless be carefully examined by the Punjab officers (27—38).
- Utilization of surplus Indus water; or below Kushab would ever result in any extension of irrigation at all commensurate with the cost, but the question can be considered with much greater advantage when the scheme for the irrigation of the Sind-Sagar Doab is taken up. It may then be found advisable to make escape channels from the canal into the Chenab which may be utilized when necessary for the diversion of surplus Indus water to be picked up at a weir below the confluence of the Jhelum and Chenab (39).
- Sind-Sagar Canal. 7. The Sind-Sagar Canal should not be put in hand until the Lower Bari Doab Canal and its allied works are approaching completion. But as a means of testing the capacity of the soils for irrigation, an inundation canal should be made taking off from the Indus near Bhakkar (40).
- Extensions of existing perennial canals. 8. Extensions on the Bari Doab Canal will apparently have nearly reached their practicable limit when the works now in progress have been completed. The Sidhnai cannot effectively command a much larger area. The future development of the Lower Sohag and Para should be considered in connection with the Sutlej Valley scheme. The Western Jumna and Sirhind Canals require special consideration, because any extensions which can be made on these will benefit Rohtak and Hissar.
- Curtailment of supply to the Delhi Branch of the Western Jumna Canal. 9. One proposal for providing a supply of water to Hissar is the curtailment of the present supply from the Delhi Branch of the Western Jumna Canal

to certain areas of the Karnal and Delhi districts which ordinarily enjoy a favourable rainfall and in which the high spring level admits of wells being worked with profit; and the diversion to Rohtak and Hissar of the water thus economized. The information at the disposal of the Commission is not sufficient to justify them in expressing a final opinion on the merits of this proposal; and until it has been examined and recommended by the Local Government, they are unable to assume that any considerable portion of the cold-weather supply of the Delhi Branch can be regarded as available for diversion to Hissar (42—45).

10. The question of constructing subsidiary head-works at some point in the Jumna, such as Panipat, is not worth further examination. But that of making the main Western Jumna Canal capable of carrying an extra 600 cusecs during the rainy season for the extension of irrigation in Rohtak and Hissar deserves consideration (46). Supplementary supply from the Jumna for Rohtak and Hissar.

11. The alteration of the existing distribution of the Jumna supply between the two provinces is not recommended unless it should be found possible to feed the Eastern Jumna Canal from the Ganges (47 and 48). Reduction of Eastern Jumna Canal's share of supply.

12. Attention should first be directed to those sections of Government channels in which the loss by percolation is known or believed to be considerable. At the same time systematic observations should be made, on a considerable scale, of the loss by percolation in channels of all sizes and classes; and when this has been determined, money should be freely allotted for the purpose of determining the most effective and economical form of lining and the saving of water that may be effected thereby. Such experiments may be most advantageously carried out on the Western Jumna and Sirhind Canals (49 and 50). Puddling of canal channels.

13. The Native States Branches of this canal might be extended so as to afford a *kharif* supply to a small portion of the Hissar district (51). The Sirhind Canal.

14. A systematic remodelling of the machinery of distribution on these canals is emphatically called for (53). Extensions of inundation canals.

15. There is a strong case for the completion of the Jalalpur Canal and the construction of other small inundation canals in the river valleys, even though they may not be considered likely to prove directly remunerative. Money and establishment should be provided for them (56). The Jalalpur Canal and similar works.

16. The area of closed drainage in Umballa and Karnal should be surveyed and projects be prepared to remedy, as far as possible, the evils of flooding. The works would give employment to relief labourers from Patiala and Hissar, but irrespective of this something should be done for the improvement of the tract (57). Drainage works in Umballa and Karnal.

17. Generally speaking, works like the Ferozpur Canals and Gurgaon Bands should be carried out by Government and not by District Boards, though they need not necessarily be managed by Government (61). District works.

18. Government should not prevent landowners from making canals in their own lands, but it should prevent the growth of vested interests which might hereafter hamper the introduction of a more extensive and efficient scheme of irrigation (62). Private canals.

19. Departmental advice and assistance may be required in utilizing hill streams in Jeshawar and Dera Ismail Khan, and also in Umballa, Hoshiarpur, Jhelum, and Gujrat (63). Private works on hill streams.

20. Rights in the water of hill streams should be recorded at settlement as carefully as rights in land (63). Record-of-rights in water.

21. It is, in principle, inexpedient to levy royalty on water in any insecure tract; or, if thought advisable to keep alive right of Government in its water, the rate should be nominal (64). Royalty on water.

22. The use of the water of new channels connected with inundation canals in any village should be conditional on a certain number of wells being made in the village. Wells in inundation canal tracts.

in the village; and the construction of wells should be encouraged in all tracts at present irrigated by inundation canals in which the present number of wells is below requirements.

- Substitution of wells for canals. 23. Should it be decided to substitute well for canal irrigation in any tract owing to the rise in spring level, liberal assistance should be given towards the construction of new wells (72).
- Extension of wells in insecure tracts. 24. An extension of wells is very desirable in Gujrat, Jhelum, Umballa, Gurgaon, Rohtak, and Delhi; and in tracts which are notoriously insecure, such as the last three of these districts, substantial grants-in-aid should be given towards the construction of wells (72).
- Borings. 25. In Hissar expert assistance should be given in making borings.
- State aid to be given cautiously. 26. State aid in the construction of private irrigation works should be given cautiously, and with regard to the capacity and industry of the cultivator and to other conditions.
- The Annhi Canal, Lahore district. 27. The tract commanded by the Annhi Canal from the right bank of the Ravi in the Lahore district should be properly surveyed by the Irrigation Department; and if a supply can be assured to a properly aligned canal, it should be undertaken as a provincial work or held over for the next famine.
- Relief work programmes. 28. (a) A special staff should be appointed to complete the programmes in each district that can be considered at all liable to severe famine.
- (b) Civil officers should be held primarily responsible for suggesting projects at any rate as regards village works and works to be undertaken by local bodies (77).
- (c) The number provided for by sanctioned works should be compared with the actual number on relief in the most severe of the last two famines (78).
- (d) The work need not necessarily lie in the tract providing the labour.
- (e) All current Public Works Department schemes which are suitable for relief labour should be shown in the programme (79).
- Additions to programmes. 29. (a) A full programme of *bands* should be prepared for Gurgaon.
- (b) The lines of possible extensions from the Western Jumna and Sirhind Canals into the Rohtak and Hissar districts should be laid down in advance of arrangements for providing the supply.
- (c) Some of the new famine tanks and of the old village tanks might be supplied from canals. Where this is possible, projects should be prepared.
- (d) The filling in of old channels and levelling of old banks of Western Jumna Canals might be useful as village works (80).

BOMBAY,

SIND,

- Water-rates. 30. (a) *Hakabo* rates might be increased, at least in the case of extensions. (b) The difference between the flow and lift rates is remarkably small (90—91).
- Extensions of existing canals. 31. The inundation canals should be remodelled, more especially the system of distribution (92).
- Proposed weir at Bukkur. 32. The construction of a weir is not of urgent importance. There is still considerable scope for extension of irrigation on present lines. The areas that could be irrigated by means of extensions of existing systems or by perennial canals should, however, be demarcated, and a plan be prepared showing clearly

the position of the cultivable waste and the possibilities of irrigating it. Meanwhile the question of a weir should not be dropped, and all necessary information regarding it should be collected (93—96).

33. Landowners should not be prevented from making canals in their own Private canals. lands under conditions which would prevent the growth of vested interests (97).

34. Might be given under the Agriculturists' Loans Act instead of the Land Advances for clear-Improvement Loans Act (98). ances.

GUJERAT.

35. In the deep pure black soil irrigation, even for rice, must be most Irrigation in black carefully restricted both in area and supply if it is not to do harm (104). soil.

36. The regulation of the drains in the water-logged tracts should receive Drains. attention (108).

37. (a) The tanks should be put into thorough order within five years, and Tanks. subsequent repairs conducted on a system of rotation (114).

(b) The customary obligation on the cultivators to carry out ordinary repairs should be strictly enforced; if necessary legislation being undertaken for the purpose (115).

(c) Very small tanks should be relinquished to the cultivators, a liberal reduction being made in the assessment.

38. The utilization of the Sabarmati should have early consideration, but The Sabarmati. the project should not be undertaken until the question of making a large stor- age work in one of the Native States has been considered (119).

39. At the same time the possibility of utilizing the Mahi should be in- The Mahi. vestigated (120).

40. Canals from the Nerbudda and Tapti are less urgently required and The Nerbudda and great caution is essential in introducing canal irrigation into the black soil tract Tapti. of Gujerat. A canal from the Tapti should be undertaken only if likely to prove remunerative, for purposes of irrigation on lands not required for the growth of cotton. It is a question whether the south-bank project should not be under- taken before that from the north-bank, but for both schemes detailed soil maps must be prepared and a careful examination made of the suitability of the soils for irrigation. There appears to be a wider field in Baroda than in Gujerat for the utilization of the Nerbudda, and the country should be exam- ined by British and State Engineers, working in conjunction (121—127).

41. Permanent gauges should be established on all the more important River gauges. rivers of Gujerat (128).

42. With a view to the construction of tanks a thorough examination of Minor irrigation the country should be made wherever there are likely to be suitable sites works. commanding lands in which rice cultivation will certainly be practised (129).

43. (a) The people should be assisted to complete as many of the wells made Extension of well ir- during the recent famine as may be worth completing (132). rigation.

(b) Takavi should be given freely and a trial given to most of the mea- sures recommended in Chapters V and VI for encouraging wells, but extra caution will be required owing to the uncertain life of wells in some parts (132).

44. The special investigation recommended in Part I, paragraph 176, Subsoil water survey. should be undertaken (133).

45. Where water is pumped from streams or rivers for purposes of irriga- Steam pump- ing and tion the right to royalty should be waived for a definite and long period or be royalty. made purely nominal, and there should be no limit to the field of operations (134).

- Private tanks. 46. The construction of private tanks should be liberally assisted (135).
- Exemption of im-
provements from
enhancement. 47. Steps should be taken to make the rayats and officials aware of the provision of the law which makes perpetual the exemption of private im-
provements from enhancement of revenue (140).
- Famine programmes. 48. In all future programmes the first place should be given to the construction and repair of small tanks for irrigation and of field embankments. Where nothing better can be proposed the beds of tanks should be cleared of silt. Drainage works should also have a prominent place (140).

THE DECCAN.

- Rice. 49. No attempt should be made to force the extension of rice cultivation (142).
- Foreign States. 50. In schemes for extending irrigation in the Deccan the requirements of Kolhapur and other States should be considered (146).
- Size of tanks. 51. Storage works should be made of the largest possible capacity wherever suitable sites can be found in the zone of unfailing rainfall or when they can be fed from a river or canals; but in the region of uncertain rainfall a number of small tanks are better than one large tank of the same collective capacity (160).
- Productive *versus* protective system of working. 52. Subject to one limitation—the necessity for a wise and equitable distribution of the supply—the system of working which will give the best commercial results will also give the best protective results (164).
- Distribution. 53. A canal in the Deccan should ordinarily be designed to command four or at least three times the cultivable area which it may be expected to irrigate in normal years (166).
- Visvesvaraya's block system. 54. Mr. Visvesvaraya's block system is regarded with approval.
- Establishment charges. 55. The account of each work should be debited only with its fair share of establishment charges (168).
- Classification of tanks. 56. Some of the smaller first class tanks should be transferred to the second class (169).
- Small unclassified works. 57. The importance of increasing the number of small unclassified works should not be lost sight of (170).
- Ghat-fed works. 58. The continuous prosecution of a systematic survey of all the catchment areas of the Ghats and examination of all possible sites for storage works is a matter of the very highest importance (171).
- Maladevi project. 59. The Maladevi reservoir should be commenced and completed as soon as possible (173).
- Gokak extension. 60. Detailed plans and estimates for extending the Gokak Canal should be worked out as soon as possible, and the question of substituting steam for water power in working the Gokak mills should receive attention (175—176).
- Nira Right Bank Canal. 61. Effort should be made to store and to utilize as much as may be practicable of the rainfall over the whole catchment and the scope of any proposed canal should be fixed with reference to the combined capacity of as many storage works as it may be found expedient to construct (178).
- Phaltan State. 62. If the Phaltan State cannot be induced to contribute towards the capital cost, the area within the State for which irrigation is to be provided should be restricted (179).
- Godavari project. 63. If suitable sites for storage works can be found, the Godavari Canal project should be prepared in detail (180).
- Bhima and Ghod rivers. 64. The possibility of utilizing the Bhima and Ghod rivers should be further investigated.

65. The possibility of constructing large canals from the Krishna for The Krishna. irrigation in the Satara and Bijapur districts and in the Koihapur State should be fully investigated ; and also the field for the construction of *bandharas* in the upper parts of the catchment (182).

66. The Panna river project should be further investigated (183). The Panna.

67. The Mula river project should be worked up in detail (184). The Mula.

68. The Siv-Dhinli tank is a promising project ; the Malprabha scheme Other projects. should be worked up (185—186).

69. Automatic gates should be provided, whenever circumstances admit, Automatic gates. on the waste weirs of all large tanks ; and even on those of small tanks when they are liable to overflow frequently (190).

70. A storage work should be made at Manad or some other suitable site Manad tank. for increasing the supply of the Jamda Canal (191).

71. All possible means should be adopted for increasing the number of Bandharas. *bandharas* (192).

72. The extension of canal and well irrigation should go on side by Wells. side (193).

73. When Mr. Mollison's experiments on the quantity of water required for Irrigation of sugar- cane have been completed, the results should be studied with the object of cane. devising measures for economizing water (196).

74. A well-boring agency on the lines followed in the United Provinces Borings. should be organized as soon as possible (197).

75. For relief purposes small tanks costing 5 or 6 lakhs are the most Relief works. suitable (191).

76. (a) In Khandesh the completion of the Purmepada tank should be Completion of relief contemplated (200). works.

(b) In Ahmadnagar the Visapur tank should be completed after a detailed estimate has been submitted (202). The Ojhar right bank canal and the Musalvadi tank should be completed as part of the Maladevi project (203).

(c) In Poona the Khamgaon tank should be completed (204).

(d) In Sholapur the six tanks on which relief labour was employed should be completed except perhaps the Bambhurdi (205).

(e) In Bijapur operations on the Sangogi tank might be confined to completing the puddle trench. The Hullur tank might be completed as an experiment, but detailed estimates and proposals regarding both these works should be submitted by the Local Government (207).

77. (a) Tanks costing more than 10 lakhs of rupees, including all charges, Relief programme. should only be entered in the programmes when they have been formally sanctioned on their merits as desirable protective works (200).

(b) Where suitable sites can be found the programmes should include a number of tanks not likely to cost more than 10 lakhs (200, 201, 209).

(c) In Satara the work already done on the Goregaon tank should be safeguarded, and the foundations should be examined. If, on examination, these are found to be reliable the work might be resumed hereafter for employing relief labour. The projects proposed in connection with the Yerla and Man river works should be worked out in detail (206).

(d) The policy of supplementing the larger tank works with small village works and private irrigation works should be developed as far as possible (209).

(e) Beale's *Kachcha bands* should be tried in suitable places (210).

MADRAS.

- Periyar project. 78. The question of increasing the storage capacity of the work should be considered (236).
- Rushikulya project. 79. Arrangement in connection with the utilization of supply faulty, involving loss of revenue (237).
- Smaller storage works. 80. Outside the Ghats, extensions of small storage works probably more beneficial than large works (238).
- Tungabhadra project. 81. Much cannot be done without storage, but storage expensive, and can (Bellary, Anantapur, Cuddapah and Nellore districts). only prove productive if the agricultural classes avail themselves regularly of the supply. Water wanted only in years of drought in Bellary. Steady and regular demand dependent on readiness of cultivators to substitute wet for dry irrigation. No chance of such substitution. If a canal could be taken through Bellary district into Anantapur, Cuddapah and Nellore, supplementing discharge of the Penner, there are many tracts in which water would be eagerly utilized (243).
- Kurnool-Cuddapah Canal. 82. The canal should be placed in thorough order, its capacity increased, and extensions should be made into adjacent tracts more suited to irrigation than much of the area at present commanded (244).
- Further investigation of Tungabhadra project. 83. The construction of the Tungabhadra project and the extension and improvement of the Kurnool-Cuddapah Canals on lines proposed above, likely to protect large areas in Bellary, Anantapur, Kurnool, Cuddapah and Nellore districts, as being those most liable to drought in the Presidency. The Commission, after visiting Madras, addressed Government of India on the subject, with the result that survey parties have since been formed for preliminary investigation of proposal made. It is hoped the investigations will receive hearty co-operation of the Native States of Hyderabad and Mysore, through whose territories the rivers pass (245).
- Cauvery delta. 84. Measures required to prevent failure of river supply at critical seasons to control distribution between the innumerable channels intersecting the delta. The question of constructing a large storage work on the Cauvery or one of its principal tributaries has been under discussion for many years, and a project for making a reservoir on the Bhavani, a tributary of the Cauvery, has been recently prepared in detail, but is in abeyance owing to objections as to utility. Further investigation required before final decision can be arrived at (246).
- Storage on the Kistna. 85. A storage reservoir on the Kistna recommended; it would lead to the development of the Kistna Canal to its fullest capacity and render it independent of the supplies now received from the Tungabhadra; the second crop cultivation, which at present amounts to practically *nil*, will be secured and the first crop cultivation will be extended (247).
- Divi pumping project. 86. An interesting and important project, which should be considered on its merits as a productive work. Absence of steam lift irrigation in India brought to notice, and a well-devised pumping scheme recommended for favourable consideration of Government (248).
- The Godavari. 87. Further investigation recommended of storage works proposed and wanted in the uplands of the Godavari district on the Sagilleru, Yerrakalva and Yelleru rivers (249).
- Periyar project. 88. Measures for extension of the Periyar project suggested. Cost will be considerable, but probably not prohibitive, and the area under irrigation will be extended by 20,000 acres (250).
- Kistnagiri reservoir. 89. If this work is to be constructed it must be on a smaller scale than originally contemplated. The area likely to take irrigation and the possibility of utilizing the water in South Arcot, if not taken in Salem, should first be determined by close inquiry (251).
- Other proposals for extension of major works. 90. Estimates for proposals to be considered on their merits when submitted (252).

91. A wide field for multiplication and extension of small works of this Provincial irrigation class. Change proposed in the rules regarding financing such works. A list inspected of 70 works situated in 16 different districts, of which 54 works with Capital Account. had been so far examined as to permit an idea being formed of their irrigating capacity. Some reported by the Superintending Engineer on special duty as likely to fulfil conditions of a productive public work. With ordinary caution in selection they are likely to prove remunerative (253).

92. (a) New works should be designed with reference to requirements of Irrigation of dry dry crops; (b) small pumping stations should be erected on banks of streams from crops. which an adequate supply can be relied on (254—255).

93. Where large works of this class are possible, they may be undertaken Minor works without as State works for which capital accounts are kept. In the opinion of local Capital Account. officers of both the Revenue and Public Works Departments the grants for maintenance of existing works have been insufficient, although the revenue dependent on them is considerable (256).

94. The work of restoration should be more vigorously prosecuted than Tank restoration hitherto and the grants for the maintenance of minor works increased until scheme. it has been completed; certain changes in the establishment employed on the scheme suggested (258—264).

95. The system of *kudi-maramat*, or maintenance of tanks by those bene. Kudi-maramat repair fited by them, might be revived, by legislation if necessary; or should cess. it be found that the *kudi-maramat* system would not work, the imposition of a repairs cess might be legalised, the administration of the cess funds being entrusted to local *panchayats* (267—270).

96. *Tank Inspectors* of the rank of Sub-Engineer should be appointed in Tank Inspectors. all districts in which there is at present no arrangement for inspection of tanks maintained by Government. This is necessary to successful working of a *kudi-maramat* Act (271).

97. Absence of any Irrigation Law in Madras brought to notice (272). Irrigation Law in Madras.

98. *Zamindars* should be obliged by legislation to maintain their tanks Maintenance of irrigation and other irrigation works in proper efficiency (273—275). works by zamindars.

99. Legislation to impose on *zamindars* charges for improvements in means Charges for improvements in means of irrigation is absolutely necessary if Government propose to embark on expensive programme of irrigation, such as recommended by Commission irrigation. (276—277).

100. There exists at present no definite statutory declaration of the rights Rights of Government and responsibilities of Government in respect of the control of the public water- in respect of water. supply. These should be secured by legislation (278—281).

101. Legislation also required—(a) to deal with offences such as stopping Other points on which up other people's channels; improperly opening one's own; tampering with legislation recommended. bank, etc., which interfere materially with proper management of a canal; (b) to acquire by *consent of the parties* a partial usufruct in land (282—284.)

102. Almost all available sites already occupied by works constructed or Scope or extension of maintained by Government, and the construction of new works by private private irrigation proprietors might seriously interfere with existing interests. When the investi- works other than gation now in progress in various parts of presidency is completed, it may be wells. found advantageous to allow certain smaller projects to be carried out by private enterprise (288).

103. The land assessment rules now in force should be supplemented by a Wells in dry lands. clear direction that the rates assessed on well lands should in no case exceed those assessed on adjacent lands enjoying similar qualities and advantages, but unprovided with wells (291—295).

104. It is inexpedient to levy any royalty on irrigation from these wells in 'Doruvu' wells. tracts where staple crops are insecure in absence of irrigation. Every encourage- ment should be given to extension of such wells (296).

- Supplemental wells.** 105. Extension of these deserves every possible encouragement both by grant of all the advantages, etc., proposed for other classes of wells and by reasonable liberality in assessment (298).
- Takavi.** 106. In every district, excepting Vizagapatam and Ganjam, irrigation from wells is capable of considerable development. Policy of advancing liberally for wells, which has of late years slackened, deserves to be resumed with full vigour (299).
- Famine programmes.** 107. Provision made for irrigation works in the relief programmes might be greatly increased, especially in districts where these works exist in any considerable numbers. All works on the tank restoration programmes should find a place in the famine relief programmes until carried out. When famine imminent all useful works of repairs to tanks to be entered first. When nothing better to be done, relief labour might be applied to removal of silt from beds, collection of road metal, etc. Difficulty of supervision not insuperable. Execution of repairs might be entrusted to local headmen or other respectable rayats owning land under the works. With care taken to select persons for whom employment to be provided and to prescribe tasks for different descriptions of work, no danger of relief being misapplied, etc. Attention invited to recommendations in paragraph 209 (Bombay Chapter), which apply generally with even greater force to Madras, where minor irrigation works are more numerous and more important. In addition to the minor works the programme of each district should have a few larger works suitable for relief labour in large camps. When carried out in regular course before occurrence of a famine, they should be replaced by others until all possible projects in each district are exhausted (305).

THE CENTRAL PROVINCES.

- Field for irrigation by State works.** 108. The most promising field for the extension of irrigation by Government works comprises the rice tracts and the better drained and higher lying wheat lands (331).
- Works in black cotton soil tracts.** 109. The construction of irrigation works in black cotton soil tracts is not recommended at least for the present (319—331).
- The Nerbudda.** 110. A preliminary survey should be made to ascertain the possibility of carrying a canal from the Nerbudda along the foot of the Satpura Range (334).
- Small canals.** 111. Small canals taking off from rivers or streams are the class of work which should receive the first attention. Systematic surveys for these should be put in hand (336).
- River discharges and rainfall.** 112. Observations should be made of the flow at the sites of all existing and proposed large storage works and the number of rainfall recording stations should be increased (337).
- Large storage works.** 113. More and larger tanks are required for the protection of the rice districts (339).
- Distribution of supply.** 114. The limits of the area to be protected by new works should be regarded as provisional only (341).
- Revenue from new works.** 115. The most suitable form of irrigation revenue would be an enhancement of the land revenue. Such enhancement, however, can only be made at settlement. Meanwhile an occupier's or owner's rate might be levied. Probably no difficulty about this in the Waingunga district, but elsewhere it may be advisable to give the water free of charge for two or three years. Eventually the landowners might compound for the water-rate by an annual payment for a number of years or until next settlement. But probably the full value of the water will not be realized until the first or second revision of settlement after the completion of the works. Water-rates should be charged for water supplied to lands outside the "protected area." A scale of charges may be required for filling private

tanks. The supply to private tanks may have to be given gratis where Government tanks prevent water from reaching them (345—346).

116. Experimental works should be carried out on an extensive scale in different districts and under varying conditions. At least fifty lakhs should be devoted to their construction (347—348).

117. The Ramtek project will, it is hoped, be taken up at no distant date. The Ramtek project. (350).

118. The special establishment employed on the preparation of project should be retained to provide a suitable programme of relief works for each district (351).

119. The State should contribute towards the repair and improvement of private tanks by giving grants-in-aid or loans on liberal terms ; or, where the owner wished to secure exemption from enhancement, by giving him professional aid. The obligation of the landowner for future repairs should be strictly enforced (356).

120. Inspectors should be employed for the periodical inspection of tanks. Tank Inspectors. (357).

121. The necessary surveys for improving the tanks should be undertaken at once. Surveys of tanks. (357).

122. Government should be empowered to take over private tanks temporarily. Acquisition of tanks. (359).

123. In the construction of private tanks Government should give the same assistance as in the case of improvements and also remit the revenue on the land submerged (360).

124. In the case of large works a special concession of the kind recommended by Messrs. Sly and Low is desirable. Concession for large works. (361).

125. Powers should be given for the acquisition of land on behalf of a person constructing a tank. It will generally suffice to acquire only a right of occupation for the purpose of the work. Acquisition of land for private tanks. (362).

126. The extension of wells should receive all the encouragement that can be afforded by liberal grant of *takavi* and, where good cause is shown, by grants-in-aid, or similar concessions. And even in some experimental cases Government should bear the whole cost of construction (367—368).

127. The tracts in which temporary wells would be useful should be mapped and clear instructions issued as to the measures to be adopted therein for encouraging the construction of such wells in time of threatened famine. Temporary wells. (369).

128. (a) The construction and repair of field embankments should be encouraged by grants-in-aid. In certain tracts Government should bear the whole cost of a few experimental works (375).

(b) The Public Works Department should render assistance in the design and construction of field embankments in uneven lands (376).

(c) In the case of the large embankments which have been already made Government should provide waste weirs and outlets free of charge (376).

129. (a) The programmes should be completed by including village and forest works and a complete scheme of irrigation works.

(b) Field embankments should form a prominent feature of the programmes of certain districts.

BENGAL.

- Orissa Coast Districts. 130. There is no urgent need for further protection to the plains of Orissa, but the number of irrigation sluices in the flood embankments might be multiplied (391).
- Angul District. 131. One of the Executive Engineers at Cuttack should visit the Angul District periodically (392).
- Puri District. 132. In the Puri District loans should be offered to the landowners to enable them to repair existing works. The requirements of the Government estates should be investigated under professional advice (393).
- The Eden Canal. 133. A weir is required across the Damodar, but should not be made until the irrigators are ready to pay for the water (395).
- The Sone Canals. 134. (a) When water is plentiful in the Sone Canals the *aharas* within the "blocks" should be filled free of charge. For filling *aharas* outside the blocks there should be a fixed charge according to size (406).
- (b) There is room for a considerable enhancement of the water-rates on these canals, and the question of making some progressive advance on the present rates deserves early consideration (408—410).
- (c) A serious endeavour should be made to get a substantial return from the landowners for the enormous benefits which they have derived from the Sone Canals (409).
- The Karamnassa scheme. 135. If it be decided to proceed with the Karamnassa scheme, Bengal should consult with the United Provinces (412).
- Legislation. 136. In all districts or parts of districts in which the maintenance of private irrigation works is neglected owing to the non-observance of customary obligations, or where disputes about water are frequent, full record-of-rights in water should be prepared without delay; and the Collector should be given for the enforcements of the rights so recorded not less authority than he has for the enforcements of rights in land. Power should also be given to the Collector to compel the owners of a *pain* to build a proper masonry sluice or outlet at its head when necessary for purposes of distribution of water. Some power of compulsorily acquiring a right of occupation of land for water channels, etc., should be conferred upon the proper authority (417).
- The Tribeni Canal. 137. The Tribeni Canal should be extended to the west of the Tilari river (420).
- Tilari, Pussa and Bakhiya rivers. 138. Relief labour might be employed in excavating channels from the Tilari, Pussa and Bakhiya rivers (422).
- The Bagmati scheme. 139. Detailed estimates for the larger of the two schemes from the Bagmati should be prepared so as to have the work available for relief labour. It should not be carried out as an ordinary work until the Tribeni and Kamla schemes have been in operation for some time. There may be a good case for completing the smaller scheme as a district work, either at once or whenever it may be necessary to employ famine labour (425).
- The Dous project. 140. The volume available in the river at all seasons should be ascertained (426).
- The Kamla project. 141. A detailed estimate of the Kamla scheme should be prepared, and if the cost per acre to be irrigated is not more than Rs. 25 per acre, the work should be undertaken (429).
- District Board works. 142. In the Bihar districts, north of the Ganges, a comprehensive survey of the country should be made by the District Boards for the object of preparing schemes like Mr. King's. They should be empowered to execute works of irrigation in certain emergencies. Any funds they may allot for such works should be liberally supplemented by loans from Government. The District Boards in these districts might be utilized for the preparation of a comprehensive famine relief programme, the District Engineer being given the help of a special staff (433).

143. In districts in which the demand for water is so intermittent that the Irrigation cess. cost of assessing and collecting a water-rate on the particular lands supplied in each season would form a very high proportion of the amount collected, a small annual cess might be levied on the area actually protected by an irrigation work, except when the work has been undertaken *bonâ fide* for the purpose of affording employment during famine (435—436).

144. Before anything can be decided with reference to these canals, Gov- The Saran Canals. ernment must have before it a detailed project showing (1) what it would cost to ensure a steady water-supply in the *kharif* and *rabi* seasons; (2) what arrangements could be made for obtaining a return for the outlay. A general cess is inadmissible; the most that can be proposed is a cess limited to the lands protected (439—442).

145. In Chota Nagpur there should be a law granting exemption from Tenants' improve- enhancement of rent for a period sufficiently long to make it worth the tenants' ments, Chota Nag- pur. while to carry out an improvement (446).

146. In Chota Nagpur advances should be freely given to prudent land- Takavi, Chota Nagpur. owners, who are willing to make improvements (446).

147. In Government estates an enhanced rent should be levied on so much of Estates, Chota Nag- a tenant's holding as receives benefit from an irrigation work made or improved pur. by Government. In Wards Estates Government should execute such improvements as a solvent and prudent landlord would be willing to undertake; and in the case of an encumbered estate it should spend the revenues of the estate liberally on the execution of improvements. If these views are accepted, an investigation should be made under professional advice into the requirements of the three classes of estates (447).

148. One of the three weir projects in the Palamau District should be given Palamau District. a trial (448—449).

149. The Karo project should be carefully worked out (450). The Karo project.

150. An intelligent Engineer should be attached to the Commissioner of Engineer for Chota Chota Nagpur for five years for preparing projects for improving irrigation. Nagpur. A lakh a year should be provided for the execution of the works (451).

151. Relief labour should be freely employed in Chota Nagpur on the Relief works, Chota clearance of *aharas* and repairs of *bands* (452). Nagpur.

152. An Engineer should be sent for a year to study the irrigational cap- Sonthal Parganas. abilities of the Sonthal Parganas, and to prepare rough estimates of the cost of works (454).

153. A systematic inquiry should be made throughout Bihar, especially in Well-irrigation. the western and central portions, with the object of determining the places best suited to irrigation from permanent wells, etc. An officer of the Agricultural Department might visit the United Provinces and experiments be tried in Government estates, with the object of introducing the United Provinces methods of well-irrigation (459).

154. Powers of granting *takavi* should be conferred as a matter of course Takavi. on all officers in charge of sub-divisions and on selected subordinates. The aid of European planters and landowners might be enlisted for the distribution of advances. Officers should take money with them on tour and give it out on the spot. In certain cases special officers should be entrusted with the duty of distribution. The officers of the Opium Department might be utilized for distribution and for selecting proper recipients (460).

155. As in the Central Provinces the tenant's interest in his holding might Tenants' improve- be made transferable for purposes of recovery of *takavi* (461). ments.

156. Where irrigation is practised at all, when famine labour is available Famine programme. every sort of irrigation or drainage work should be put into thorough repair (464).

UNITED PROVINCES.

- Protection of submontane tract east of Naini Tal *tarai*. 157. Question of utilizing hill streams for protection of rice areas and for general extension of irrigation in tracts east of Naini Tal *tarai* should be investigated as soon as services of a qualified officer can be spared for the purpose (496).
- East Ganges and Ramganga Canals. 158. Projects for these works prepared over 30 years ago for irrigation of tract between Ganges and Ramganga rivers in districts of Bijnor, Moradabad and Budaon, but abandoned for certain reasons. Protection afforded by existing means of irrigation, however certainly insufficient. Question of introducing canal irrigation into these districts should again be examined and considered on more recent information. Unlikely that a canal from the Ramganga would afford sufficient supply for *rabi*, and it would be too costly to construct; but it may be possible to provide a fair amount of protection at reasonable cost by means of a *kharif* or inundation canal from left bank of the Ganges; also eventually to divert some of the cold-weather supply of the Jumna river for irrigation of *rabi* and perennial crops in parts of these districts (498—499).
- Sardah Canal project. 159. (a) A detailed project should be prepared for taking out a canal from a point high up on the Sardah river for the protection of Hardoi and the adjoining districts.
- (b) The Sardah Canal scheme, as a whole, must take a much lower place in the order of urgency of protective works than can be assigned to any fairly promising scheme for protection of above district and very detailed inquiries will be necessary to ascertain if the drainage difficulty can be surmounted at a reasonable cost (500—516).
- Extensions of existing works in Ganges-Jumna Doab. 160. There is scope for a number of small extensions, but they are possible only by economising water (517).
- Storage works and prevention of percolation. 161. Observations should be made on the lines recommended for the Punjab for determining loss by percolation from channels of all sizes; then steps taken to ascertain the best means of rendering the channels water-tight and the volume of water that can be saved thereby (518—519).
- Possible utilization of Sardah waters outside Oudh. 162. Possibility of diverting the surplus of Sardah's supply to the Ganges river might be investigated more fully than done hitherto. Were a sufficient volume made available from the Sardah, there would be no difficulty in diverting a portion of the Ganges supply into proposed Eastern Ganges Canal, and the connecting channel might also be utilized for supplementing the often insufficient supplies of the Rohilkhand canals and for irrigating Moradabad and Budaon. It might even be found possible to take a supply from Deoband Branch of Ganges Canal into lower portion of Jumna-Hindun Doab, thus setting free a share of Eastern Jumna Canal's supply for protection of Hissar and Rohtak districts at tail of Western Jumna Canal in the Punjab (520—522).
- Ken Canal. 163. Proposal for construction of this canal most important of all laid before the Commission for protection of *Trans-Jumna* districts. Supply may have to be supplemented by storage. Weir should be constructed so as to store largest volume of water possible at reasonable cost. Early construction of canal recommended (523—524).
- Proposed canals in Mirzapur, Benares and Allahabad. 164. Promise to be of considerable protective value; water likely to be utilized for rice even in years of average rainfall. One or two of the most promising schemes should be worked out and carried out (526).
- Chandraprabha Canal. 165. A canal 80 years old on the private demesnes of His Highness the Maharaja of Benares. The supply requires controlling. Plans and estimates for realigning the channel, etc., with view to improving control might be laid before His Highness and the advantages of carrying out the work explained to him (527).
- Improvement of Betwa Canal. 166. Additional storage and remodelling of channels so as to carry larger supplies would considerably increase the financial and protective value of the canal. One or two of the most suitable sites that have been found for storage works should be selected, and detailed plans and estimates prepared with view

to early provision of at least 1,000 million cubic feet of extra storage. Eventually another 1,500 or 2,000 million cubic feet will be required. The branches of the canal should be made to carry between them the largest volume that can be run in the main canal (528).

167. A small farm should be established by the Agricultural Department Establishment of a farm on Betwa Canal. in the vicinity of one of the distributing channels for purpose of experiments in utilising water for rice cultivation; also the water-rates for rice should be considerably reduced so as to induce cultivators to make experiments themselves. Some selected cultivators might be given water free for a few years (529).

168. These tanks should be made a separate sub-division and placed, for Storage tanks in next few years, in charge of a specially qualified Assistant Engineer or sub-ordinate who would devote his whole time to their improvement and to Bundelkhand. preparation of projects for new tanks and field embankments to be carried out either at once or by relief labour in a year of famine (530).

169. There is wide room for extension of well irrigation which should be encouraged largely by giving advances for construction. Parts of Ganges- Wells. Gogra Doab afford considerable scope for extended construction of permanent wells. In the Lucknow Division grants-in-aid might be allowed in addition to advances (531—541).

170. No strenuous or sustained endeavour has been made to stimulate Takavi. the execution of private improvements by means of *takavi*. Such endeavours should be persevered in. Subordinate district officers should be empowered to make advances without reference to head of district, and necessary inquiries should be made and money advanced on the spot. Borrowers should be allowed free option of long terms of repayment fixed solely with reference to durability of the work. A period up to at least 25 years might be allowed at discretion of granting officer (542—543).

171. In Bundelkhand the need of wells as a protection against famine is Wells in Bundelkhand. so great that no measure of liberality allowed elsewhere ought perhaps be denied here (544).

172. When a tenant constructs a permanent well, the land commanded by Improvements by which was previously unirrigated and assessed only at dry rates at time of tenants. construction of well, the land should be exempted from wet rates until expiry of ten years after the period for which the tenant is entitled to hold the land at existing rental (545).

173. Effect of the legislation passed in the Central Provinces should be Transfer of occu- watched; and if it is found to facilitate advance of *takavi* to tenants, advis- pancy rights. ability of undertaking further legislation in the United Provinces might then be considered (546).

174. The system recently introduced by the Agricultural Department Boring tools. deserves extended trial (547).

175. In case of larger works which would irrigate in more than one village Extensions of private or estate, it would be better for Government to undertake their construction works other than as State works. The only classes of private works urgently requiring Govern- wells. ment assistance are the tanks and field embankments of Bundelkhand. When an Engineer has been appointed as recommended in paragraph 530, the first measure necessary will be a systematic reconnaissance of each separate catchment and a survey. Rough estimates should then be prepared for repairing existing and constructing new tanks. Then the extent to which the cultivators are willing to meet the cost can be ascertained, and the assistance which Government can be expected to render in carrying out the work can be considered. It can then be decided what works shall be carried out as State or private works. But no work, either of improvement or construction, should be undertaken until the landowners concerned have agreed to be responsible for the annual petty repairs. As regards acquisition of land, the recommendations in paragraph 362, Central Provinces Chapter, may be taken as applicable to all districts of these Provinces (553—554).

Programme of relief works. 176. In the south-Jumna districts a number of really useful irrigation works, including field embankments, could be substituted for some doubtful works now on the programme (556).

Works in ravines. 177. In the absence of anything better and if suitable sites have been carefully selected beforehand, relief labour may with advantage be employed on such works as the small tank works at Raksha, the object of which is to check scouring and ravining caused by too rapid off-flow of rainfall (557).

UPPER BURMA.

Scope for extension of State works. 178. In the Kyaukse district there is room for extending irrigation by improving smaller distributary channels. Same remark applies to the distributary system of the Nyaungyan-Minhla storage works in the Meiktila district. There is also possibility of utilizing, for extension of irrigation in eastern districts of the dry zone, the more assured rainfall of the Southern Shan States plateau and of the hills dividing Yamethin from Magwe and Meiktila from Myingyan (563).

Programmes of relief works. 179. When necessary observations have been made of the supplies likely to be available for contemplated irrigation works, all promising schemes should be included in the programmes (566).

NATIVE STATES.

RAJPUTANA.

Storage works for Dholpur. 180. Sir Swinton Jacob, Consulting Engineer, recommends carrying out of the most promising schemes at once (588).

Extensions and improvements. Territorial difficulties in carrying large projects. 181. Much money might be spent in improving most of the existing works. In most States there are suitable sites for new large works. As yet, however, although projects have been prepared from time to time, no attempt has been made to utilize water of some of the principal rivers. In case of many of the larger projects more than one State is concerned. To remove difficulties arising out of this fact, friendly and disinterested arbitrament and persuasive influence of paramount power is required (591).

Necessity for systematic survey. 182. Information as to the exact capabilities of the country for storage of surface water and the manner they can be best made use of should be obtained by a systematic examination of Rajputana as a whole based upon its physical rather than its political divisions. Each catchment should be taken up in turn; and such detailed schemes as will afford an ample programme for relief, should famine recur, should always be kept in readiness. Storage reservoirs should be large enough to retain all rain water that may be received. Certain projects proposed by the Government Engineer should be completed at once (592—593).

Surveys, plans, etc., should invariably be printed. 183. And surveys, plans and papers connected with such projects should invariably be put into print to prevent their being lost (594).

Consulting Engineer for Irrigation in Rajputana. 184. The Commission learn with satisfaction that their recommendation regarding the appointment of a Consulting Engineer for Irrigation in Rajputana has been given effect to (595).

Assistance required by the States. 185. All reasonable encouragement should be afforded to the States in preparation of plans and estimates of promising schemes. Constant stimulation will be needed by some States. To lead them on to renewed efforts a careful selection should be made of the schemes to be first taken in hand (596).

186. It might often be possible for the Political Officers to bring about such arrangement as will remove difficulties arising out of *jagir* lands forming considerable portion of irrigable areas commanded by promising irrigation projects (597). Difficulties in dealing with *jagir* lands.

187. There are many subsidiary forms of irrigation works, the construction of which should be encouraged, such as the *bands* in Bhartpur, small banks across minor drainage lines in Dholpur, embanking of fields in Kishengarh, small irrigation cuts from streams in parts of Tonk. In the systematic survey recommended by Commission these minor works should not be neglected, and the importance of prosecuting them, whenever famine labour is available, should be impressed upon the States (600). Field embankments, etc.

188. The introduction of the system in vogue in Kishengarh or of a fixed period of exemption would lead in many States to substantial increase of area protected by irrigation. In some States where construction of wells is difficult, help from trial borings advisable (601). Measures for stimulating construction of private irrigation works.

189. If effect be given to the recommendations made in paragraph 593, the Darbars should be much better prepared as regards programmes of irrigation works to meet the contingencies of another famine (603). Famine works and programmes.

KATHIAWAR.

190. An extensive system of storage works the only means of increasing irrigated area of Kathiawar to extent required for protection against famine. Any extensive system of canals out of question. The area irrigable by wells far short of protective requirements of the province (613). Necessity for storage works.

191. All the difficulties that exist in Rajputana are here greatly intensified. No irrigation works on anything like a considerable scale possible without co-operation of many of the States. Political pressure necessary to ensure utilization of available water-supply to the best advantage of all (615—616). Political difficulties.

192. Further expenditure should be incurred in completing such of the works as are worth completing. Government of India should assist when necessary with loans upon moderate terms (617). Unfinished famine tanks.

193. A systematic survey similar to that recommended for Rajputana required. A specially qualified officer should be deputed for investigation of projects and paid from Imperial Funds. He should make a general survey of the irrigational possibilities of the entire province and propose the best means of utilizing the available supply of water with reference only to physical considerations, not to territorial boundaries, due regard, however, being paid to the rights in water of the several States concerned. It may be necessary for Government to advance to many States loans on liberal terms (618). Systematic survey of country.

194. There are extensive tracts suited to well-irrigation. Construction of wells might be stimulated by advances or by the system of State aid already prevalent. When necessary, loans might be granted by Imperial Government at moderate rates. The States should be urged to complete, or advance further money for completion of, certain unfinished wells, and where necessary be assisted financially for the purpose. Well-construction should go hand in hand with extension of tank construction, as the latter greatly increases the security afforded by the former (619). Private wells.

195. The recommendations made in paragraph 618 to result in preparation of a programme of really useful works. In a year of famine, works should be pushed on to utmost extent necessary for employment of famine labour, and those works should be finished which will repay cost of their completion irrespective of expenditure already incurred (620). Employment of famine labour.

196. To prevent emigration during famine the States should be assisted in preparing a complete programme of relief works and urged to put the works in hand on first occurrence of a famine. There appears to be a much wider field for useful employment of emigrants from Kathiawar on canal works in Sind than in Gujerat where their presence causes much embarrassment in famine. Immigration into Sind would be much facilitated by construction of proposed railway for connecting Kathiawar with Lower Sind, which appears on this account to be a project deserving favourable consideration (621). Prevention of emigration.

MYSORE.

Restoration and repairs of tanks. 197. Arrangements should be made for more frequent periodical overhauling of the minor tanks under professional supervision. These as well as the major tanks should be taken up in regular rotation and brought up to standard once in every 20 or 30 years (634—635).

River channels and ghat-fed storage works. 198. For supply of any new canals or to increase the dry-weather supply of existing canals, construction of large storage works necessary on the main rivers or their tributaries and within region of assured rainfall. Sites for such works now being systematically investigated. The works very remunerative. The extensions of the channels will be very beneficial both to the cultivators and to the State. In the valley of the Tungabhadra some excellent sites found, but reservoirs there, though of great value to Madras, would apparently be of little use to Mysore. But even if but few suitable sites discovered, the area irrigated by river channels could be largely extended by improving existing works. This could be tested by remodelling a few selected works (640—644).

Proposed new tanks. 199. Not much scope for extension of irrigation by means of new tanks constructed outside the regions of the ghats, but the area matured under existing works could be largely increased by thoroughly remodelling the channels and providing them with masonry or pipe outlets for distribution of supply, and in years of short rainfall by restricting the area irrigated in proportion to available supply (645—646).

COORG.

New works and improvements required in existing works. 200. An officer with experience of irrigation works should be deputed to prepare projects for new works for further protection of the tract liable to drought and to advise generally regarding improvements required in existing works (653).

HYDERABAD.

New works in Carnatic districts. 201. These districts can be partially protected by the construction of a large reservoir on the Muski river, the restoration and repair of existing tanks, the proposed Benur Canal, and possible extension of existing canals (671—673).

New works in Telingana. Projects under consideration. 202. In addition to restoring a large number of derelict works, there is some scope for construction of new storage works and a very large scope for construction of channels to connect tanks with rivers and ensure them a supply in years of deficient rainfall. The proposed dam across the Kistna may render it possible to command a considerable area in Warangal by a canal from left bank. The question whether the land is suitable deserves investigation when preparing the general project. Other important projects enumerated, many of which likely to be remunerative. In restoring some of the larger tanks, adoption of self-acting gates for the waste weir, such as those in use in Bombay, recommended. But the works now contemplated not likely to afford complete protection (674—676).

New works in Marathwara. 203. Construction of reservoirs, with sufficient catchment areas to ensure a supply of water in all years, would probably afford most useful employment for relief labour in this tract. It would be advisable to have the country examined with view to preparation of projects and to their inclusion in a programme of relief works. The examination may possibly lead to discovery of sites for tanks or other works worth taking up before occurrence of another famine, and may show the advisability of repairing certain existing irrigation works probably commanding areas suitable for irrigation. Small irrigating channels might be taken out from above weirs constructed across some of the numerous streams said to afford a supply of water throughout, and for some time after, the rainy season (677).

Wells. 204. A fair trial should be made of the system of advancing *travi* loans, for extension of wells in Marathwara (680).

205. A systematic survey of the underground supply in *athwara* and *Borings*. Carnatic suggested, such as that recommended for similar tracts in British territory (681).

206. A full and adequate programme of relief works should be prepared without delay, if it has not been already prepared, particularly for such portions of His Highness's territory as adjoin the frontier of British India. It would afford work for simultaneous employment of His Highness's and British subjects in case famine afflicts territories of both Governments at the same time. In Telingana and Carnatic there would be a considerable field for employment of relief labour on construction or restoration of irrigation works which have been sanctioned or proposed (682). Famine works and programmes.

BERAR.

207. Both in Melghat and Balaghat it should be possible to construct storage tanks and small canals taking out of the numerous rivers and streams which carry the drainage of the highlands into the Purna and Wardha rivers. Necessary surveys and preparation of projects should be put in hand as soon as possible. The more promising schemes might be carried out as experimental works and the remainder brought on to the programme of famine works (689). Scope for further extension of State irrigation works.

208. In many of these it may be advisable to substitute for the present temporary structures either permanent masonry dams or self-acting flood gates to be erected and maintained at Government expense, the maintenance of the channels and distribution of water being left as at present in the hands of the cultivators (690). Private irrigation works. River channels.

209. Practically the whole of the irrigation is from wells. There are no private tanks in Berar. Private improvements are perpetually exempted from enhancement as in Bombay. But there seems to be in Berar similar uncertainty as to the exact effect of the law. No pains should be spared to get the people perfectly informed on the subject (691—692). Tanks and wells.

210. The portions of Berar suitable for well-irrigation resemble those of the adjoining districts of Bombay, and the recommendations made in the Bombay Chapter regarding encouragement of wells and surveys of the underground water-supply in those districts apply also to Berar, except that the special measures recommended in the General Chapter for districts exposed to famine and in particular free grants-in-aid are less required than in the Deccan (693).

211. (a) The work which remains to be done in connection with the enlargement of the catchment area of the tank in the Amraoti district should be completed (694). (b) When the survey recommended in paragraph 689 has been carried out, it should be possible to include in the programme a fair number of really useful irrigation works (695). Famine works and programmes.

BARODA.

212. Possibilities of extending irrigation should be definitely ascertained and developed. His Highness has made some useful preliminary investigations into the capacities of the head-waters of the Sabarmati, Tapti and a tributary of the Nerbudda. As recommended in paragraph 127, however, an examination should be made by British and State Engineers working in conjunction so as to secure the maximum benefit to the country at large with little or no reference to territorial considerations except in so far as they may affect the expense of the resulting irrigation to the territory benefited. The Commission trust— (a) that after fully investigating the resources of the country it may be possible for His Highness to considerably increase the annual allotment for irrigation; and (b) that the system of well-construction by State agency which His Highness proposes to extend will not induce him to limit the grant of *takavi* loans, as it is exceedingly probable that the State will have to rely for protection on wells more than any other class of work. General recommendations.

CENTRAL INDIA.

General recommenda-
tions.

213. (a) The appointment—for examination of country and preparation of projects and relief work programmes—of Irrigation Engineer Officers for each large State and for each group of minor States. (b) Appointment of a Superintending or Consulting Engineer for whole agency to supervise the work of the Engineers referred to above. Government to pay the Consulting Engineer and the Engineer for the smaller States. Effect should be first given to these recommendations in Northern Gwalior, Bundelkhand and Baghelkhand, but active operations should be postponed until completion of the programme for Rajputana. The experience there gained should prove of great value in preparing programmes for Central India.

