

REPORT
OF THE
WORKING GROUP
FOR FORMULATION OF
FOURTH FIVE YEAR
PLAN PROPOSALS
ON
MINOR IRRIGATION



MINISTRY OF FOOD & AGRICULTURE
DEPARTMENT OF AGRICULTURE
GOVERNMENT OF INDIA

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SUMMARY OF THE

SCOPE OF MINOR IRRIGATION (I & III)

Minor irrigation comprises 22 different types of schemes classified in Chapter I. Besides irrigation schemes, the programme also includes items, such as, drainage, flood protection, anti-sea water intrusion and water conservation-cum-groundwater recharge schemes. The scope and the technical features of the schemes are described in Chapter III.

PROGRESS (CHAPTER IV)

The progress attained on minor irrigation during the First and the Second Five Year Plans and anticipated achievement during the Third Five Year Plan according to the present trends has been analysed in Chapter IV, State-wise into various categories of benefits, such as, new irrigation, Old irrigated area over which irrigation is improved or made more certain, areas benefited by non-irrigation items, etc. The figures are given below:—

	First Plan	Second Plan	Third Plan
(Rs. in crores)			
<i>Financial outlay</i>			
(i) G. M. F. Sector	85	95	249
(ii) C.D. Sector . . . . .	..	45	57
(iii) Cooperative Sector (Land Mortgage Banks) . . . . .	..	..	50
TOTAL	85	140	356
(in million acres)			
<i>Physical progress</i>			
(i) New irrigation			
(a) Surface water	2.30	2.20	2.48
(b) Ground-water	2.20	3.00	6.70
TOTAL	4.50	5.20	9.18
(ii) Old area over which irrigation is improved	1.50	1.80	2.05
(iii) Area benefited by water conservation-cum-groundwater recharge schemes	1.00	0.70	0.81
(iv) Area benefited by drainage flood protection and anti-sea water intrusion works	2.50	1.30	0.9
GRAND TOTAL	9.50	9.00	9.94

Estimated at Rs. 45 crores.

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PROSPECTS FOR FURTHER DEVELOPMENT (CHAPTER V)

Technological prospects for further development of minor irrigation have been worked out in Chapter V as exhaustively as possible under the present state of investigations, data and information available. The study places the long-term potential for minor irrigation development as 75 million acres (gross), 30 million acres from surface water and 45 million acres from groundwater sources. The actual level of development expected to be reached at the end of the Third Five Year Plan is 49·84 million acres, 24·10 million acres from surface water and 25·74 million acres from groundwater.

TECHNICAL AND ORGANISATIONAL ASPECTS (CHAPTERS VI TO XI)

The various technical and organisational aspects of the minor irrigation programme have been discussed in detail in Chapter VI to XI. The up-to-date position obtaining in different States has been indicated. The most important measures or directions in which concerted efforts are required to be made by most of the States are as under:—

1. Strengthening the existing organisations for surveys and investigations, particularly for assessing groundwater potentialities and opening out fresh groundwater worthy areas and preparing basin-wise integrated master plans—formulating specific schemes for surveys and investigations;
2. Imparting greater technical bias in planning and implementation of minor irrigation schemes by (a) intensifying research and training programme (b) undertaking preparation of technical manuals and literature on minor irrigation schemes and arranging increased dissemination of technical knowledge on the subject, and (c) follow-up action on all important technical recommendations on various schemes that have been made from time to time and are summarised in Chapter IX;
3. Strengthening the existing organisations for providing technical guidance on groundwater schemes, particularly on such items as design, size and spacing of open wells and tubewells and selection of water lifting appliances;
4. Entrusting the work of planning and preparing annual State plans on integrated basis and according to phased priorities indicated in the long-term master plans, only to one technical agency at the District level and ensuring full cooperation of other technical agencies in preparing these plans;
5. Improving arrangements for maintenance of completed irrigation works—need for departmental maintenance of small group works until they are transferred to the Panchayats and the Panchayats are equipped with financial, statutory and technical requisites for carrying out the maintenance;
6. Improving assessment of irrigation benefits—adopting standard classification of schemes; clear appreciation of various terms used; undertaking regular sample surveys or evaluation of yardstick adopted; improvement in collecting and reporting Land Utilisation Statistics.

TARGETS FOR THE FOURTH FIVE YEAR PLAN (CAPTER XII)

Recognising the need for development of minor irrigation facilities as quickly as possible, it has been desired that the physical target for minor irrigation during the Fourth Five Year Plan should be set up as high as is considered feasible from the techno-economic and organisational considerations. The scheme-wise targets for different States and Territories for the Fourth Five Year Plan have been formulated, taking into consideration the following factors:—

- (i) the administrative and organisational arrangements obtaining in various States for surveys and investigations, execution, maintenance and utilisation of minor irrigation works;
- (ii) the directions in which fresh or increased efforts need to be made to strengthen and gear up the existing organisations for taking up the Fourth Five Year Plan;
- (iii) Tempo of the programme likely to be built up at the end of the Third Five Year Plan;
- (iv) Appropriate rate at which the tempo may further be accelerated during the Fourth Five Year Plan keeping in view items (i) and (ii) above.

Considering the organisational problems and the volume of efforts that would have to be made for effecting improvements, the Working Group is of the view that pace of acceleration of the minor irrigation programme during the Fourth Five Year Plan should not be too fast in order that the organisational efforts need may catch up with the accelerating tempo and technical and administrative control is assured in implementation of the programme.

From techno-economic considerations, special emphasis has been given on the following schemes in framing the Fourth Five Year Plan targets:—

1. Renovation of derelict tanks which still remain unrestored at the end of the Third Five Year Plan;
2. Construction of open wells;
3. Boring and deepening of existing wells to augment their discharge;
4. Installation of power pumps, particularly the electrical pump-sets in areas where cheap hydro-electric power is extended;
5. Construction of small tubewells;
6. Lift irrigation from rivers and streams in areas where cheap hydro-electric power is available.
7. Groundwater recharge schemes.

The total all-India target for minor irrigation comes to 16 million acres made up of 14·8 million acres under the GMF Sector and 1·2 million acres under the C.D. Sector. The target of 14·8 million acres in the GMF Sector would be linked up with the provision of Rs. 460 crores from the Governmental source and Rs. 125 crores from the Land Mortgage Banks. Under the C.D. Sector, the anticipated outlay during the Fourth Five Year Plan on the basis of the schematic budget is estimated at Rs. 45 crores.

The total target would include 12·06 million acres of new irrigation (3·60 million acres from surface water schemes and 8·46 million acres from groundwater schemes), 1·92 million acres of irrigated area over which irrigation is improved, 1·02 million acres benefited by water conservation-cum-groundwater recharging schemes, 1·00 million acres of area benefited from drainage, flood protection and anti-sea water intrusion works.

INCREASED ACCENT ON GROUNDWATER DEVELOPMENT (CHAPTER XII)

There has been increased emphasis on groundwater development under the minor irrigation during the Third Five Year Plan. Whereas during the Second Five Year Plan the groundwater schemes accounted for 33 per cent of the total physical achievement, the percentage is likely to increase to 51·60 during the Third Five Year Plan. This trend is accounted for mainly by the facts that the overall potentialities for development of minor irrigation are more from groundwater than surface water and that the lift irrigation from groundwater has certain advantages over flow irrigation from canals. It is expected that the trend towards increased groundwater development would continue during the Fourth and the subsequent Five YEAR PLANS.

PATTERN OF FINANCIAL ASSISTANCE PROPOSED FOR THE FOURTH FIVE YEAR PLAN (CHAPTER XIII).

Considering such factors as (a) expansion in targets proposed for the Fourth Five Year Plan, (b) rise in the cost of pumping equipment, (c) increase in the cost of diesel oil due to imposition of excise duty, (d) comparatively unfavourable economics of lift irrigation in general due to high recurring cost, (e) need for providing greater incentive to cultivators for realising the increased targets, and (f) urgency for intensifying surveys and investigations, a more liberal pattern of financial assistance is proposed for the schemes during the Fourth Five Year Plan as indicated in Chapter XIII. The main points recommended are that :—

- (i) 25 per cent subsidy should also be extended for schemes of diesel pumpsets, persian wheels, tube-wells, lift irrigation from rivers and streams;
- (ii) the quantum of subsidy should be increased to 50 per cent in backward areas;
- (iii) Central subsidy should be re-introduced for survey schemes at the rate of 50 per cent of the total cost; and
- (iv) 100 per cent Central grants should continue to be given for the schemes of research and training.

PROPOSED RESEARCH AND TRAINING PROGRAMME (CHAPTER XIV & XV).

Two schemes, one on research and other on training of minor irrigation and water use were initiated during the Third Five Year Plan. With increased emphasis on minor irrigation and irrigated agriculture, it is proposed to intensify both these schemes during the Fourth Five Year Plan. In addition, it is proposed to initiate an additional training programme for imparting training on the subject of surveys and investigations for groundwater utilisation. The financial requirements for research and training programme during the Fourth Five Year Plan are estimated at Rs. 1·50 crores, Rs. 90 lakhs for the training programme and Rs. 60 lakhs for the research.

PROGRAMME FOR GROUNDWATER EXPLORATION (CHAPTER XVI)

The exploratory programme in the Fourth Five Year Plan will be directed towards assessing the groundwater resources in the semi-consolidated and consolidated formations and also in the left-over alluvial tracts including bouldery terrain (intermontane valleys). For this purpose the fleet of drilling equipment on hand is proposed to be replaced and reinforced as found necessary. A Geophysical Wing is proposed to be set up in the Organisation. The Exploratory Tubewells Organisation will also take up field investigations with regard to rehabilitation of State-owned sick tubewells and on the job training of drillers and groundwater technicians. The estimated expenditure on the Exploratory Tubewells Organisation in the Fourth Plan is expected to be of the order of Rs. 400 lakhs gross, out of which a sum of Rs. 140 lakhs may be recovered from the State Governments the sale of successful exploratory wells. The net expenditure may thus be of the order of Rs. 260 lakhs.

The Organisation also proposed to undertake construction of 1,500 production tubewells in the Fourth Plan on behalf of the State Governments. This involves an initial outlay of Rs. 140 lakhs on establishment, for purchase of equipment, etc. The operational charges are recoverable from the State Governments concerned.

Negotiations are being made with the U.N. Special Fund for the establishment of a Water Resources Basin Management Training Institute. It is likely that a provision of Rs. 100 lakhs would be needed on this account.

REQUIREMENT OF KEY MATERIALS AND EQUIPMENT (CHAPTERS XVII & XVIII).

The requirement of cement for realising the proposed target works out at 44 lakh tonnes, of coal 26 lakh tonnes, of steel 1.5 lakh tonne and of diesel oil 3 million tonnes. The requirement of equipment and machinery comprising drilling rigs 400 Nos., air compressor units 425 Nos., moving 370 items including scrapers, power shovels, dozers and tractors 200 lakh running feet; electric motors 3.1 lakhs in Nos. and diesel engines 2 lakhs in number. The total equipment would involve a foreign exchange component of Rs. 16.50 crores.

IMPORTANT MEASURES FOR URGENT ADVANCE ACTION (CHAPTER XIX).

The Fourth Five Five Year Plan proposals envisage about 2—4 times acceleration on the following schemes which would contribute to 5.7 million acres of new additional irrigation out of the total target of 12 million acres (new additional irrigation).

Sl. No.	Name of the scheme	Third Plan estimated achievement	Fourth Plan target
1.	Boring of wells (Nos.)	1,25,687	2,07,920
2.	Deepening of wells (Nos.)	99,549	1,99,000
3.	Electric motor pumpsets (Nos.)	72,960	2,40,580
4.	Diesel engine pumpsets (Nos.)	76,306	1,27,960
5.	Private tubewells (Nos.)	11,925	38,880
6.	Lift irrigation from rivers and streams (acres)	2,75,990	4,46,500

In order to ensure that the proposed target is fully realised, urgent advance action is necessary in implementation of the following important measures :—

1. Fast acceleration of tempo of surveys and investigations, particularly on groundwater schemes with a view to (a) delineating new groundwater-worthy area, (b) establishing full potentialities of the already proven areas so that over-draft of groundwater and the consequent lowering of the water table and failure of wells is avoided, (c) preparing basin wise/district-wise integrated master plans which would enable to take up the programme on a priority basis and in coordination with different categories of schemes, so that there is integrated development of irrigation resources without any duplication of efforts, and (d) collecting hydrological and geological data and preparing contour maps for enabling projection and preparation of designs and construction details of the individual schemes—preparation of specific survey schemes for the purpose by the States and making available 100 per cent grant-in-aid for these schemes by the Centre during the remaining period of the Third Five Year Plan;
2. Expeditious strengthening of the technical organisation in the States for undertaking accelerated programme of boring and deepening of wells, installation of pumpsets and advising the cultivators on location, size and design of open wells and choice of water lifting appliances including pumpsets;
3. Stepping up the tempo of the training programmes;
4. Providing incentive to the cultivators for taking to lift irrigation works by (a) liberalising terms and conditions for sanction of electric power to the irrigators and charging concessional or subsidized rates for the electricity consumed as recommended in Chapter VIII, (b) extending benefit of subsidy to schemes of pumpsets, tubewells and lift irrigation from rivers and streams as recommended in Chapter XIII, and (c) increasing the quantum of subsidy in the backward areas to help the poorer cultivators in taking up the work as suggested in Chapter XIII.
5. Undertaking of adequate steps with the industrial sector to ensure that the increased requirements of key materials, equipment and machinery, diesel engine, electric motors, pumps, pipes, etc. for achieving the Fourth Five Year Plan targets as detailed in Chapters XVII & XVIII would be fully met with;
6. Ensuring timely release of foreign exchange for meeting phased requirements of equipment to be imported from abroad for achieving the targets as indicated in Chapter XVIII;
7. Integrated planning of lift irrigation, small scale industries and rural electrification programme with a view to ensuring maximum coverage of agricultural area under lift irrigation for taking up lift irrigation schemes (Chapter VIII);
8. Improving technical standards in planning, designing and execution of works by much more increased emphasis than hitherto given on (a) research and training programmes, (b) production

of technical manuals and literature on various minor irrigation schemes and increased dissemination of knowledge on the subject, and (c) follow-up action on all important technical recommendations on various schemes that have been made from time to time and are summarised in Chapter VII;

9. Undertaking measures suggested in Chapters IX to XI for proper maintenance and utilisation of completed works and improving assessment of irrigation benefits.

PERSPECTIVE FOR THE FIFTH FIVE YEAR PLAN

The Working Group is of the view that notwithstanding the various problems and shortcomings confronting the minor irrigation programme, as a result of implementation of the organisational and technical measures recommended for the Fourth Five Year Plan, it would be possible during the Fifth Five Year Plan not only to maintain the tempo of development attained at the end of the Fourth Five Year Plan but also to accelerate it further. Against the overall target of 16 million acres set for the Fourth Five Year Plan, the Working Group visualises a target of 18—20 million acres for the Fifth Five Year Plan. This would include about 14-15 million acres of additional new irrigation.

On the basis of the above projection, the following picture emerges for the perspective development of minor irrigation during the Fourth and the Fifth Five Year Plans:—

Period	Gross irrigated area (Million acres)		
	Surface water	Ground water	Total
1950-51	19.91*	16.14*	36.05*
1960-61	22.86*	20.21*	43.07*
Third Five Year Plan anticipated achievement	2.44	6.71	9.15
<i>Deduct</i> depreciation for 5 years at 1 per cent per annum over averaged irrigated area per year during the Third Plan	1.20	1.18	2.38
Net addition during the Third Plan	1.24	5.53	6.77
1965-66	24.10	25.74	49.84
Target for Fourth Plan	3.60	8.46	12.06
<i>Deduct</i> depreciation for 5 years at 1 per cent per annum over average area irrigated per year during Fourth Plan	1.30	1.50	2.80
Net addition during the Fourth Plan	2.30	6.96	9.26
1970-71	26.40	32.70	59.10

Period	Gross irrigated area (Million acres)		
	Surface water	Ground water	Total
Projected target for the Fifth Plan	3.80	10.70	14.50
<i>Deducting</i> depreciation for 5 years at 1 per cent per annum over averaged irrigated area per year during period 1971-76	1.42	1.90	3.32
Net addition during the Fifth Plan	2.38	8.80	11.18
1975-76	28.78	41.50	70.28

*NOTE.—These figures have been obtained from the Land Utilisation Statistics, reckoning the area from all the different sources except Government canals under minor irrigation and calculating break-up of gross irrigated area from break-up of net irrigated area on proportionate basis.

CHAPTER I

INTRODUCTION

1.01. In pursuance of the proposals received from the Planning Commission for preparation of long-term economic development plans upto the end of the Fifth Plan and more especially for the preparation of the projects for the Fourth Five Year Plan, the Ministry of Food & Agriculture (Department of Agriculture) constituted various Working Groups in the Agriculture Sector. The composition of the Working Group set up for Minor Irrigation & Drainage is as under:—

Ministry of Food & Agriculture

1. Shri I. J. Naidu, Joint Secretary.—Chairman.
2. Shri J. K. Jain, Deputy Irrigation Adviser.—Convener.
3. Shri Mahavir Prasad, Irrigation Adviser.
4. Dr. R. V. Tamhane, Adviser, Soil Conservation.
5. Shri I. P. Mathur, Deputy Secretary.
6. Shri V. Balasubramanian, Under Secretary.
7. Shri J. S. Sarma, Addl. Economic & Statistical Adviser.
8. Shri D. S. Dhese, Irrigation Specialist, Extension Directorate, later substituted by Dr. T. R. Mehta, Director, Farm Advisory Unit, Directorate of Extension.
9. Dr. Mukhtar Singh, Deputy Agricultural Commissioner, Indian Council of Agricultural Research.
10. Shri O. P. Kumra, Assistant Irrigation Adviser.
11. Shri Aftab Ahmed Ramino, Research Officer, Minor Irrigation.
12. Shri P. G. Adyalkar, Senior Geologist, Exploratory Tubewells Organisation.
13. Shri B. Garudachar, Executive Engineer, Exploratory Tubewells Organisation.

Ministry of Community Development & Cooperation

14. Shri Phool Prakash, Adviser Irrigation, later substituted by Shri Ibne Ali, Director, Agriculture.

Ministry of Irrigation & Power

15. Shri B. K. Uppal, Deputy Secretary, later substituted by Shri G. K. Vij, Deputy Secretary, who too on transfer was substituted by Shri K. S. S. Murthy, Deputy Secretary.
16. Shri B. R. Shori, Director, Central Water & Power Commission, later substituted by Shri S. S. Lamba, Director (WIN), Central Water & Power Commission.

17. Shri R. N. Chawla, Director, Flood Control, Central Water & Power Commission.
18. Shri R. C. Shenoy, Director, Hydrology, Central Water & Power Commission.

Planning Commission

19. Shri D. P. Singh, Joint Secretary (Agriculture).
20. Shri K. D. Sanwal, Chief (Irrigation).
21. Shri Baleshwar Nath, Member, Committee on Plan Projects-Team on Minor Irrigation.
22. Dr. J. P. Bhattacharjee, Director, Programme Evaluation Organisation.
23. Dr. J. N. Tewari, Joint Director, Programme Evaluation Organisation.
24. Shri C. S. Seshadri, Director (Agriculture).
25. Dr. A. Vaidyanathan, Assistant Chief.
26. Shri Sada Nand, Senior Research Officer, later substituted by Dr. Vidya Sagar, Assistant Chief (Agriculture).
27. Shri C. S. Parthasarthy, Assistant Chief (Irrigation).

Terms of Reference

1.02. General terms of reference laid down for the Working Group were as under:—

- (i) To make a critical review of the progress of the programmes and schemes in the Third Plan period;
- (ii) To assess, in the light of current trends and other available data, the position likely to be reached at the end of the Third Plan period; and
- (iii) To formulate proposals for the Fourth Plan in the perspective of a 10-year period, 1966—76.

1.03. The Working Group on Minor Irrigation, in its first meeting, considered it desirable that while making its studies the undermentioned objective may also be explicitly kept in view:—

To indicate priorities, policies, measures and machinery for achieving both the short-term and long-term objectives.

1.04. Vis-a-vis item (iii) above, the Working Group was also desired to work out in detail the requirements of key materials, equipment and machinery from indigenous manufacture, foreign exchange for import of equipment and machinery from abroad, trained personnel, etc. It was further required that the Working Group may detail the items on which advance action, commencing from the present stage of the Third Plan, should be necessary for ensuring smooth implementation of the Fourth Plan proposals right from the first year.

Constitution of the Sub-Groups

1.05. With a view to having a greater pooling and concentration of thought and more detailed and effective appraisal of minor irrigation schemes, the Working Group agreed, in its first meeting, to constitute the following four Sub-Groups:—

Sub-Group No. 1—Groundwater.

1. Shri Phool Prakash (Min. of C.D. & C.)
2. Shri R. C. Shenoy, (C.W. & P.C.)
3. Shri J. K. Jain (Min. of F.&A.)
4. Shri B. Garudachar (E.T.O.) —Convener

Sub-Group No. 2—Surface Water.

1. Shri Mahavir Prasad (Min. of F.&A.)
2. Shri Baleshwar Nath (Coop—Planning Commission)
3. K. D. Sanwal (Planning Commission)
4. Shri B. K. Uppal, (Min. of I.&P.)
5. Shri D. R. Shori, (C.W. & P.C.)
6. Shri O. P. Kurma (Min. of F.&A.) —Convener

Sub-Group No. 3—Drainage, Flood Protection and Anti-sea Water Intrusion.

1. Shri Mahavir Prasad (Min. of F. & A.)
2. Dr. R. V. Tamhane (Min. of F. & A.)
3. Shri R. N. Chawla (C.W. & P.C.)
4. Dr. Mukhtar Singh (I.C.A.R.)
5. Shri D. S. Dhesi (Extension Dte.)
6. Shri C. S. Parthasarthy, (Planning Commission)
7. Shri J. K. Jain (Min. of F.&A.) —Convener

Sub-Group No. 4—Assessment of Benefits and Allied Problems.

1. Shri J. S. Sarma (E. & S. Dte.).
2. Shri Phool Prakash (Min. of C.D. & C.).
3. Dr. J. P. Bhattacharjee (P.E.O.—Planning Commission)
4. Shri C. S. Seshadri (Planning Commission)
5. Shri Sada Nand (Planning Commission).
6. Shri Aftab Ahmad Ramino (Min. of F. & A.)—Convener.

Studies carried out by the Sub-Groups.

1.06. The main Working Group held its first meeting on 5th August, 1963. During this meeting, the Working Group clearly spelled out the different categories of schemes that are or may be included under the minor irrigation programme and also laid down precisely the scope of each category of scheme. The Working Group also detailed important aspects and issues pertaining to the programme which should be paid particular attention by the Sub-Groups in their studies. The Sub-Groups were required

to give their recommendations on each category of schemes giving State-wise targets and covering all other relevant information required under the terms of reference.

1.07. The Sub-Groups No. 1 to 3 had a number of meetings and discussed all important aspects of the individual minor irrigation scheme in detail. The progress achieved during the First and Second Five Year Plans on individual schemes was critically reviewed. The anticipated progress during the Third Five Year Plan was projected year-wise for each category of scheme on the basis of present trends and possibilities for acceleration during the remaining years of the Third Plan. Targets for the Fourth Five Year Plan were then projected after carefully taking into consideration the organisational capacity and tempo of consideration that will be built up at the end of the Third Five Year Plan, technological possibilities for further development and the problems and bottle-necks that are likely to be thrown up by the accelerated implementation. The Sub-Groups considered in detail the various technical and organisational aspects of the minor irrigation programme and made an appraisal of the up-to-date position obtaining in different States. In formulating their views, the Sub-Groups also examined in detail the following reports and documents:—

1. Report of the Minor Irrigation Committee, 1957.
2. Recommendations of the Minor Irrigation Conferences held in 1958 and in 1961. !
3. Report of the Committee on Plan Projects (Minor Irrigation Team) on minor irrigation programmes in the States of Andhra Pradesh, Gujarat, Kerala, Madras, Mysore, West Bengal and Maharashtra and of tubewell programme in the States of Uttar Pradesh and Punjab.
4. Study of the problems of minor irrigation conducted by the Programme Evaluation Organisation, Planning Commission.
5. Proceedings and recommendations of the Annual Conferences of the Ministers of Community Development & Panchayat Raj.
6. Proceedings and recommendations of the Conferences of the State Ministers of Agriculture.

1.08. The Sub-Group No. 4 on Assessment of Benefits and Allied Problems carried out detailed studies on methodological problems of assessment and benefits under the minor irrigation programme.

Interim Report—Discussion by the Working Group.

1.09. An interim report of the Working Group was prepared by the Convener on the basis of the detailed studies carried out by the Sub-Groups. This report was divided into three parts dealing with the following aspects:—

- I. Scope, performance and prospects.
- II. Technical and organisational aspects.
- III. Targets.

1.10. The interim report was discussed chapter-wise in the two meetings of the Working Group held on the 2nd January and the 15th January 1964. The first two parts of the report were approved subject to a few minor modifications. As regards the third part relating to the 'Targets', some members felt that in view of the key importance of minor irrigation programme for rapid agricultural development, scope for further raising the target of 14.6 million acres as envisaged in the interim report might be examined. If there were any limiting factors or bottle-necks considered to be in the way of accelerated implementation, these might be carefully assessed and advance measures for controlling or minimising the same clearly brought out in the report. The Steering Group set up in the Ministry to examine the interim reports also recommended that the Working Group on Minor Irrigation might examine the feasibility of setting up a higher target and indicate both administrative and technical measures necessary for achieving it.

1.11. A detailed review of the proposed programme and the organisational problems, was carried out in the light of the above recommendations. It was felt that while it might be feasible to increase the target to about 16 million acres, provided concerted efforts were made by the States on the lines suggested in the report, it would not be realistic to raise the target further. Revised proposals drawn up in the context of the enhanced target were discussed by the Working Group in the Fourth Meeting of the Working Group on the 4th May, 1964. These proposals were approved by the Working Group.

Final Report of the Working Group.

1.12. The Final Report of the Working Group has been prepared after incorporating the changes mentioned above in the Interim report. The final report has 19 Chapters in three parts as under:—

1. Scope, performance and prospects—Chapters I to V
2. Technical and organisational aspects—Chapters VI to XI
3. Targets—Chapters XII to XIX

At the end of the report, there are 23 appendices giving detailed State-wise and scheme-wise proposals in a tabular form for minor irrigation programme during the Fourth Five Year Plan.

CHAPTER II

MINOR IRRIGATION

(Concept, Scope & Benefits)

2.01. Irrigation is the backbone of agriculture in a country like India where the rainfall, in by far most parts of the country, is received only for a few months during the year and even during that period its amount and distribution is erratic. The role of irrigation is further bound to become more important with gradual introduction of science and technology in agriculture and increased use of fertilisers.

2.02. Among various types of irrigation schemes, minor irrigation has been playing a significant role in the development of agricultural production in the country. Out of the total irrigated area of 60.2 million net acres in 1961, 37.80 million acres (about 62.7 per cent of the total irrigated area) was irrigated by minor irrigation works.

2.03. Minor irrigation comprises small projects which can be conceived and handled to a large extent by the cultivators themselves. As compared to major-medium irrigation, minor irrigation has the advantages that the works can be completed quickly with lesser out-lay and they also yield quicker results. The works being owned by the cultivators themselves, bring about greater satisfaction of the psychological as well as physical needs of the cultivators. As the cultivator knows fully the capability of these works, he can plan his cropping strictly according to the water output; also he can operate his work and get the water at his will and convenience. Moreover, as the utilisation of water from a minor irrigation source is usually confined to the area very near the source, loss of water in conveyance and distribution is very much reduced.

2.04. Minor irrigation works in India are as old as the Indian civilization. The Indian Irrigation Commission (1903) recognised the importance of small irrigation works and assessed that they were responsible for more than half the irrigation area in the country. The importance of minor irrigation was later stressed by the Royal Commission of Agriculture (1928). The drive for minor irrigation works, however, started under the Grow More Food Campaign launched in 1943 when the financial assistance began to be extended by the Government for these works. The programme was integrated on an All India basis and intensified with the initiation of the First Five Year Plan. The position changed very significantly during the Second Five Year Plan when greater emphasis was laid on the programme and additional finances were made available for expanding it. The Grow More Food Enquiry Committee (1952), the Foodgrains Enquiry Committee (1957) and the Agricultural Production Team of the Ford Foundation (1959), in succession, emphasised the role and scope of minor irrigation for augmenting food production within a short time.

2.05. According to the cost criterion in vogue for classifying major, medium and minor irrigation, the works costing individually less than Rs. 10 lakhs come under the purview of minor irrigation. This criterion is subject

to the proviso that only those schemes which have independent water source would be taken up under the minor irrigation programme. Any schemes catering for alterations or extension in the existing major-medium irrigation systems would not be eligible for being taken up under the minor irrigation programme. In view of rise in the cost of labour and materials, a proposal to raise the financial ceiling of minor irrigation schemes from Rs. 10 lakhs to Rs. 15 lakhs is under the consideration of the Government of India.

2.06. Local drainage and flood protection works costing less than Rs. 50,000 each are also financed under the minor irrigation programme. At its present stage of development, the programme includes the following categories of schemes:—

A. Wells Schemes.

- (1) Construction of new wells.
- (2) Restoration of old wells.
- (3) Boring of wells.
- (4) Deepening of wells.

B. Tubewells Schemes.

- (5) State tubewells.
- (6) Cooperative tubewells.
- (7) Private tubewells.
- (8) Filter point tubewells.
- (9) Artesian tubewells.

C. Water lifting appliances.

- (10) Electric motor pumpsets.
 - (a) Distribution of electric motor pumpsets.
 - (b) Extension of power lines.
- (11) Diesel engine pumpsets.
- (12) Persian wheels.

D. Storage Schemes.

- (13) Construction of new tanks and reservoirs.
- (14) Restoration of old tanks and reservoirs.

E. Diversion Schemes.

- (15) *Hilly channels*—kuhls, dongs, lowkhongs.
- (16) *Non-hilly channels*—anicut, weirs, pynes, bandharas etc.

F. Surface water Lift Irrigation Schemes.

- (17) State lift irrigation schemes.
- (18) Cooperative lift irrigation schemes.

G. Water Conservation-cum-Groundwater Recharging Schemes.

- (19) Ahars, bundhies, rapats, percolation tanks, head water tanks, etc.

H. *Local Drainage, Flood Protection and Anti-sea Water Intrusion works.*

- (20) Drainage works.
- (21) Flood Protection Works.
- (22) Anti-sea water intrusion works.

2.07. It would appear from above that works included in categories A to F are those which provide direct irrigation benefit. Those under categories A to C aim at utilisation of groundwater; others under categories D to F exploit surface water. Since the programme also includes restoration of existing derelict works, the irrigation benefits provided are of two types: (a) new area brought under irrigation, and (b) old irrigated area over which irrigation is improved, that is made more certain or assured. Works under categories G and H bring about benefits others than that of irrigation. The scope of these benefits is as under:—

Water Conservation-cum-Groundwater Recharging Schemes (Ahars, bundhies, rapats, percolation tanks, head water tanks).

2.08. Although the works included under this category do not bring about any direct irrigation benefit, they are essential counterpart of the minor irrigation programme. They serve three important functions: (a) by impounding water they help the conservation of moisture in the submerged fields and the adjoining fields below with the result that these fields can then grow post-monsoon crops satisfactorily; (b) they increase underground percolation of surface run-off and thus help to recharge ground water; and (c) when constructed in the head water region serving as catchment area for tanks down below, they arrest the silting process of those tanks. The benefit from these works in the form of agricultural production is substantial.

Local Drainage, Flood Protection and Anti-Sea Water Intrusion Works.

2.09. These schemes form an integral part of a comprehensive programme for development of water resources of a region. Proper drainage is very important in irrigated tracts as well as in humid non-irrigated lands for successful and sustained development of agriculture. Excess water in the root zone or over the land, if retained over a long period, is very injurious to plant growth. By expelling air from the root zone, it kills bacteria which is essential for plant development. It also affects growth of plant adversely in many other ways. Removal of excess water by drainage, therefore, greatly promotes the healthy growth of plants. Besides, drainage brings about two more important advantages: (a) it renders possible cultivation of permanently sub-merged low-lying areas which are usually of great potential fertility but too wet in their original state to cultivate and produce crops; and (b) it enables raising post-monsoon crops in areas which otherwise dry up very late for ploughing and sowing operations.

2.10. In arid and semi-arid regions, drainage is intimately inter-related with irrigation and salinity. It plays a pivotal role in regulating and maintaining water table at a safe minimum level below the ground surface and thus keeping the agricultural land free from salts and water logging. Irrigation lends heavily to addition of sub-soil water by way of losses in conveyance, distribution and application, particularly if the irrigation practices in vogue lead to wastage and over-use of irrigation water. In case the soil

or irrigation water is saline, the leaching requirements further add to the sub-soil inflow. All these factors point to the need for adequate drainage to avoid hazards of water logging and salinisation.

2.11. In areas which have become water-logged or salinised, drainage is the only effective remedial measure which may depress and regulate the water table and enable leaching down of the soluble salts and thus reclaim the land for cultivation.

2.12. Floods cause heavy annual destruction of land, property and crops in many parts of the country. Agricultural loss is particularly heavy if floods occur at a time when the crops are ripe for harvesting. At many locations, the heavy erosive action of flood water eats away coastal agricultural land. Construction and maintenance of adequate flood protection works, therefore, becomes essential to save agricultural land and crops in affected areas.

2.13. In coastal areas there exist large areas of paddy field bordering lagoons, estuaries and back-waters that lie in that region. Most of these lands are well below mean sea level. Consequently, much of this land is flooded by the fresh water brought over by the rivers in the monsoon season and is subsequently inundated by salt water when the river flow dwindles down. There is great need for construction of suitable projects that would act as salt water barriers and prevent the in-rush of salt into the paddy fields. Such works have a high grow more food value.

2.14. Benefits accruing from the minor irrigation programme may thus be classified under the following four heads:—

1. New irrigated area;
2. Old irrigated area over which existing irrigation is improved, that is much more certain or assured;
3. Benefits in the form of conservation of moisture in the root zone for raising of crops or recharging groundwater; and
4. Benefits by way of local drainage, flood protection and anti-sea water intrusion works.

2.15. Minor irrigation programme, by and large, is a people's programme and provides scope for individual as well as cooperative effort. The schemes like wells, pumpsets, etc., which benefit a small area normally restricted to the individual holdings, are amenable to individual enterprise. Government offers finances in the form of mostly recoverable loans and partly subsidy for meeting part or full initial cost of these schemes. In some States, loan finance for these schemes is also made available by the Land Mortgage Banks and Sugarcane Cooperative Societies. The works like tanks, anicuts, lift irrigation scheme from rivers and streams which benefit groups of cultivators, are either taken up by the cultivators themselves through specially formed cooperatives or panchyat institutions or by the Government Departments. In the former case, the part finances are made available by the Government. When the works are taken up by the Departments, the required finances may either be met fully by the Department concerned or realised in part by way of popular contribution in the form of cash, kind, labour, etc., from the beneficiaries. With the development of panchayat institutions, it is envisaged that these institutions would be able to handle a major part of the minor irrigation programme.

2.16. Minor irrigation works have a sphere of feasibility and utility of their own which, with a little care in initial planning, should not clash with those of major-medium irrigation. In fact, major, medium and minor irrigation projects are the inevitable partners in any programme of development of water resources of a region. There are certain tracts where major-medium schemes may be considered more feasible, but there are other areas where only minor irrigation schemes can possibly be taken up. Yet there is a third category of areas where major-medium and minor irrigation schemes may have a complementary role to perform and only through integrated development of these resources may it be possible to obtain maximum utilisation of available resources.

CHAPTER III

MINOR IRRIGATION SCHEMES

(Salient Technical Features and Scope)

3.01. Different categories and types of schemes included under the minor irrigation programme have been mentioned in Chapter II. A description of the salient technical features and the comparative scope of individual schemes in so far as it is essential or helpful for planning the programme is given in this Chapter.

A. WELLS SCHEMES

3.02. As distinguished from tubewells, ordinary wells comprise open surface wells of varying dimensions, dug or sunk from the ground surface into the water bearing stratum to extract water for irrigation purposes. Nearly 1/3rd of the total irrigation in the country is provided by open wells. Their scope is more pronounced in the alluvial tracts of the Punjab, Uttar Pradesh and Bihar, and in alluvial pockets and coastal fringes existing in other States. There are many areas where, though the groundwater availability is limited, yet the wells provide the only convenient means of irrigation.

3.03. All well schemes are of private nature with works belonging to individual cultivators. Financial assistance is provided by Government/Co-operative Banks for execution of these schemes.

1. Construction of new wells

3.04. Usually, two types of wells are constructed under this scheme. These are:—

(i) *Masonry wells*

3.05. These wells have a masonry steining wall usually sunk in sub-soil by applying static weight of sand bags and simultaneously scooping out of earth from inside. In locations, where it is not possible to sink masonry steining by ordinary methods due to presence of hard clay or boulders, etc., it is built up in a dug pit from the bottom upwards. The wells usually have their bottom at about 20 feet below the static water level. The thickness of masonry steining is increased with its depth below the surface to withstand the increased earth pressure.

3.06. The well steining may either be left in a sandy stratum or embedded in a thick impervious stratum called 'mota' over-lying a water bearing medium. The 'mota' is bored at the centre to tap the aquifer. The well of the latter type is more stable and yields greater discharge but is not feasible everywhere. The well of the former type draws water from its pervious bottom. The arrangement is applicable for tapping only thin aquifers available near the water table. Only very small discharges usually under 500 gallons per hour may be obtained from such wells. If the

velocity of the flow in these wells exceeds the critical velocity—the velocity at which the sand particles just belong to move—sand particles will be lifted up with water and there will be danger for the steining wall to settle down, get damaged and even collapse. The draw-down and, therefore, the discharge of these wells has to be restricted in order to avoid any movement of sand. In the second type of wells, as the water is raised, a cavity is gradually formed in the water bearing medium below the bore. The cavity increases the perforation area and reduces the resistance to flow at the entrance of the well. Such wells, therefore, often yield good discharges of the order of 2,000 gallons per hour or more, provided a good water bearing medium is available immediately below the impervious bed.

(ii) *Wells in Rocky Sub-strata*

3.07. These wells are usually open excavated pits through top soil mantle and soft rock. For their water supply, these wells usually depend on joints, cracks, fissures, embedded layers of unconsolidated material, etc., which usually exist in rocks and serve as passages and receptacles of water. They are generally constructed in large sizes to provide storage and also in order to tap more joints and cracks or water bearing beds, if possible. The top portion above the rock is usually lined with masonry. The discharge of these wells is usually a few hundred gallons per hour. A good storage inside the well is, therefore, necessary for their sustained operation over a week or so.

2. *Restoration of Old Wells*

3.08. This scheme includes repairs of old existing open wells which have been lying in a dilapidated condition. The repairs usually consist of re-shaping the masonry steining wall which is cracked and got in bad condition as a result of either settlement due to cavity formation at the bottom or some other reason.

3. *Boring of Wells*

3.09. Boring of a well essentially consists of drilling a small sized bore through the bottom of the well and extending the bore up to layer or layers of good ground water bearing medium lying further underneath the bottom of the well, with a view to tapping these underlying aquifers. The bore may be of two types, according to whether they tap the water bearing medium through the cavity formed below a hard impermeable strata or through strainer or screens provided opposite the vertical depths of the water bearing stratum/strata. In the first type, the bore is installed with plain pipe extending upto the cavity; in the second type, with pipe assembly having screens opposite the water bearing media and blind pipe opposite impermeable strata. The first type of bore is cheaper but is not feasible at all locations.

3.10. Boring is an useful scheme to augment the well discharge; it brings new area under irrigation at comparatively much less cost and also enables utilisation of the part of the local groundwater source which would otherwise remain untapped. There is good scope for boring of existing wells, particularly in the alluvial areas. The boring in rocky wells is also carried out to tap embedded beds of water bearing material, if available. Such boring, however, is costly and is encouraged only if no alternative means of cheaper irrigation are available.

3.11. The cultivators get the work of boring executed either by private parties or by a Government organisation. The work of the Government organisation is usually carried out on no-profit-no-loss basis.

4. Deepening of Wells

3.12. Deepening of wells consists of blasting the bottom of the wells in rocky sub-stratum by dynamite, in stages, upto the desired depths. This is resorted to in cases where boring is not likely to help. If the rocks dip more towards the vertical, borings are least likely to help. The objective of deepening is two-fold: (a) to expose additional water bearing joints, cracks, crevices, etc., and (b) to increase the storage capacity of the well. Some wells, however, require deepening in consequence of the lowering of water table due to unusual drought. Air compressors are common used for drilling of wells required for the purpose of blasting. Usually in a 10 feet diameter well, 6 to 8 holes at a time, each $2\frac{1}{2}$ ft. in depth, are drilled. After the first layer has been blasted the process is repeated till the well is deepened to the desired depth.

3.13. Deepening results in increasing percolation, particularly in the rocks where the inter-connections between water bearing voids, interstices cracks, joints, etc., are not sufficiently developed. It has good scope for augmenting well discharge in most areas underlaid with rock sub-strata.

B. TUBEWELLS

3.14. Tubewell essentially consists of a deep bore drilled into ground with the purpose of tapping groundwater through one or a series of permeable layers of water bearing strata. The bore is installed with blind pipes (in cavity type) or an assembly of blind pipes and perforated pipes (in other types) such that the latter come opposite the water bearing media. Tubewells are of three types: (a) strainer tubewells; (b) tubewells with gravel pack shrouding either artificial, that is, added from outside, or natural, developed from the existing surrounding material; and (c) cavity tubewells. The first two types draw water through the perforated pipes opposite the water bearing media. The screen in the first type and the gravel pack in the second type enable the withdrawal of water from the adjoining sub-soil strata at a very fast rate. In the cavity type, the water is directly pumped from a cavity formed at the bottom end of the boring. Cavity tubewells are cheapest but are feasible only where a strong roof of hard impervious stratum immediately overlying a good and comparatively thin water bearing medium is available. Gravel-pack (artificial) tubewell is preferable to strainer tubewells where the water bearing medium contains fine sand. A mixture of coarse, fine sand and gravel may be left unshrouded and bore developed as a natural gravel-pack well.

3.15. Drilling for tubewells is done either by hand boring sets or by mechanical rigs—percussion or rotary. Hand boring sets are manufactured indigenously but give slow progress. For fast progress and drilling, large-sized and deep holes, mechanical rigs are necessary. For drilling large-sized holes, particularly where speed is an important factor, rotary drilling is more feasible. Percussion drilling is a satisfactory method of drilling in almost all types of formations if speed is not a dominating consideration and size and depth of the bore are not very large.

3.16. Tubewells are operated either by horizontal centrifugal pumps or by deep bore hole turbine pumps. The latter type of pumps do away with the need of constructing a deep pump house and are particularly suitable where lift involved is high. Running of tubewells on diesel engines is comparatively much more expensive.

5. *State Tubewells*

3.17. State tubewells are those which are constructed, maintained and operated by a Government Department as a State work. Water rate is charged from the cultivators by the Department for the water supplied.

6. *Cooperative Tubewells*

3.18. Cooperative tubewells are those which are constructed, maintained and operated by a cooperative of beneficiaries. Government advances loans to the cooperatives for construction of these wells.

7. *Private Tubewells*

3.19. These tubewells belong to the individual cultivators and are constructed, maintained and operated by them themselves. Government advances loans assistance to the individuals for construction of these tubewells.

8. *Filter-point Tubewells*

3.20. These are small 3 to 6 inches strainer tubewells (total depth of the bore being about 35 to 40 feet and the strainer 7 to 10 feet) driven or drilled in coastal and deltaic areas where sub-strata is soft and sandy and groundwater is plentiful. They are operated by electric or diesel pump-sets installed at the ground level. The discharge of a filter-point tubewell is usually under 5,000 gallons per hour. They usually belong to the individual cultivators; financial assistance is made available by Government/Cooperative Banks.

9. *Artesian Tubewells*

3.21. The borings that are extended in artesian belts are called 'artesian wells'. These may be either simple borings or provided with strainer at the lower end, depending on the nature of groundwater formation tapped. In some artesian wells, pressure is sufficient to raise the water automatically upto the ground surface. In others, pressure may not be sufficient to raise the water upto the ground surface. In such cases, water lifting may have to be done partially by power pumps. These wells either belong to individual cultivators or are constructed and operated as State works.

C. WATER LIFTING APPLIANCES

3.22. They are used for lifting water from wells mostly but also from tanks, ponds, lakes, rivers, etc. The appliances belong to the individual cultivators. Power pumps and persian wheels are the two types of appliances that are most popular and are being encouraged by sanction of loan assistance under the minor irrigation programme. Power pumps not only enable to increase the effective water output of the wells but also help to release the bullock power of the cultivators required for other agricultural

operations. There is good scope for installation of pumpsets in all wells which have satisfactory water output.

3.23. Power pumps used for lifting water from open wells are invariably centrifugal pumps (volute type) with horizontal spindle. They are simple, cheap and easy of installation. Suction lift on such pumps is limited to about 15 feet for average conditions. It, therefore, becomes necessary that the pump is installed as near the water surface as possible. If there is large fluctuation of water level, the position of the pump may have to be adjusted from time to time.

3.24. Power pump may be operated either by diesel engine or electric motor. Diesel engines are more expensive in initial cost, operation and maintenance than electric motors. Electric motors, on the other hand, are dependent on the availability of electric power, and if the electric transmission lines are not available in the immediate vicinity, it may also require expensive extension of power lines. The cost of these power lines may become excessive if the wells to be installed by electric motor pumps are scattered far and wide and the demand for irrigation is not keen all the year round. In such cases, diesel engine may be preferred. A 5 H.P. pumpset would yield a discharge ranging 5,000 to 15,000 gallons per hour when the lift involved is about 30 to 40 ft. Details about the performance of pumps, their capacities, characteristics and other allied information are supplied by the manufacturers. These help very much in selecting a pump of the right specification for a given set of conditions.

10. *Installation and Energisation of Electric Motor Pumpsets*

(a) *Installation of Electric Motor Pumpsets*

3.25. Usually 5 H.P. electric pumpsets are supplied to the cultivators for irrigation purposes in areas where electricity is available.

(b) *Energisation of Electric Motor Pumpsets—Extension of Power Lines*

3.26. Under this scheme, in vogue in some States, loan is advanced by Government to the Electricity Boards for extension of power lines to provide electric connections to the pumpsets newly installed by the ryots.

11. *Installation of Diesel Engine Pumpsets*

3.27. Under this scheme, diesel engine pumpsets are supplied to individual cultivators for irrigation purposes mainly, in areas where electric power is not available.

12. *Installation of Persian Wheels*

3.28. Under this scheme, financial assistance is given to the cultivators for purpose of various improved types of persian wheels. A persian wheel consists of a number of component parts, such as, the bucket, the drum, the gear mechanism, the driving beam, etc., which can be varied in size and design arrangements to suit various discharge requirements, lifts and other conditions involved. Design of persian wheel can thus always be fitted to a given set of conditions—discharge requirement and the lift involved. The discharge of a persian wheel is usually of the order of 2,000 gallons per hour when the lift involved is about 30 ft.

D. STORAGE SCHEMES

3.29. Storage schemes include tanks and reservoirs which impound water of streams and rivers for irrigation purposes. After wells, tanks occupy a very important place under the minor irrigation programme. They provide nearly 2/3rd of total irrigation from minor sources in the States of Andhra Pradesh, Madras, Mysore, Orissa and Kerala. Tracts with undulating topography and rocky sub-strata are eminently suitable for tank irrigation.

3.30. The essential features of these schemes are: (a) a bund or a dam which is generally of earth but also sometimes partly or fully of masonry, (b) anicuts and feeder channels to divert water from adjoining catchments, (c) a waste weir to dispose of surplus flood water (d) sluice or sluices to let out water for irrigation, and (e) conveyance and distribution system. The size of the storage is determined by the run-off expected on the basis of dependable monsoon rainfall in the catchment and by the fact whether the rainfall and cropping pattern would permit more than one filling of the tank. The best and direct method to calculate the run-off would, of course, be to gauge the storm flow at the proposed site for a number of years. However, as the observed data over a long number of years is normally not available, the run-off is computed on the basis of empirical formulae found applicable from past experience for the region. When tanks are constructed in a series of bunding up the same valley at several points, some spill-over yield from the bunded catchment is also accounted for. In the gross storage provided some percentage provision is allowed for dead storage to be consumed by silting in course of year.

3.31. The irrigable command of the scheme is fixed on the basis of certain standard duties in terms of crop area irrigated per unit of water. The proposed cropping pattern is decided on the basis of past experience in the region. The flood discharge to be escaped over a waste weir is computed by empirical formula which from experience are found to generally hold good for the region. The design of the various component parts of the tank usually requires specialised engineering knowledge.

13. *Construction of new tanks and reservoirs*

3.32. The new works are usually taken up as State works by the State Public Works Department.

14. *Restoration of old tanks and reservoirs*

3.33. A large number of existing tanks in many States have been lying in a dilapidated condition due to long neglect of repairs. The tanks fail mainly due to two reasons—(a) silting of bed, and (b) breaches due to inadequate surplussing arrangements or bad maintenance of the bund. Renovation of derelict tanks so as to restore the lost irrigation potential is being accorded priority under the minor irrigation programme. The work of restoration generally consists of—(a) strengthening or raising of bunds, (b) improving the surplus capacity, and (c) occasional de-silting of bed. De-silting is costly but in some cases, this is being rendered economical by utilising the excavated earth for reclaiming part of the previously submerged land. This scheme is named as “De-silting-cum-Reclamation of Tanks”. The work of restoration is usually carried out by the State Public Works Department. After renovation, works irrigating below a

specified acreage are handed over to the Panchayats for maintenance. Works having higher irrigation capacity are maintained by the Public Works Department.

E. DIVERSION SCHEMES

3.34. These schemes aim at providing gravity flow irrigation by mere diversion of stream water supply without arranging any storage. As compared to storage schemes they are economical but their feasibility is dependent on the presence of flow in the stream at the time of actual irrigation requirements. Essentially this scheme consists of two parts: (a) an obstruction (weir) or bund constructed across the stream for raising and diverting water. The weir is called anicut in the South, bandhara in Maharashtra and Gujarat and thingal in the Assam region; and (b) an artificial channel to carry the diverted water to the fields. This channel is known as kuhl in the hilly areas, pyne in Chhota Nagpur, Bihar, dongs and lowkhongs in the Assam region and so on. In case of small schemes which have prominent scope in the hilly tracts and foot-hill plains, the water is usually diverted by constructing temporary bunds across the streams, made up of earth, stones or even bamboos. The discharge tackled being of small order, the bund on the head of the channel is not provided with any gated structure for controlling and regulating the flow. Construction of the work is, therefore, simple and cheap and can be handled to a large extent by the people themselves. However, these constructions being temporary, require frequent renovation. The bunds are liable to be washed away by every major flood. The channels also get silted up and scoured frequently. It is essential that whenever such schemes aim at diverting higher discharges, say, more than 5 to 10 cusecs, or tackle streams having high intensity of flood discharge, proper regulation structures equipped with suitable types of gates should be provided. Weir should be provided with scouring sluices in order to regulate the flow of silt in the off-taking channels. The construction of masonry weir is comparatively simpler and cheaper where rocky foundation is available beneath the stream bed. The design of the weir on permeable and erodable foundations is more complicated and requires specialised engineering knowledge.

3.35. The irrigation capacity of the diversion schemes is dependent on the actual flow in the stream at the time the irrigation is required. The cold weather and the hot weather flows, therefore, need to be ascertained carefully before deciding the feasibility and economics of these schemes. This is particularly important in the case of non-snow-fed flashy streams which spurt to lift suddenly in the rainy season after which the discharge in them dwindles down to inappreciable quantity. Some diversion schemes are also constructed as kharif or monsoon channels supply water only during the monsoon season. Such schemes are useful for providing supplemental irrigation for paddy and preliminary watering for sowing of rabi.

15. Hilly Channels—Kuhls

3.36. Hilly channels include small irrigation channels which are constructed in hilly areas to carry water diverted from streams by constructing temporary or *pucca* bunds across the streams. These channels are often constructed in hazardous hilly terrain under very difficult conditions.

16. *Non-hilly Channels—anicuts, bandharas, pynes, etc.*

3.37. Under these schemes are covered diversion schemes in non-hilly areas.

F. LIFT IRRIGATION FROM RIVERS & STREAMS

3.38. In regions, where the topography does not permit direct flow irrigation from rivers and streams, water has to be lifted into the irrigation channels. The works are similar to those of diversion schemes, but in addition pumps are installed and pump houses constructed. These schemes being costly in operation are feasible only in areas where (a) gravity flow irrigation is not at all possible, (b) there is keen demand for irrigation and cultivators are enthusiastic, (c) water is available in the streams for at least about 200 days in a year, and (d) cheap electric power is available. Installation of diesel operated pumpsets for lifting water makes the operation and maintenance cost of these schemes exorbitantly high. However, for lifting smaller order of discharge by individual cultivators, portable diesel engine pumpsets are more feasible as they provide greater flexibility and mobility for installation at different points of the water source or sources.

17. *State Lift Irrigation Schemes*

3.39. Under this head are covered these lift irrigation schemes which are executed and operated as State works.

18. *Cooperative Lift Irrigation Schemes*

3.40. This head includes lift irrigation schemes which are executed and operated as cooperative enterprises.

19. *Water Conservation-cum-Groundwater Recharging Schemes*

3.41. Under this head are included schemes which serve primarily one or more of the following purposes:—(a) sub-merging agricultural land during monsoon for sowing post-monsoon crops, (b) improving moisture regime of the adjoining fields down stream for raising of post-monsoon crops without irrigation, (c) replenishing the groundwater. In some cases, these schemes also provide some direct irrigation. An additional advantage of these schemes is that they help to conserve the soil. When constructed in the head water region serving as a catchment area of tanks down below, they serve the important purpose of retarding the silting rate of these tanks.

3.42. The system of water conservation through field embankments is peculiar to Central India tracts and is commonly in vogue in the Northern Districts of Madhya Pradesh, Bundhelkhand Districts of Uttar Pradesh and Eastern Districts of Rajasthan. In the Bundhelkhand Districts of Uttar Pradesh, these works are known as 'bundhies'. Bundhies consist of earthen embankments thrown across gently sloping ground. During the rainy season, water is stored upstream and the land gets submerged. If the land slope is gradual, often large areas get submerged even by low embankments. Ordinarily, no direct irrigation is carried out and benefit is mostly due to submergence. In nearly all these districts, the soil is generally black which is retentive of moisture. After remaining submerged under water during the rainy season, the soil retains sufficient moisture to grow

good rabi crops. The remaining water is let out and the sub-merged land released for cultivation. The other advantage of submerging land in this manner is that the first flood brings a lot of silt which acts as a rich manure. By preventing from free flow of water across steep gradient, the soil of the land is also conserved.

3.43. Ahars in Bihar, which store water for irrigation of paddy fields also function somewhat in a similar manner. Water is let out in October for irrigating the rice fields and the drained out fields in the bed of the ahars are cultivated with rabi crops. The head water tanks popularly in vogue in Orissa have a similar role to perform. These consist of bunds put up across slope at the head of gullies with the objective of impounding and diverting the cumulative run-off into the wider valley area down stream of the bunds by percolation, seepage and surface flow. Surface channels are provided in the flanks to carry flood water received in excess of the storage capacity of the bunds during the monsoon season.

3.44. Percolation tanks primarily for the purpose of recharging groundwater are in vogue in Maharashtra, Mysore, Madras, Kerala and Rajasthan.

3.45. Check-dams or rapats are in vogue in Rajasthan. They consist of bunds constructed across the streams for the purpose of retarding the surface flow and also the sub-surface flow to some extent by making the bed slope of the stream flattened. This results in increased percolation of water in the sub-soil with consequent increase of the groundwater supply.

3.46. In the case of big embankments impounding large catchments, it is essential that adequate arrangements may be made at one or both the flanks or at some other suitable location for passing the flood water. If no such provision is made the embankments are likely to breach.

H. DRAINAGE, FLOOD PROTECTION & ANTI-SEA WATER INTRUSION WORKS

3.47. While irrigation is necessary to make up the deficiency of water in the soil and to sustain plant life through all its stages, the schemes under this category play an important role of protecting agricultural land and crops against ravages of excessive fresh or sea water. There is prominent need for varied types of work under this category in nearly all the States for minimising losses of agricultural production and obtaining increased crop yields from the affected lands. Larger works under this category are tackled under the major-medium irrigation sector. Only small works having localised scope and costing less than Rs. 50,000 each are taken up under the minor irrigation programme.

20. Drainage Works

3.48. Drainage may either be surface or sub-surface. Surface drainage aims to relieve surface congestion of water. Sub-surface drainage removes excess of water from beneath the soil surface. The surface and sub-surface drainage problems are closely inter-related—one type of problem, if allowed to prolong over a period of time aggravating the other. A purely surface drainage problem is comparatively simple to tackle. The sub-surface drainage, however, is more complicated, requires extensive surveys including study of groundwater contours and sub-soil stratigraphy and is expensive.

3.49. A drainage system whether surface or sub-surface, essentially consists of an inter-linked system of drainage channels or conduits in which smaller drains empty into larger and larger ones, until they reach some natural or artificial water course that carries water away without damage to the land. Various methods that have been employed for drainage are, (1) open drains, (2) tile drains, (3) pumping from wells, (4) mole drains and (5) vertical drains. Methods (1) to (3) are commonly employed; (4) & (5) can be used only under very special circumstances. Open drains are most suitable as storm water drains for relieving surface congestion of water. As sub-surface drains also, they are effective for withdrawing water from the soil but to a limited extent depending upon their depth and permeability of the soil. Open field drains for sub-surface drainage have to be spaced sufficiently close, spacing usually varying from 60 to 600 ft. depending mainly upon the soil permeability.

3.50. Tile drains are more effective for sub-surface drainage. They consist of cylindrical pipes, usually 3 to 6 inches in diameter, in convenient lengths, laid to form continuous line at a specified depth and grade. The pipes are placed end to end with gaps or alternatively there are slots in the body of the pipes. The free water in the soil enters the drain through joints or perforations and flows by gravity to the outlet. The tiles commonly used are either clay or porous concrete. The depth of tiles usually varies from 3 to 6 ft. and the spacing from 50 to 500 ft. The main drain even in tile drainage system is usually of open drains.

3.51. The digging of open drains may be done by hand V-drag, scrapers, motor graders or drag-line excavators. The V-drag and scrapers can be operated by animals or by tractor power. The drag-line excavators are highly suitable for big and deep drains, particularly when under water excavation is involved. Trenching of tile drains in developed countries is mostly done by power operated trenching machines which are of two types (a) wheel excavators and (b) endless chain excavators. The wheel excavator is more common in farm drainage construction.

3.52. Tile drains though superior to open drains in many ways, particularly for sub-surface drainage, are very costly in initial construction. This is the main reason why this method has not yet been introduced extensively in India.

3.53. Pumping of groundwater at some locations in conjunction with gravity drainage system is an effective manner for lowering the water table. Pumping from wells for drainage could be successful when high water table has direct connection through porous sand or gravel to the aquifers from which water is being pumped. Shallow tubewells or open surface wells are likely to be more suited for the purpose of drainage pumping. Pumped water, if sweet, can be used for irrigation.

3.54. Mole drains which are unlined underground channels have limited applicability only to fine textured plastic mineral soils and fibrous organic soils with strong cohesion under compression. Being unsupported they are liable to collapse and consequently have short span of life.

3.55. Vertical drainage which aims at disposal of drainage water by gravity through wells into a porous layer of earth or an open rock formation underneath, can be feasible only under exceptional conditions where the underlying formation has outlet lower than the land to be drained, is

capable of taking high volume of water rapidly and can be reached without cost being prohibitive.

3.56. The problem of surface drainage is very acute in the Indo-Gangetic plains, the Brahmaputra system and in the deltaic region of the Peninsula rivers. The problem of sub-surface drainage is very acute in the Punjab and Uttar Pradesh and also in some intensely irrigated Deccan tracts.

21. Flood Protection Works

3.57. Floods are primarily caused by concentrated rainfall and occur when the resulting run-off in the form of stream or river flow exceeds that which the river channel can carry within its banks. Damage due to floods occurs in three ways: (a) inundation, (b) erosion of the stream/river bank and (c) change of river/stream course. Flood protection works usually consist of earthen embankments constructed along drainage channels, streams and rivers, to prevent spilling of flood water. The embankments have adequate free board over the high flood level ever recorded. In reaches subject to heavy action of water, the embankments are protected by means of revetments, pitching flexible aprons, spurs, etc.

3.58. Sluices are provided in the embankments to pass the drainage water when the water level in the main streams is low. Sluices are closed when the main stream is in spate. Flood irrigation is also resorted to some time from the water of the river in spate, let in through the sluices. This practice is particularly in vogue in the Assam region.

3.59. At some locations, the flood protection works merely consist of one or more spurs constructed to keep off river currents from eroding the banks. Other flood control measures resorted to are: (a) construction of cut-offs to reduce pressure of river along the existing water course, (b) desilting of stream channels and (c) diverting the stream water into some other creeks or basins. Apart from these works, storage works big or small also help to a large extent in reducing the intensity of the flood. The economics of a flood control project is one of the major governing factors to be reckoned with in deciding the nature and the size of the project.

3.60. The States subject to recurring floods are: Andhra Pradesh, Assam, Bihar, Jammu & Kashmir, Punjab, Uttar Pradesh and West Bengal. Of late some other States like Gujarat, Madhya Pradesh and even Rajasthan which are normally free from floods have been subject to heavy floods. Besides, Union Territories of Delhi, Himachal Pradesh, Manipur and Tripura also occasionally experienced floods.

22. Anti-sea Water Intrusion Works

3.61. Anti-sea water intrusion works are constructed in the coastal region to prevent ingress of brackish sea water into the agricultural land. These works usually consist of embankments either of earth or masonry constructed along the affected area. Proper regulators are constructed at the mouths of the rivers and the streams to prevent ingress of brackish water and at the same time allow the fresh river water to pass into the sea during the period of low tides. These works also enable gradual reclamation of low-lying saline lands in the coastal region for agricultural purposes. Location, spacing, section provided and the construction material used are the important factors which require consideration in design and construction of stable and effective embankments.

CHAPTER IV

REVIEW OF PROGRESS

Pre-Plan Period

4.01. The practice of organised irrigation in India has been traced to well before the Christian Era. However, substantial development in irrigation took place during the 19th century and the current century. The following figures give the progressive increase of irrigation in India since the beginning of the last century:—

In 1800	about 2 million acres.
In 1900	about 30 million acres.
In 1925	about 43 million acres.
In 1950	about 50 million acres.

4.02. According to the Land Utilisation Statistics, the total net area irrigated in the country in 1950-51 *i.e.*, before the First Five Year Plan was launched, was 53 million acres. The corresponding figure for the gross area irrigated was 55.76 million acres. The source-wise break-up, which is available only for the net irrigated area, is as under:—

Government canals	17.898 million acres
Private canals	2.814 million acres
Tanks	8.776 million acres
Open wells	14.712 million acres
Other sources	7.329 million acres
TOTAL	51.529 million acres

4.03. Reckoning that all the area under Government canals as reported in the Land Utilisation Statistics is from major-medium works (although some area under Government canals is also from minor irrigation works) and that under other sources is from minor works, the total area irrigated by minor irrigation works during that year was 33.63 million acres (51.529 million acres—17.898 million acres). Contribution from minor irrigation thus worked out to about 65 per cent of total irrigation. On State-wise proportionate basis the gross irrigated area due to minor irrigation in 1950—51 works out to about 36.05 million acres, made up of 16.14 million acres from groundwater schemes and 19.91 million acres from surface water schemes.

4.04. It is, however, to be realised that in 1950-51, quite an appreciable percentage of area under tanks, although classified and reported as irrigated in the Land Utilisation Statistics did not actually receive assured irrigation. This was due to the fact that a large number of tanks had been lying in derelict condition due to long neglect of repairs by the erstwhile landlords and zamindars.

4.05. State-wise break-up of the area in 1950-51 under the minor and major-medium sources is given in Annexure I.

4.06. The total number of open wells existing in the country in 1950-51 is estimated at 50 lakhs. The number of electric motor pumpsets used for irrigation purpose was 24,800 and that of diesel engine pumpsets 66,000. There were about 2,400 State tubewells in operation. Besides, there were about 5 lakh irrigation tanks of sizeable capacity. Quite a large number of these tanks, however, had gone into dis-use due to silting and neglect of repairs over a long period. The approximate State-wise break-up of the number of these works as existing in 1950-51 is given in Annexure I.

4.07. Drainage works and dykes and embankments for protection against floods and sea-water have been in use in India for thousands of years. Drainage works completed in the past mostly comprised artificial open drains constructed from time to time to tackle isolated cases of surface congestion. Although the need for drainage to avoid hazards of water logging and salinization had been recognised as early as 1874 by the Reh Commission, the programme of drainage had not been taken up on an intensive scale. Sub-surface drainage being costly had practically not been attempted anywhere. A precise statistics of the lengths of drainage channels completed in the Pre-plan period in various States is not available.

4.08. The earliest efforts at the construction of embankments and dykes were made mainly by the private individuals who put up these works for the protection of specific localities in the flood affected areas. In the course of time, this individual activity led to un-planned and haphazard construction of embankments along the river banks and elsewhere. Not being scientifically planned, the embankments suffered several breaches. The inadequacy of individual efforts in the sphere of flood control led to governmental interest in the problem chiefly during the last century. As a result of this, a number of well-planned embankments were constructed on some of the rivers which had been causing recurrent flood damage. The works completed comprised embankments in Bihar and West Bengal for about 100 miles along either bank of the Gandak, 75 miles along the Damodar and 2,200 miles in the Sunderbans area. In Orissa all the major rivers *i.e.*, Mahanadi, Brahmani and Baitarni were embanked in their coastal regions for a total length of 1,029 miles, 751 miles along the Mahanadi, 178 miles along the Brahmani and 100 miles along the Baitarni. In South India, the Godavari and Krishna were embanked in their deltatic reaches on both sides for about 80 miles and 75 miles respectively. The Cauveri also had flood banks in its lower reaches.

4.09. Precise statistics about the embankments which may be classified as major-medium and minor is not available.

First Five Year Plan

4.10. The achievement under minor irrigation during the First Five Year Plan comprised sinking of about 15,000 new wells, repair of about 50,000 old wells, boring and deepening of about 20,000 wells, installation of about 15,000 pumpsets and 15,000 persian wheels, construction of about 200 artesian tubewells, 2,900 State tubewells, 3,000 private tubewells and 3,000 filter-points and construction and repair of about 10,000 tanks. In addition, a large number of small irrigation drainage and embankment schemes had been undertaken and completed. The works completed are reported to have benefited a total of additional area of 9.5 million acres.

4.11. The total financial assistance sanctioned by the Government of India for the minor irrigation programme during the First Plan was Rs. 45.83 crores. This was made up of a loan amount of Rs. 37.68 crores, and grants totalling to Rs. 8.15 crores. Besides the Central assistance, quite a substantial amount of financial outlay was incurred by the States from their own budgets which is not reflected in these figures.

4.12. Out of the total area benefited of 9.5 million acres, it is estimated that about 2.5 million acres were benefited by drainage and embankments schemes and about 1.00 million acres of water conservation-cum-ground-water recharging schemes. The balance of 6.00 million acres were benefited by irrigation schemes. Of this figure, it is estimated that about 1.5 million acres consisted of old irrigated area over which irrigation was made more certain. The new area brought under irrigation by the schemes completed is estimated as 4.5 million acres made up of 2.3 million acres from surface water schemes and 2.2 million acres from ground water schemes. This was gross irrigated area in terms of crop acres. This figure, however, does not represent the net increase in the gross irrigated area during the Plan period as out of this figure some portion has to be offset against area lost due to depreciation on the existing works. It is very difficult to have any precise assessment made for the area lost by depreciation, particularly because the rate of depreciation would vary widely from region to region and scheme to scheme, and no reliable data on this aspect is available.

4.13. The State-wise break-up of the All India achievement of 9.5 million acres under different categories of benefits is given in Annexure IV.

Second Five Year Plan

4.14. During the Second Five Year Plan an additional area of 9 million acres was benefited by different categories of works completed under the programme. The works during this Plan were financed from G.M.F. funds as well as from the funds available under the schematic budget of the C.D. blocks. The outlay incurred under the G.M.F. Sector was about Rs. 95 crores and about Rs. 45 crores under the C.D. Sector.

4.15. The achievement in terms of physical units included construction of about 1,60,000 new wells, repair of about 30,000 old wells, boring of about 25,000 wells, deepening of about 15,000 wells, installation of about 35,000 pumpsets and about 15,000 persian wheels, construction of about 200 artesian tubewells, 4,500 private tubewells, 3,800 State tubewells, 3,000 filter-points and construction and repair of about 15,000 tanks. In addition, a large number of diversion schemes, schemes for drainage and

embankments and those for water conservation-cum-recharging ground-water works had been completed.

4.16. The total area benefit of 9 million acres included about 1.30 million acres benefited by drainage and flood control schemes, 0.70 million acres benefited by water-conservation-cum-groundwater recharging schemes. Out of the balance of 7.00 million acres, about 1.8 million acres was accounted for by the old irrigated area over which irrigation was made more assured. The new area brought under irrigation is estimated to be of the order of about 5.2 million acres (gross) made up of 2.2 million acres from surface water schemes and 3.00 million acres from groundwater schemes. To calculate the net increase in the gross irrigated area during the Second Plan, a portion of this figure of 5.2 million acres would have to be off-set against area lost due to depreciation over the Plan Period. As mentioned before, any reliable assessment of the area lost due to depreciation is not possible.

4.17. The State-wise break-up of the All-India achievement of 9 million acres under different categories of benefits is given in Annexure V.

Position at the end of the Second Five Year Plan

4.18. The State-wise level of irrigation development at the end of the Second Five Year Plan *i.e.* in the year 1960-61, on the basis of the Land Utilisation Statistics is indicated in Annexure III. Making similar assumption as in paragraph 4.03, the total gross area irrigated by minor irrigation works in 1960-61 works out to 43.07 million acres, made up of 20.20 million acres from groundwater schemes and 22.87 million acres from surface water schemes. These figures reflect an increase of 4.06 million acres in groundwater development and 2.96 million acres in surface water development from minor irrigation schemes over the figures of 1950-51. The corresponding figures resulting from the analysis of the GMF progress reports for the corresponding period are 5.2 million acres for groundwater and 4.5 million acres for surface water respectively. The difference in the two sets of figures may be attributed to the depreciation in works which is appreciable in the case of such schemes as wells, tanks, pumpsets.

Third Five Year Plan

4.19. The target set for minor irrigation during the Third Five Year Plan is about 12.8 million acres made up of 9.5 million acres under the G.M.F. Sector and 3.3 million acres under the C.D. Sector. The target of 9.5 million acres under the G.M.F. Sector was linked up with the combined outlay under the following three categories:—

- (a) the existing Plan provision of Rs. 174.76 crores;
- (b) supplementation to the extent of Rs. 38.84 crores made up of Rs. 10 crores in Andhra Pradesh, Rs. 1 crore in Gujarat and Rs. 27.84 crores in West Bengal; and
- (c) an outlay of about Rs. 33 crores to be made available for the Cooperative Sector in the States of Gujarat, Maharashtra and Punjab.

4.20. If the supplemental provision of Rs. 38.84 crores is not taken into account, the total Plan target for minor irrigation programme under the G.M.F. Sector during the Third Five Year Plan works out to about 8.4 million acres. A State-wise break-up of the targets in terms of outlays and area benefited is given in Annexure VI.

4.21. In August 1962, it was decided in consultation with the Planning Commission, to increase the total Plan target under minor irrigation by 20 per cent. Later in the context of the present emergency, the National Development Council decided to set up the target by 50 per cent instead of 20 per cent as envisaged earlier. Efforts have consequently been made to accelerate the programme as much as possible. Additional allocation over and above the ceiling of Central assistance and the annual State Plans have been sanctioned to the States for this purpose. The additional outlay over and above the existing Plan provision of Rs. 174.46 crores is likely to far-exceed the additional supplementation of Rs. 38.84 crores as envisaged earlier.

4.22. The actual outlay incurred on minor irrigation programme during 1961-62 was of the order of Rs. 30 crores. During 1962-63, the original budget provision of Rs. 32.08 crores was later increased to Rs. 41.34 crores by an additional allocation of Rs. 9.26 crores during the latter part of the year. The actual expenditure is reported as 37.28 crores. During the year 1963-64, the original budgeted amount of Rs. 39.45 crores was later supplemented by an additional sanctioned outlay of Rs. 14.80 crores. The anticipated expenditure is of the order of Rs. 50.78 crores. Thus the total anticipated outlay during the first three years of the Third Five Year Plan comes to Rs. 118.06 crores. The State-wise break-up is given in Annexure VII.

4.23. For the year 1964-65, the outlay budgeted by the State Governments is of the order of Rs. 51.35 crores. Additional sanctions amounting to a total of Rs. 12.85 crores, however, have recently been conveyed to the State Governments for agricultural production and minor irrigation schemes. It is expected that the total outlay during the year 1964-65 would be of the order of Rs. 60.07 crores. The State-wise break-up is indicated in Annexure VII.

4.24. With adequate organisational, administrative and technical measures, implementation of which is being strongly pressed on the State Governments, it is considered possible to further accelerate the tempo during the last year of the Third Five Year Plan. The Working Group considers the suggested outlay of Rs. 70.50 crores as quite realistic for the year 1965-66. The State-wise break-up is indicated in Annexure VII.

4.25. On the above basis, the following picture emerges for the progressive year-wise outlay on minor irrigation during the Third Five Year Plan:—

Years	Outlay (Rs. in crores)
1961-62	30 (actual)
1962-63	37 (actual)
1963-64	51 (anticipated)
1964-65	60 (anticipated)
1965-66	71 (projected)
TOTAL	249 crores

4.26. The order of acceleration indicated above would mean that the total Plan outlay on minor irrigation would be increased by about Rs. 74.27 crores over and above the existing Plan provision of Rs. 174.46 crores.

4.27. In addition to the outlay under the G.M.F. Sector indicated above, there would also be expenditure on minor irrigation under the Co-operative and the C.D. Sectors. Under the C.D. Sector, the outlay during the first three years *i.e.*, 1961—64 is estimated at about Rs. 31 crores. The total plan outlay under this Sector is anticipated to be about Rs. 57 crores. The State-wise break-up is given in Statement 'D'.

4.28. Under the Co-operative Sector, besides Gujarat, Maharashtra and Punjab, which States had earlier indicated a part of the programme to be taken up under this Sector, some outlay is also being incurred in the States of Andhra Pradesh, Orissa and Uttar Pradesh. It is roughly estimated that the total Plan outlay under this Sector may rise from the earlier expectation of Rs. 33 crores to Rs. 50 crores.

4.29. In regard to the physical achievement, the States are usually not able to report separate figures under the G.M.F., Co-operative and the C.D. Sectors. The physical achievement under the G.M.F. and Co-operative Sectors is usually linked up together—the works which are awarded loans from the Land Mortgage Banks under the Co-operative Sector are also usually financed under the G.M.F. Sector as far as subsidy and the differential rate of interest under the two Sectors is concerned.

4.30. From such figures as the States have been able to furnish, it is estimated that the total area of 5.06 million acres would have been benefited by schemes completed under the G.M.F. and the Co-operative Sectors during the first three years of the Third Five Year Plan. On the basis of the outlay anticipated for the year 1964-65 and the outlay projected for the year 1965-66, it is expected that the total plan achievement under these two Sectors would be of the order of 10.47 million acres. The State-wise and the year-wise break-up is given in Annexure VIII.

4.31. The all-India picture, State-wise and scheme-wise of the total projected achievement during the Third Five Year Plan under the GMF Sector is given in Statements 'A' & 'B'. The scheme-wise achievement under the G.M.F. Sector in different States is given in Annexure IX-1 to IX-4.

4.32. The total all-India achievement under the C.D. Sector during the Plan period is estimated to be of the order of 2.5 million acres. The State-wise break-up is given in Statement 'D'.

4.33. Thus, to sum up, it is anticipated that the all-India achievement on minor irrigation would be Rs. 355.73 crores in terms of financial outlay made up of Rs. 248.73 crores under the GMF, Section Rs. 50.00 crores under the Co-operative Sector and Rs. 57.00 crores under the C.D. Sector and 13.00 million acres in terms of area benefited, 10.47 million acres under the GMF and Co-operative Sectors and 2.53 million acres under the C.D. Sector. The cost benefit ratio of groundwater schemes under the GMF Sector works out to 206 and that of surface water scheme

under the Sector as 279. The highlights of accelerated implementation expected during the Third Five Year Plan over the performance of the Second Five Year Plan are given as under:—

Items	Achievement during Second Five Year Plan	Anticipated achievement during Third Five Year Plan
1. Open wells (Nos.)	1,60,000	4,33,090
2. Repair of wells (Nos.)	30,000	49,400
3. Boring of wells (Nos.)	25,000	1,25,687
4. Deepening of wells (Nos.)	15,000	99,549
5. Diesel engine pumpsets (Nos.)	35,000	76,306
6. Electrical pumpsets (Nos.)	}	72,961
7. Private tubewells (Nos.)	4,500	11,925

Analysis of the projected Third Five Year Plan achievement under different categories of benefits

4.34. According to present trends, the achievement under the ground water scheme usually pertains to new area brought under irrigation. However, under surface water schemes, a large part of the programme consists of restoration of old works and the benefits, therefore, include new irrigation as well as improved irrigation in old irrigated area. The restoration of old tanks, it is reckoned, results mostly in stabilisation of irrigation in old irrigated area, new irrigation usually being of the order of 5 to 20 per cent of the total benefited area. On diversion schemes, the new irrigation is usually 50 to 60 per cent of the total acreage benefited.

4.35. Pumpsets purchased by the individual cultivators under the Governmental assistance programme are installed on open wells for lifting groundwater as well on rivers, streams, ponds, lakes, etc., for lifting surface water. In the States of Assam, West Bengal, Orissa and Kerala where there are very few irrigation wells, these pumpsets are more of less installed on surface water sources. In other States, though they are mostly installed on wells, yet quite a sizeable percentage of them is installed on surface water sources. It is estimated that the percentage of surface water installations in these States would usually range from 20 to 40 percent for the diesel engine pumpsets and from about 10 to 20 per cent in respect of electrical pumpsets.

4.36. The State-wise physical achievement under the G.M.F. Sector has been analysed into different categories of benefits on the above basis in Statement 'C'. Similarly, assessment of the achievement under the C.D. Sector has been carried out in Statement 'D'. The category-wise break-up

of the anticipated all-India achievement of 13 million acres during the Third Five Year Plan is abstracted as under:—

Items	Million acres
1. New irrigated area.	
(a) groundwater	6.70
(b) surface water	2.48
2. Old irrigated area over which irrigation is improved i.e., made more assured or certain	2.05
3. Area benefited by water conservation-cum-groundwater recharging schemes	0.81
4. Area benefited by drainage, flood protection and anti-sea water intrusion works	0.96
TOTAL	13.00

Progress under Major-Medium Sector

4.37. During 1950-51, the area irrigated by works which may be classified as major-medium was 17.90 million acres (net) and about 19.70 million acres (gross). The works taken up during the three Five Year Plans are estimated to cost Rs. 1,764 crores. On completion, the First and Second Plan schemes are expected to irrigate about 38 million acres. By the end of the First Plan the outlay of Rs. 380 crores (including Rs. 80 crores spent before the First Plan period) on these schemes had been incurred. The outlay on the Second Plan was Rs. 375.85 crores. In the Third Plan, an outlay of Rs. 603.15 crores has been provided for the irrigation schemes.

4.38. In the First Five Year Plan, 250 irrigation schemes (20 major irrigation and 230 medium) were included, of which 237 (18 major and 219 medium) schemes were taken up for actual execution during the First Five Year Plan. In the Second Five Year Plan, 188 new schemes (30 major and 158 medium) were included of which 154 irrigation schemes (20 major and 134 medium) were taken up for execution. In addition, 13 irrigation schemes which were not taken up in the First Five Year Plan were also started in this period bringing the total number of major and medium irrigation schemes taken up in the Second Plan to 167. In the Third Plan, 103 irrigation schemes (16 major and 87 medium) have been included.

4.39. As a result of these works taken up, the irrigation potential of about 6.47 million acres was created during the First Five Year Plan with an actual utilisation of the order of about 3.06 million acres. During the Second Plan, additional irrigation potential of 5.62 million acres was created bringing the progressive total to 12.09 million acres. The actual progressive utilisation at the end of the Second Plan was of the order of 8.59 million acres. Additional utilisation during the Second Plan thus works out to 5.53 million acres. It is anticipated that the progressive figure of irrigation potential created by the end of the Third Five Year Plan would be 23.16 million acres and that of actual utilisation of 18.60 million acres. This would mean an additional utilisation of 10.01 million

acres during the Third Five Year Plan. The State-wise break-up of these figures is given in Annexure X.

4.40. Under the drainage, flood control and anti-sea water erosion programme an expenditure of Rs. 13.48 crores was incurred during the First Plan. The expenditure during the Second Plan was Rs. 47.46 crores. State-wise break-up of these figures is given in Annexure XI. Out of the total expenditure of Rs. 60.89 crores during the first two Plans, expenditure incurred on surface drainage schemes was Rs. 6.5 crores, bulk of which (about Rs. 4.3 crores) was in the State of Punjab only. There was no expenditure on anti-water logging scheme during the first two Plans.

4.41. The provision for this programme during the Third Five Year Plan is Rs. 61.32 crores. This is made of Rs. 15.70 crores for surface drainage schemes and Rs. 3.41 crores for anti-water logging measures and the rest Rs. 42.21 crores for flood and sea-water control works. The anticipated expenditure during the Third Plan is of the order of Rs. 85.11 crores. The State-wise break-up is given in Annexure XI.

STATEMENT 'A'

Anticipated Achievement on Minor Irrigation Programme during Third Five Year Plan.

Financial — Rs. in lakhs
Acreage — '000 acres

Sl. No.	Name of State/ Union Terri- tory	G.M.F. Sector		C.D. Sector		Total	
		Acreage	Financial	Acreage	Financial	Acreage	Financial
1	2	3	4	5	6	7	8
1.	Andhra Pradesh	928.50	2956.25	160.00	500.00	1088.50	3456.25
2.	Assam	326.63	476.56	100.00	150.00	426.63	626.56
3.	Bihar	802.84	1356.67	320.00	550.00	1122.84	1906.67
4.	Gujarat	995.50	1463.97	80.00	220.00	1075.50	1683.97
5.	Jammu and Kashmir	27.80	158.02	12.00	60.00	39.80	218.02
6.	Kerala	178.84	613.77	55.00	180.00	233.84	793.77
7.	Madhya Pradesh	458.53	1948.97	88.00	370.00	546.53	2318.97
8.	Madras	500.16	1843.73	125.00	450.00	625.16	2293.73
9.	Maharashtra	1050.50	2075.20	185.00	550.00	1235.50	2625.20
10.	Mysore	410.66	3333.19	40.00	300.00	450.66	3633.19
11.	Naga Land	2.50	8.75	4.50	15.00	7.00	23.75
12.	Orissa	190.07	569.26	120.00	350.00	310.07	919.26
13.	Punjab	919.72	922.40	165.00	250.00	1084.72	1172.40
14.	Rajasthan	354.77	994.69	90.00	250.00	444.77	1244.69
15.	Uttar Pradesh	2931.22	4583.868	840.00	1100.00	3771.22	5683.868
16.	West Bengal	318.50	1349.60	90.00	270.00	408.50	1619.60
	TOTAL	10396.74	24654.898	2474.50	5565.00	12871.24	30219.898
1.	Andamans	..	..	1.50	3.00	1.50	3.00
2.	Delhi	17.694	46.91	2.50	5.00	20.194	51.91
3.	Goa	8.790	35.13	N.A.	N.A.	8.790	35.13
4.	Himachal Pradesh	18.50	70.30	18.70	70.00	37.20	140.30
5.	Manipur	12.40	16.20	15.00	18.00	27.40	34.20
6.	NEFA	1.00	2.50	5.60	14.00	6.60	16.50
7.	Pondicherry	4.79	12.22	3.00	7.00	7.79	19.22
8.	Tripura	12.88	35.00	7.20	18.00	20.08	53.00
	TOTAL	76.054	218.26	53.50	135.00	129.554	353.26
	GRAND TOTAL	10472.794	24873.158	2528.00	5700.00	13000.794	30573.158

STATEMENT 'B'

Scheme-wise break-up of Anticipated Achievement—on Minor Irrigation Programme under G.M.F. Sector during the Third Five Year Plan.

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial Cost (Rs. in lakhs)	Cost per acre of benefit
A. WELL SCHEMES					
1.	Construction of new wells	433,090	1892.12	5113.55	270
2.	Restoration of old wells	49,400	92.70	108.40	117
3.	Boring of wells	125,687	380.625	383.63	101
4.	Deepening of wells	99,549	60.10	187.85	313
TOTAL GROUP 'A'			2425.545	5793.43	239
B. TUBEWELL SCHEMES					
5.	State tubewells	2,762	1304.75	2945.21	226
6.	Cooperative tubewells	220	22.00	100.00	455
7.	Private tubewells	11,925	519.35	628.00	121
8.	Filterpoint tubewells	2,343	23.33	41.78	183
9.	Artesian tubewells	415	12.80	23.75	186
TOTAL GROUP 'B'			1882.23	3738.74	199
C. WATER LIFTING APPLIANCES					
10.	Electric motor pumpsets	72,961	604.405	1300.87	215
11.	Diesel engine pumpsets	76,306	888.194	1330.88	150
12.	Persian wheels	60,180	197.240	210.57	107
TOTAL GROUP 'C'			1689.839	2842.32	168
GROUNDWATER SCHEMES			5997.614	12374.49	206
D. STORAGE SCHEMES					
13.	Construction of new tanks and reservoirs		650.15	3368.408	518
14.	Restoration of old tanks and reservoirs		1428.47	4321.97	303
TOTAL GROUP 'D'			2078.62	7690.378	370
E. DIVERSION SCHEMES					
15.	Hilly channels—kuhls/dongs and lowkhongs etc.		124.67	500.72	401
16.	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas, etc.		699.26	1982.20	283
TOTAL GROUP 'E'			823.93	2482.92	301

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Cost per acre of benefit
F. SURFACE WATER LIFT IRRIGATION SCHEMES					
17.	State lift irrigation		195.93	556.57	284
18.	Cooperative lift irrigation		80.06	200.26	250
	TOTAL GROUP 'F'		275.99	756.83	274
G. WATER CONSERVATION-Cum-GROUNDWATER RECHARGING SCHEMES					
19.	Rapats, submerging dams, ahars, bundhies, percolation tanks		579.06	592.19	91
	TOTAL GROUP 'G'		579.06	592.19	
H. DRAINAGE, EMBANKMENT AND FLOOD PROTECTION WORKS					
20.	Drainage works		523.68	600.48	116
21.	Embankment and flood protection works		154.90	185.87	120
22.	Anti-sea water intrusion works		39.00	181.00	464
	TOTAL GROUP 'H'		717.58	976.35	136
	SURFACE WATER SCHEMES		4475.180	12498.668	279
	GRAND TOTAL		10472.794	24873.158	238

STATEMENT 'C'

Category-wise break-up of the Anticipated Achievement on Minor Irrigation Programme under GMF Sector during Third Five Year Plan

Sl. No.	Name of State/ Union Territory	New area brought under irrigation		Old irrigated area over which irrigation is stabilized or restored	Benefit in the form of submerging land or recharging ground water	Benefit by way of drainage, flood control or anti-sea water intrusion works	Total
		Ground water schemes	Surface water schemes				
1	2	3	4	5	6	7	8
1	Andhra Pradesh	158.76	185.74	484.00	..	100.00	928.50
2	Assam	3.00	86.67	54.16	..	18.80	3
3	Bihar	212.07	103.52	102.25	360.00	25.00	802.84
4	Gujarat	636.20	255.60	91.20	..	12.50	995.50
5	Jammu and Kashmir	..	8.58	19.22	..	..	27.80
6	Kerala	..	90.64	30.70	..	57.50	178.84
7	Madhya Pradesh	176.01	207.48	75.04	..	..	458.3
8	Madras	143.43	36.79	319.94	..	..	500.16
9	Maharashtra	598.96	302.21	99.88	..	49.45	1050.50
10	Mysore	118.80	86.32	173.48	9.06	23.00	410.66
11	Nagaland	..	1.25	1.25	..	..	2.50
12	Orissa	8.60	123.83	57.64	..	..	190.07
13	Punjab	845.87	53.36	9.79	..	10.70	919.72
14	Rajasthan	147.26	75.51	72.00	60.00	..	354.77
15	Uttar Pradesh	2339.63	239.59	12.00	150.00	190.00	2931.22
16	West Bengal	106.00	125.60	42.40	..	44.50	318.50
TOTAL STATES		5494.59	1982.69	1644.95	579.06	695.45	10396.74
1	Andaman	..	..	..	..	..	..
2	Delhi	11.952	3.042	..	..	2.70	17.694
3	Goa	2.845	3.285	2.66	..	..	8.79
4	Himachal Pradesh	..	9.25	9.25	..	..	18.50
5	Manipur	..	1.82	1.83	..	8.75	12.40
6	N.E.F.A.	..	0.50	0.50	..	..	1.00
7	Pondicherry	0.496	1.23	1.064	..	2.00	4.79
8	Tripura	0.450	2.39	1.36	..	8.68	12.88
TOTAL TERRITORIES		15.743	21.517	16.664	..	22.13	76.05
GRAND TOTAL		5510.333	2004.207	1661.614	579.06	717.581	10472.794

STATEMENT 'D'

Anticipated Achievements on Minor Irrigation Programme under C.D. Sector during Third Five Year Plan (also Category-wise break-up of Area Benefit)

Financial Rs. in lakhs
Acreage '000

Sl. No.	Name of State/ Union Territory	Total anti-cipation achievement		Category-wise break-up of total anticipated achievement				
		Financial	Acreage	New area brought under irrigation		Old irrigated area over which irrigation is stabilised or restored	Benefit in form of sub-merging land or re-charging sea ground water	age, flood control or anti-intrusion works
				Ground water schemes	Surface water schemes			
1	2	3	4	5	6	7	8	9
1	Andhra Pradesh	500.00	160.00	30.00	40.00	85.00	..	5.00
2	Assam	150.00	100.00	..	15.00	15.00	..	70.00
3	Bihar	550.00	320.00	110.00	45.00	25.00	120.00	20.00
4	Gujarat	220.00	80.00	50.00	15.00	10.00	..	5.00
5	Jammu and Kashmir	60.00	12.00	..	5.00	7.00	..	..
6	Kerala	180.00	55.00	..	25.00	10.00	..	20.00
7	Madhya Pradesh	370.00	88.00	58.00	20.00	10.00	..	..
8	Madras	450.00	125.00	42.00	10.00	73.00	..	..
9	Maharashtra	550.00	185.00	95.00	61.00	20.00	5.00	4.00
10	Mysore	300.00	40.00	15.00	8.00	14.00	..	3.00
11	Nagaland	15.00	4.50	..	2.25	2.25	..	..
12	Orissa	350.00	120.00	5.00	80.00	35.00	..	..
13	Punjab	250.00	165.00	150.00	5.00	5.00	..	..
14	Rajasthan	250.00	90.00	40.00	10.00	20.00	20.00	..
15	Uttar Pradesh	1100.00	840.00	590.00	60.00	10.00	90.00	90.00
16	West Bengal	270.00	90.00	12.00	47.00	23.00	..	8.00
TOTAL STATES		5565.00	2474.50	1197.00	448.25	364.25	235.00	225.00

1	2	3	4	5	6	7	8	9
1	Andamans . .	3.00	1.50	..	1.50	..	..	..
2	Delhi . .	5.00	2.50	2.25	0.25	..	..	..
3	Goa . .	N.A.	N.A.	..	..	..	..	..
4	Himachal Pradesh	70.00	18.70	..	9.00	9.70	..	..
5	Manipur .	18.00	15.00	..	7.00	8.00	..	..
6	NEFA ;	14.00	5.60	..	2.60	3.00	..	..
7	Pondicherry .	7.00	3.00	0.25	1.15	1.60	..	..
8	Tripura .	18.00	7.20	..	4.00	3.20	..	..
TOTAL TERRITORIES .		135.00	53.50	2.50	25.50	25.50	..	..
GRAND TOTAL .		5700.00	2528.00	1199.50	473.75	389.75	235.00	225.00

ANNEXURES

ANNEXURE I

Statement showing State-wise number of Tanks, Wells and Pumpsets used for Irrigation purposes at the commencement of the First Five Year Plan
(in hundreds)

Serial No.	Name of State / Union Territory	Tanks			Wells			Pumpsets		Remarks
		Below 100 acres	100 acres & above	Total	In use	In disuse	Total	Diesel Engine	Electric motor	
1	Andhra Pradesh	483	84	567	4,145	201	4,346	81	15	
2	Assam	Nil	Nil	Nil	Nil	Nil	Nil	1	..	
3	Bihar	269	9	278	1,053	54	1,107	6	3	
4	Gujarat	192	12	204	3,586	227	3,813	*297	*18	
5	Jammu & Kashmir	..	..	..	..	..	..	..	..
6	Kerala	14	1	15	..	..	..	12	16	
7	Madhya Pradesh	383	19	402	2,573	1,021	3,594	22	1	
8	Madras	247	67	314	7,885	333	8,218	137	137	
9	Maharashtra	440	41	481	7,953	1,324	9,277	..	..
10	Orissa	12	5	17	..	..	..	1	..	
11	Mysore	338	27	365	988	NA.	988	44	31	
12	Punjab	2	..	2	2,160	298	2,458	17	3	
13	Rajasthan	N.A.	N.A.	N.A.	4,997	1,737	6,734	13	3	
14	Uttar Pradesh	1,352	48	1,400	7,578	1,771	9,349	19	15	
15	West Bengal	N.A.	N.A.	950	N.A.	N.A.	N.A.	6	6	
TOTAL STATES				4,995	42,918	6,966	49,884	656	248	

1	Andamans	.	.	.	.	.	..	..	..	..	..	..	..
2	Delhi	.	.	.	.	.	..	81	34	115	2	..	..
3	Goa	.	.	.	.	.	..	..	..	..	..	..	..
4	Himachal Pradesh	.	.	.	.	.	..	..	..	..	..	..	..
5	Manipur	.	.	.	.	.	..	..	..	..	..	..	..
6	N.E.F.A.
7	Pondicherry	1	1	2	1	..	1	..
8	Tripura	3	..	3	2

TOTAL TERRITORIES	4	1	5	82	34	116	4	..
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GRAND TOTAL	5,000	43,000	7,000	50,000	660	248
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*Includes figure for Maharashtra also.

ANNEXURE II

Statement showing net and Gross Irrigated Area from Minor and Major—Medium Irrigation Works during 1950-51.

('000 acres)

Serial No.	Name of State/Union Territory	Net area irrigated						Gross area irrigated		
		Major Medium Irrigation Works (Govt. Canals.)	Minor Irrigation Works				Total	Major Medium Irrigation Works	Minor Irrigation works	
			Private canals	Tanks	Wells	Other sources			Ground-water	Surface-water
1	2	3	4	5	6	7	8	9	10	11
1	Andhra Pradesh	2,906	59	1,851	706	205	2,821	3,142	764	2,288
2	Assam	150	641	..	..	548	1,189	150	..	1,189
3	Bihar	997	640	698	639	2,162	4,139	997	639	3,500
4	Bombay	462	62	505	1,697	119	2,383	500	1,838	744
	(i) Gujarat									
	(ii) Maharashtra									
5	Jammu & Kashmir	93	510	8	8	25	551	94	8	549
6	Kerala	321	68	82	26	247	423	342	28	424
7	Madhya Pradesh	877	..	581	605	140	1,326	898	615	734
8	Madras	1,923	5	1,373	1,008	167	2,553	2,352	1,233	1,891
9	Mysore	346	16	716	303	135	1,170	348	305	872
10	Orissa	358	72	1,365	118	604	2,159	361	120	2,062

11 Punjab	3,785	268	8	2,291	51	2,618	4,390	2,658	375
12 Rajasthan	835	5	77	1,849	177	2,108	922	2,043	286
13 Uttar Pradesh	4,547	37	14	5,391	1,970	7,412	4,903	5,814	2,179
14 West Bengal	259	431	1,494	36	685	2,646	263	37	2,652
TOTAL STATES	17,859	2,814	8,772	14,677	7,235	33,498	19,662	16,102	19,749
1 Andman Islands	..	..	..	..	..	..	..	..	..
2 Delhi	39	..	4	35	..	39	39	35	4
3 Himachal Pradesh	..	..	..	(A)	94	94	..	..	164
4 Laccadive Islands	..	..	..	..	..	..	..	..	..
5 Manipur	..	..	..	..	..	..	..	..	..
6 Tripura	..	..	..	..	..	..	..	..	..
TOTAL TERRITORIES	39	..	4	35	94	133	39	35	168
GRAND TOTAL	17,898	2,814	8,776	14,712	7,329	33,631	19,701	16,137	19,917

'A' Less than 500 acres.

ANNEXURE III

Statement showing net and Gross Irrigated Area from Minor and Major—Medium Irrigation Works during 1960-61

('000 acres)

Serial No.	Name of State/Union Territories	Net area irrigated						Gross area irrigated			
		Major—Medium Irrigation Works (Govt. Canals)	Minor irrigation works				Total Irrigation	Minor Irrigation works			
			Private canals	Tanks	Wells	Other sources		Major—Medium Irrigation Works	Ground water	Surface Water	
I	2	3	4	5	6	7	8	9	10	11	
1	Andhra Pradesh	3,260	30	2,844	810	244	3,928	3,890	967	3,723	
2	Assam	178	721	..	..	634	1,355	178	..	1,355
3	Bihar	1,323	285	799	646	2,042	3,772	1,323	646	3,126	
4	Gujarat	161	2	32	1,403	90	1,527	173	1,507	133	
5	Jammu & Kashmir	153	480	..	12	32	524	172	13	577	
6	Kerala	377	73	79	35	315	502	544	50	674	
7	Madhya Pradesh	1,083	5	302	802	90	1,199	1,100	815	404	
8	Madras	2,175	4	2,314	1,478	114	3,910	2,858	1,942	3,195	
9	Maharashtra	526	75	476	1,471	102	2,124	598	1,673	743	
10	Mayore	570	13	849	328	360	1,550	649	373	1,391	
11	Orissa	487	69	1,223	94	541	1,927	569	110	2,141	

12	Punjab	4,945	124	8	2,462	109	2,703	6,205	3,090	305
13	Rajasthan	1,321	..	409	2,507	91	3,007	1,321	2,507	500
14	Uttar Pradesh	4,920	24	1,036	5,898	661	7,619	5,364	6,430	1,867
15	West Bengal	966	956	910	39	468	2,373	977	39	2,363
TOTAL STATES		22,445	2,861	11,281	17,985	5,893	38,020	25,921	20,162	22,497
1	Andaman Islands	..	..	..	..	..	..	..	..	..
2	Delhi	33	..	6	45	..	51	33	45	6
3	Himachal Pradesh	..	..	..	..	95	95	..	..	166
4	Laccadive Islands	..	..	..	..	..	..	..	..	..
5	Manipur	..	168	..	..	..	168	..	..	168
6	Tripura	..	..	1	..	28	29	..	..	29
TOTAL TERRITORIES		33	168	7	45	123	343	33	45	369
GRAND TOTAL		22,478	3,029	11,288	18,030	6,016	38,363	25,954	20,207	22,866

ANNEXURE IV

Statement showing State-wise Physical Achievement under different categories of benefits from minor Irrigation Programme during First Five Year Plan.
(’000 acres)

Serial No.	Name of State	New area brought under irrigation.		Old irrigated area over which irrigation is stabilised or restored	Benefits in the form of submerging land or recharging ground water	Benefits by way of drainage flood control or anti-sea water intrusion works	Total
		Ground water schemes	Surface Water schemes				
1	2	3	4	5	6	7	8
1	Andhra Pradesh	25·00	75·00	75·00	..	..	175·00
2	Assam	..	90·00	85·00	..	950·00	1,125·00
3	Bihar	400·00	425·00	325·00	800·00	50·00	2,000·00
4	Bombay	100·00	175·00	75·00	..	50·00	400·00
5	Madhya Pradesh	55·00	45·00	10·00	..	..	110·00
6	Madras	200·00	135·00	250·00	..	..	585·00
7	Orissa	..	220·00	20·00	..	..	240·00
8	Punjab	280·00	180·00	90·00	..	300·00	850·00
9	Uttar Pradesh	620·00	250·00	130·00	200·00	100·00	1,300·00
10	West Bengal	..	215·00	85·00	..	1,000·00	1,300·00
11	Hyderabad	75·00	100·00	100·00	..	..	275·00
12	Madhya Bharat	50·00	30·00	5·00	..	..	85·00
13	Mysore	20·00	100·00	170·00	..	..	290·00

14	Pepsu	.	.	.	.	.	.	140.00	20.00	..	..	..	160.00
15	Rajasthan	.	.	.	.	.	.	100.00	20.00	..	..	..	120.00
16	Saurashtra	.	.	.	.	.	.	100.00	80.00	..	..	20.00	200.00
17	Trav-Cochin	.	.	.	.	.	.	..	75.00	75.00	..	30.00	180.00
18	Jammu & Kashmir	.	.	.	.	.	.	..	..	..	..	..	..
19	Ajmer	.	.	.	.	.	.	3.00	1.00	..	..	..	4.00
20	Bhopal	.	.	.	.	.	.	6.00	54.00	..	..	..	60.00
21	Coorg	.	.	.	.	.	.	..	3.00	3.00	..	..	6.00
22	Delhi	.	.	.	.	.	.	16.00	..	..	..	..	16.00
23	Himachal Pradesh	.	.	.	.	.	.	..	1.00	2.00	..	..	3.00
24	Kutch	.	.	.	.	.	.	9.00	3.00	..	..	..	12.00
25	Vindhya Pradesh	.	.	.	.	.	.	1.00	3.00	..	..	..	4.00
TOTAL STATES								2,200.00	2,300.00	1,500.00	1,000.00	2,500.00	9,500.00

ANNEXURE V

Statement showing State-wise Physical achievement under different Categories of benefits from minor Irrigation Programme during Second Five Year Plan
(⁰⁰⁰ acres)

Serial No.	Name of State	New area brought under irrigation		Old irrigated area over which irrigation is stabilised or restored	Benefits in the form of submerging land or recharging groundwater	Benefits by way of drainage, flood control or anti-sea water intrusion works	Total
		Ground water schemes	Surface water schemes				
1	2	3	4	5	6	7	8
1	Andhra Pradesh	60·00	140·00	300·00	..	..	500·00
2	Assam	..	50·00	100·00	..	650·00	800·00
3	Bihar	375·00	375·00	500·00	550·00	200·00	2000·00
4	Bombay	380·00	270·00	100·00	..	..	750·00
5	Jammu & Kashmir	..	25·00	50·00	..	..	75·00
6	Kerala	..	65·00	80·00	..	30·00	175·00
7	Madhya Pradesh	170·00	380·00	50·00	..	..	600·00
8	Madras	50·00	50·00	175·00	..	..	275·00
9	Mysore	35·00	30·00	85·00	..	..	150·00
10	Orissa	..	120·00	30·00	..	..	150·00
11	Punjab	470·00	8·00	2·00	..	20·00	500·00
12	Rajasthan	160·00	300·00	40·00	..	..	500·00
13	Uttar Pradesh	1,290·00	280·00	230·00	150·00	150·00	2,100·00
14	West Bengal	2·00	100·00	48·00	..	250·00	400·00
TOTAL STATES		2,992·00	2,193·00	1,790·00	700·00	1,300·00	8,975·00
TOTAL Union Territories		8·00	7·00	10·00	..	..	25·00
GRAND TOTAL		3,000·00	2,200·00	1,800·00	700·00	1,300·00	9,000·00

ANNEXURE VI

Statement showing State-wise Targets for Minor Irrigation Programme (under G.M.F.) during Third Five Year Plan.

Serial No.	Name of State	Target as per printed 3rd Five Year Plan ('000 acres)	Financial provision corresponding to the target of 9.5 million acres.			Total (Rs. in lakhs)	Target if additional provision is not accounted for ('000 acres)
			Provisions as per printed 3rd Five Year Plan (Rs. in lakhs)	Provisions available from Coop. Sector (Rs. in lakhs)	Additional provision (Rs. in lakhs).		
1	2	3	4	5	6	7	8
1	Andhra Pradesh	1,177	1,826	..	1,000	2,826	606
2	Assam	220	390	..	..	390	220
3	Bihar	564	839	..	..	839	564
4	Gujarat	1,050	1,500	1,500	100	3,100	960
5	Jammu & Kashmir	29	125	..	..	125	29
6	Kerala	192	572	..	..	572	192
7	Madhya Pradesh	536	1,500	..	..	1,500	536
8	Madras	524	1,280	..	..	1,280	524
9	Maharashtra	1,136	1,579	1,600	..	3,179	1,136
10	Mysore	142	1,600	..	..	1,600	142
11	Orissa	120	304	..	..	304	120
12	Punjab	763	752	200	..	952	763
13	Rajasthan	339	670	..	..	670	339
14	Uttar Pradesh	1,812	3,300	..	..	3,300	1,812
15	West Bengal	812	1,032	..	2,784	3,816	400
TOTAL STATES		9,416	17,269	3,300	3,884	24,453	8,343
TOTAL UNION TERRITORIES		62	177	..	..	177	62
TOTAL		9,478	17,446	3,300	3,884	24,630	8,405
Centrally sponsored & Category 'A' Schemes		..	230	..	..	230	..
GRAND TOTAL		9,478	17,676	3,300	3,884	24,860	8,405

ANNEXURE VII

Statement showing State-wise and Year-wise Financial Progress (Projected) on Minor Irrigation under G.M.F. during Third Five Year Plan.

(Rs. in lakhs)

Serial No.	Name of State/Union Territory	Outlay incurred			Likely outlay 1964-65	Projected Out-lay 1965-66	Likely total outlay during the Third Five year Plan
		Actual 1961-62	Actual 1962-63	Anticipated 1963-64			
1	2	3	4	5	6	7	8
1	Andhra Pradesh	223·89	458·37	700·00	763·99	810·00	2,956·25
2	Assam	46·20	63·69	99·17	127·50	140·00	476·56
3	Bihar	140·84	136·83	289·00	380·00	410·00	1,356·67
4	Gujarat	208·06	162·70	269·46	348·75	475·00	1,463·97
5	Jammu & Kashmir	22·34	30·68	25·00	40·00	40·00	158·02
6	Kerala	78·23	98·18	127·36	145·00	165·00	613·77
7	Madhya Pradesh	191·92	317·05	390·00	440·00	610·00	1,948·97
8	Madras	297·84	355·36	440·53	370·00	380·00	1,843·73
9	Maharashtra	191·74	196·36	492·10	495·00	700·00	2,075·20
10	Mysore	431·20	591·99	700·00	700·00	910·00	3,333·19
11	Nagaland	N.A.	N.A.	N.A.	N.A.	N.A.	8·75
12	Orissa	62·08	64·66	112·52	145·00	185·00	569·26
13	Punjab	109·02	101·14	112·24	260·00	340·00	922·40

14	Rajasthan	109·71	160·00	214·98	245·00	265·00	994·69
15	Uttar Pradesh	774·485	827·903	771·48	1,090·00	1,120·00	4,583·868
16	West Bengal	91·44	138·16	300·00	400·00	420·00	1,349·60
TOTAL STATES		2,978·995	3,703·073	5,043·84	5,950·24	6,970·00	24,654·898
1	Andamans	..	..	..	..	..	..
2	Delhi	4·115	5·549	10·20	12·046	15·00	46·91
3	Goa	..	2·20	5·49	13·44	14·00	35·13
4	Himachal Pradesh	11·21	8·88	11·60	14·61	24·00	70·30
5	Manipur	1·34	0·78	1·87	3·21	9·00	16·20
6	N.E.F.A.	0·12	0·13	0·01	0·74	1·50	2·50
7	Pondicherry	0·85	1·92	1·19	3·76	4·50	12·22
8	Tripura	3·795	5·70	3·96	9·545	12·00	35·00
TOTAL TERRITORIES		21·43	25·159	34·32	57·351	80·00	218·26
GRAND TOTAL		3,000·425	3,728·232	5,078·16	6,007·591	7,050·00	24,873·158

ANNEXURE VIII

*Statement showing State-wise and Year-wise Physical Progress (Projected) on Minor Irrigation under G.M.F. during Third Five Year Pl
(‘000 acres)*

Serial No.	Name of State/Union Territory	Anticipated achievement during 1961-64 (3 years)	Projected achievement during remaining 2 years		Likely total achievement during the Third five Year Plan	Remarks]
			1964-65	1965-66		
1	2	3	4	5	6	7
1	Andhra Pradesh	438·95	223·55	266·00	928·50	
2	Assam	149·30	83·33	94·00	326·63	
3	Bihar	397·70	202·14	203·00	802·84	
4	Gujarat	474·20	232·10	289·20	995·50	
5	Jammu & Kashmir	13·90	7·20	6·70	27·80	
6	Kerala	90·94	41·75	46·15	178·84	
7	Madhya Pradesh	218·33	103·20	137·00	458·53	
8	Madras	300·16	100·00	100·00	500·16	
9	Maharashtra	461·35	247·15	342·00	1,050·50	
10	Mysore	144·46	120·20	146·00	410·66	
11	Nagaland	N.A.	N.A.	N.A.	2·50	
12	Orissa	84·07	48·00	58·00	190·07	
13	Punjab	329·72	260·00	330·00	919·72	

14	Rajasthan	.	.	.	.	.	177.77	87.00	90.00	354.77
15	Uttar Pradesh	.	.	.	.	.	1601.52	670.70	659.00	2931.22
16	West Bengal	.	.	.	.	.	134.50	90.00	94.00	318.50
TOTAL STATES							5016.87	2516.32	2861.05	10396.74

1	Andamans	.	.	.	.	.	..	..	..	..
2	Delhi	.	.	.	.	.	6.694	4.90	6.100	17.694
3	Goa	.	.	.	.	.	1.79	3.40	3.60	8.790
4	Himachal Pradesh	.	.	.	.	.	7.00	4.50	7.00	18.500
5	Manipur	.	.	.	.	.	2.70	3.00	6.70	12.400
6	N.E.F.A.	.	.	.	.	.	0.12	0.34	0.54	1.000
7	Pondicherry	.	.	.	.	.	1.89	1.30	1.60	4.790
8	Tripura	.	.	.	.	.	4.88	3.50	4.50	12.880
TOTAL TERRITORIES							25.074	20.94	30.04	76.054

GRAND TOTAL							5041.944	2537.26	2891.09	10472.794
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ANNEXURE IX-1

Statement-wise anticipated progress on well schemes during Third Five Year Plan

Acreage:—'000 acres, Financial Rs. in lakhs

Sl. No.	Name of State/ Union Territory	Construction of new wells			Restoration of old wells			Boring of wells			Deepening of wells			Remarks
		Unit	Acreage	Financial	Unit	Acreage	Financial	Unit	Acreage	Financial	Unit	Acreage	Financial	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Andhra Pradesh	62,000	124.00	744.00	..	..	..	200	1.00	6.00	5,000	10.00	25.00	
2	Assam	..	..	..	..	..	..	..	..	..	..	..	..
3	Bihar	15,500	62.00	162.75	2,000	2.00	8.00	1,600*	24.00	72.00	..	..	..
								16,182%	48.55	72.82				
4	Gujarat	40,000	240.00	210.80@	8,000	16.00	2.40@	4,000	..	42.85	7,000	..	19.70	
5	Jammu & Kashmir	..	..	..	..	..	..	..	..	..	..	..	..
6	Kerala	..	..	..	..	..	..	..	..	..	..	..	..
7	Madhya Pradesh	21,750	65.25	435.00	19,000	28.50	57.00	130	0.65	3.25	7,549	15.10	30.20	
8	Madras	24,600	24.60	442.80	..	..	..	..	..	..	..	..	..
9	Maharashtra	65,000	325.00	400.00@	15,000	30.00	14.00@	1,400	..	5.46	45,000	..	77.95	
10	Mysore	26,700	53.40	801.00	..	..	..	1,000	3.00	30.00	..	..	..
11	Nagaland	..	..	..	..	..	..	..	..	..	..	..	..
12	Orissa	..	..	..	..	..	..	..	..	..	..	..	..
13	Punjab	24,750	247.50	322.00@	..	..	..	..	..	..	..	..	..

14	Rajasthan	12,000	48.00	180.00	..	..	..	..	..	..	35,000	35.00	35.00
15	Uttar Pradesh	140,000	700.00	1400.00@	5,400	16.20	27.00@	101,000	303.00	150.00	..	..	..
16	West Bengal	..	..	..	..	..	..	..	..	..	..	..	..
TOTAL STATES		432,300	1889.75	5098.35	49,400	92.70	108.40	125,512	380.20	382.38	99,549	60.10	187.85
1	Andamans	..	..	..	..	..	..	..	..	..	..	..	..
2	Delhi	650	1.95	11.70	..	..	..	150	0.30	0.75	..	..	..
3	Goa	140	0.42	3.50	..	..	..	25	0.125	0.50	..	..	..
4	Himachal Pradesh	..	..	..	..	..	..	..	..	..	..	..	..
5	Manipur	..	..	..	..	..	..	..	..	..	..	..	..
6	N.E.F.A.	..	..	..	..	..	..	..	..	..	..	..	..
7	Pondicherry	..	..	..	..	..	..	..	..	..	..	..	..
8	Tripura	..	..	..	..	..	..	..	..	..	..	..	..
TOTAL TERRITORIES		790	2.37	15.20	..	..	..	175	0.425	1.25	..	..	..
GRAND TOTAL		433,090	1892.12	5113.55	49,400	92.70	108.40	125,687	380.625	383.63	99,549	60.10	187.85

*With strainer.

% Without strainer.

@ Excluding finances which are made available for these schemes from the Cooperative Sector.

Statewise anticipated progress on Tubewell schemes

Sl. No.	Name of State/ Union Territory	State Tubewells			Cooperative tubewells			
		Unit	Acreage	Financial	Unit	Acreage	Financial	Unit
1	2	3	4	5	6	7	8	9
1	Andhra Pradesh .	25	2.50	15.00	..	..	..	..
2	Assam .	20	3.00	15.00	..	..	..	..
3	Bihar .	..	2.30	8.64	220	22.00	100.00	450
4	Gujarat .	500	125.00	375.00	..	..	..	..
5	Jammu & Kashmir	..	..	..	..	..	..	..
6	Kerala .	..	..	..	..	..	..	..
7	Madhya Pradesh .	57	14.25	34.20	..	..	..	..
8	Madras .	..	..	6.25	..	..	..	2,700
9	Maharashtra .	..	..	..	..	..	..	..
10	Mysore .	..	..	..	..	..	..	..
11	Nagaland .	..	..	..	..	..	..	..
12	Orissa .	30	6.00	22.50	..	..	..	40
13	Punjab .	32	183.00	69.00	..	..	..	6,430
14	Rajasthan .	70	14.00	63.00	..	..	..	120
15	Uttar Pradesh .	1500	846.75	1500.00	..	..	..	2,000
16	West Bengal .	500	100.00	820.00	..	..	..	150
TOTAL STATES .		2734	1296.80	2928.59	220	22.00	100.00	11,890
1	Andamans .	..	..	..	..	..	..	..
2	Delhi .	25	7.50	15.00	..	..	..	35
3	Goa .	..	..	..	..	..	..	..
4	Himachal Pradesh	..	..	..	..	..	..	..
5	Manipur .	..	..	..	..	..	..	..
6	N.E.F.A. .	..	..	..	..	..	..	..
7	Pondicherry .	..	..	..	..	..	..	..
8	Tripura .	3	0.45	1.62	..	..	..	..
TOTAL TERRITORIES		28	7.95	16.62	..	..	..	35
GRAND TOTAL .		2762	1304.75	2945.21	220	22.00	100.00	11925

*excluding finances which are made available for these

IX-2
during third Five Year Plan

Acreage:—'000 acres
Financial:— Rs. in lakhs,

Private tubewells			Filterpoint tubewells			Artesian tubewells			Remarks
Acreage	Financial	Unit	Acreage	Financial	Unit	Acreage	Financial		
10	11	12	13	14	15	16	17	18	
..	..	..	..	..	265	5.30	13.25	
..		
22.50	54.00	..	..	..	..	..	..
..		
..		
..		
54.00	67.50	193	21.93	37.28	150	7.50	10.50		
..		
..		
..		
1.60	4.00	100	1.00	3.00	..	..	..
321.50	310.00*	..	..	..	..	..	..
12.00	24.00	..	..	..	..	..	..
100.00	150.00*	..	..	..	..	..	..
6.00	15.00	..	..	..	..	..	..
517.60	624.50	2293	22.93	40.28	415	12.80	23.75		
..		
1.75	3.50	..	..	..	..	..	..
..		
..		
..		
..		
..	..	50	0.40	1.50	..	..	..
..		
1.75	3.50	50	0.40	1.50	..	..	..
519.35	628.00	2343	23.33	41.78	415	12.80	23.75		

*schemes from the Cooperative Sector.

ANNEXURE IX-3

Statewise anticipated progress on water lifting appliances schemes during Third Five Year Plan

Acreage '000 acres
Financial Rs. in lakhs.

Sl. No.	Name of State/ Union Territory	Electric motor pumpsets			Diesel engine pumpsets			Persian Wheels			Remark
		Unit	Acreage	Financial	Unit	Acreage	Financial	Unit	Acreage	Fi nancial	
1	2	3	4	5	6	7	8	9	10	11	12
1	Andhra Pradesh	1,400	8.40	21.00	2,000	12.00	60.00	..	..	..
2	Assam ]	..	..	..	1,300	32.50	65.00	..	..	..
3	Bihar	2,150	17.20	43.00	1,650	12.20	49.50	2,600	5.20	13.00	
4	Gujarat |	7,000	84.00	28.00*	18,000	270.00	108.00*	13,000	26.00	2.22*	
5	Jammu & Kashmir	..	..	..	..	..	..	..	..	..
6	Kerala	..	..	..	795	11.93	35.77	..	..	..
7	Madhya Pradesh	6,480	32.40	97.92	4,250	21.50	127.50	4,480	13.44	33.60	
8	Madras	7,500	37.50	90.00	1,500	9.00	37.50	..	..	..
9	Maharashtra	14,500	174.00	60.00*	14,550	174.60	83.30*	..	..	..
10	Mysore	12,000	36.00	240.00 450.00@	12,500	37.50	375.00	..	..	..
11	Nagaland	..	..	..	..	..	..	..	..	..
12	Orissa	..	..	..	..	..	..	..	..	..
13	Punjab	6,800	69.00	69.00*	6,445	64.45	74.00*	..	..	..

14	Rajasthan	10,000	30.00	100.00	2,690	8.07	40.35	2,500	2.50	11.25
15	Uttar Pradesh	4,750	114.00	95.00*	9,200	220.80	230.00*	37,500	150.00	150.00*
16	West Bengal	..	..	..	1,200	12.00	36.00	..	..	..
TOTAL STATES		72,580	602.50	1293.92	76,080	886.55	1321.92	60,080	197.14	210.07
1	Andamans	..	..	..	..	..	..	..	..	..
2	Delhi	46	0.230	0.920	41	0.164	1.64	100	0.10	0.50
3	Goa	335	1.675	6.03	165	1.320	6.60	..	..	..
4	Himachal Pradesh	..	..	..	..	..	..	..	..	..
5	Manipur	..	..	..	..	..	..	..	..	..
6	N.E.F.A.	..	..	..	..	..	..	..	..	..
7	Pondicherry	..	..	..	20	0.160	0.72	..	..	..
8	Tripura	..	..	..	..	..	..	..	..	..
TOTAL UNION TERRITORIES		381	1.905	6.95	226	1.644	8.96	100	0.10	0.50
GRAND TOTAL		72,961	604.405	1300.87	76,306	888.194	1330.88	60,180	197.24	210.57

@Outlay on extension of power lines.

*excluding finances which are made available for these schemes from the Cooperative Sector.

ANNEXURE IX-4

Statewise anticipated progress on surface water schemes during Third Five Year Plan

Acreage '000 acres
Financial Rs. in lakhs

Serial No.	Name of State/Union Territory	Construction & repair of tanks, reservoirs, kuhls, dongs, anicuts, weirs, pynes & channels		Surface water lift irrigation schemes.		Ahars, bundhies, rapats, percolation tanks, head-water tanks, drainage, embankment and flood protection and anti-sea water intrusion works		Remarks
		Acreage	Financial	Acreage	Financial	Acreage	Financial	
1	2	3	4	5	6	7	8	9
1	Andhra Pradesh	660.50	1920.00	4.80	12.00	100.00	140.00	
2	Assam	108.33	250.00	..	..	182.80	146.56	
3	Bihar	198.75	425.00	1.14	2.96	385.00	345.00	
4	Gujarat	212.00	630.00	10.00	25.00	12.50	20.00	
5	Jammu & Kashmir	25.48	148.75	2.32	9.27	..	..
6	Kerala	76.66	230.00	32.75	95.00	57.50	253.00	
7	Madhya Pradesh	260.52	1113.00	6.92	17.30	..	..
8	Madras	344.87	1150.00	0.76	1.90	..	..
9	Maharashtra	235.45	1225.00	62.00	155.00	49.45	54.49	
10	Mysore	248.70	1345.00	..	..	32.06	92.19	

11	Nagaland	2.50	8.75	..	..	..	..
12	Orissa	133.47	419.76	48.00	120.00	..	..
13	Punjab	19.57	52.33	4.00	10.00	10.70	16.07
14	Rajasthan	145.20	451.09	..	..	60.00	90.00
15	Uttar Pradesh	140.47	561.868	..	..	340.00	320.00
16	West Bengal	56.00	118.00	100.00	300.00	44.50	60.60
TOTAL STATES		2868.47	10048.548	272.69	748.43	1274.51	1537.91
1	Andamans	..	..	..	..	..	..
2	Delhi	..	..	3.00	7.50	2.70	5.40
3	Goa	5.25	18.50	..	..	..	..
4	Himachal Pradesh	18.50	70.30	..	..	..	..
5	Manipur	3.65	9.20	..	..	8.75	7.00
6	N.E.F.A.	1.00	2.50	..	..	..	..
7	Pondicherry	2.23	7.00	..	..	2.00	3.00
8	Tripura	3.45	17.25	0.30	0.90	8.68	15.23
TOTAL UNION TERRITORIES		34.08	124.75	3.30	8.40	22.13	30.63
GRAND TOTAL		2902.55	10173.298	275.99	756.83	1296.64	1568.54

ANNEXURE X

Statement showing Plan-wise development of Irrigation from Major-Medium Schemes

('000 acres)

Serial No.	Name of State	During 1st Plan		Second Five Year Plan				Third Five Year Plan			
		Potential	Utilisation	At the end of the Plan—progressive total		During the Plan		At the end of the Plan—Progressive total (Projected)		During the Third Five Year Plan	
				Potential	Utilisation	Potential	Utilisation	Potential	Utilisation	Potential	Utilisation
		3	4	5	6	7	8	9	10	11	12
1	Andhra Pradesh	191	146	637	464	446	318	1,850	1,344	1,213	880
2	Assam	..	..	..	..	..	..	7	5	7	
3	Bihar	308	219	966	658	658	439	2,961	1,771	1,995	1,113
4	Gujarat	157*	62*	616	164	459	102	1,601	824	985	660
5	Jammu & Kashmir	5	4	11	5	6	1	50	25	39	20
6	Kerala	239	151	350	350	120	199	612	612	262	262
7	Madhya Pradesh	10	10	83	61	73	51	1,041	530	958	469
8	Madras	299	254	618	563	319	309	736	711	118	148
9	Maharashtra	@	@	173	95	173	95	688	449	515	354

10	Mysore	. . .	119	53	544	293	425	240	1,358	1,175	814	882
11	Orissa	. . .	..	..	900	696	900	696	1,755	1,516	855	820
12	Punjab	. . .	3,058	1,423	3,307	2,348	249	925	4,152	4,000	845	1,652
13	Rajasthan	. . .	487	203	560	414	73	211	1,657	1,384	1,097	970
14	Uttar Pradesh	. . .	1,210	319	1,836	1,446	626	1,127	2,834	2,406	998	960
15	West Bengal	. . .	394	216	1,487	1,036	1,093	820	1,858	1,846	371	810
TOTAL STATES			6,468	3,060	12,088	8,593	5,620	5,533	23,160	18,598	11,072	10,005

*Includes figures for Maharashtra.

@Included in the figures for Gujarat.

ANNEXURE XI

Statement showing progress of financial outlay on drainage, flood control and anti-sea water intrusion programme under the major-medium sector

(Rs. in lakhs)

Serial No.	Name of State	During the 1st Five Year Plan	During the 2nd Five Year Plan	Third Five Year Plan Target				Anticipated achievement for combined schemes
				Surface drainage	Anti-water logging	Flood protection & anti-sea water intrusion works	Total	
1	2	3	4	5	6	7	8	9
1.	Andhra Pradesh	0.23	145.57	..	..	243.00	243.00	172.93
2.	Assam	288.47	422.55	109.35	..	390.65	500.00	1,153.28
3.	Bihar	211.99	829.57	10.00	..	890.00	900.00	900.00
4.	Gujarat	..	39.27*	23.80	..	26.20	50.00	50.00
5.	Jammu & Kashmir	45.03	199.10	..	..	900.00	900.00	850.00
6.	Kerala	..	43.38	..	..	421.00	421.00	562.35
7.	Madhya Pradesh	0.50	3.47	..	..	20.00	20.00	12.09
8.	Madras	No Flood Control allocation						
9.	Maharashtra	..	..	..	..	30.00	30.00	30.00
10.	Mysore	..	0.80	..	..	..	..	..
11.	Orissa	15.80	193.50	100.00	..	150.00	250.00	250.00
12.	Punjab	11.33	506.00	1,029.83	293.00	178.17	1,501.00	2,658.08

13. Rajasthan . . . . .	..	7.60	70.00	..	20.00	90.00	417.34
14. Uttar Pradesh	275.89	799.19	125.45	..	449.75	575.20	687.91
15. West Bengal	163.60	228.55	102.00	47.62	365.38	515.00	477.48
TOTAL STATES	1,012.84	3,418.55	1,570.43	340.62	4,084.15	5,995.20	87,221.46
1. Delhi . . . . .	..	..	..	..	110.20	110.20	220.01
2. Himachal Pradesh	No Flood Control Scheme						
3. Manipur . . . . .	..	..	..	..	11.79	11.79	9.26
4. Tripura . . . . .	..	..	..	..	10.00	10.00	27.81
TOTAL UNION TERRITORIES	4.86@	93.91@	..	..	131.99	131.99	257.08
1. Kosi (Flood Control portion only)	268.91	1,124.44	..	..	..	..	..
2. C. W. & P.C. . . . .	..	..	..	..	5.01	5.01	32.88
3. Investigation by Control Agencies	56.00	109.20	..	..	..	..	..
TOTAL	325.41	1,233.64	..	..	5.01	5.01	32.88
GRAND TOTAL	1,343.11	4,746.10	1,570.43	340.62	4,221.15	6,132.20	8,511.42

*Includes Maharashtra.

@ Break-up not available. Represents total for Union Territories.

CHAPTER V

PROSPECTS FOR FURTHER DEVELOPMENT

5.01. End use of irrigation whether major, medium or minor is increased agricultural production in which irrigation plays a pivotal role. To develop water resources on scientific lines and at minimum cost, for this purpose, it is essential that major, medium and minor irrigation schemes should be taken up in an integrated manner. The long-term development of minor irrigation should, therefore, be viewed in relation to (a) anticipated needs for increased agricultural production; and (b) possibilities of taking up major-medium irrigation schemes.

5.02. The present trends of population growth, continued shortage of foodgrains, mounting needs of the developing industry for agricultural raw materials and increasing needs of producing agricultural commodities which earn foreign exchange, indicate that the efforts to increase agricultural production are not likely to cease or even slacken for yet a number of years to come; and so long as the country needs progressively to raise its production potential for internal consumption or export, it is most likely that emphasis on irrigation will continue unabated.

5.03. In view of the above, the long-term development of minor irrigation in relation to major-medium irrigation would be mostly dependent on the land and water resources available for development. A brief appraisal of these resources is made in the following paragraphs:—

Land Resources

5.04. India has a geographical area of about 806 million acres of which land utilisation statistics are available only for 739 million acres. According to the agricultural statistics for the year 1960-61, an area of 328 million acres was under cultivation (net area sown). The gross area sown was 376 million acres. The broad pattern of land utilisation as obtaining during 1960-61, for the reporting area of 739 million acres is as under:—

	<i>Million acres</i>
(1) Total reporting area ..	739
(2) Forests ..	139
(3) Land under miscellaneous trees, crops and groves ..	13
(4) Permanent pastures and other grazing lands ..	36
(5) Culturable waste ..	47
(6) Barren and uncultivated land and land put to non-agricultural use ..	120
(7) Fallow lands other than current fallows ..	28
(8) Current fallows ..	28
(9) Net area sown ..	328
(10) Area sown more than once ..	48
(11) Gross area sown ..	376

5.05. The above pattern shows that there may be further scope for extending the area under cultivation by reclamation of existing area, particularly from categories 5 and 7 above. The present thinking on the subject, however, while admitting this scope suggests that about 10 million acres might be the upper limit of the additional area that might become available for arable farming out of the existing culturable waste and old fallows, during the period of about 15 years beyond 1960-61. This view apparently has neither been contradicted by the Wastelands Survey & Reclamation Committee nor by the study of Wastelands of India including saline and alkaline water logged lands. Taking a long-term view beyond a period of 15 years, the ultimate net area sown may be taken around 350 million acres.

5.06. With regard to the gross area sown, it is felt that with the extension of irrigation, it should be possible to achieve a greater intensity of cultivation and the gross cropped area may go up substantially, even by about 50 million acres during the period 1961—76. With greater emphasis on intensive cropping patterns consequent on introduction of irrigation it may perhaps not be very optimistic to reckon that the gross area sown would ultimately reach a figure around 450 million acres.

5.07. Against the above potential of cultivable area, net and gross, the area that actually received irrigation during 1960-61 was 60.2 million (net) acres and 68.9 million (crop) acres. The percentage of the net area irrigated to the net area sown as also that of the gross area irrigated to the gross area sown works out to 18.3.

5.08. It would thus appear from above that as far as the land resources are concerned, there is ample scope for further development of irrigation. Even if a 50 per cent intensity or irrigation on the gross area sown ultimately *i.e.* 450 million acres is aimed at, we have yet to all the way from 68.9 million acres in 1960-61 to 225 million acres (50 per cent of 450 million acres).

Water Resources

5.09. Water resources may be divided broadly into surface water and groundwater, although essentially both the resources are intimately inter-related.

(i) Surface Water Resources

5.10. It has not yet been possible to make any precise assessment of the country's surface water resources due to lack of reliable data over a sufficiently long period. In the absence of actually observed data, an appraisal of the over-all surface water resources in India was made in 1949 by Dr. A. N. Khosla. He evolved, for the purpose, an empirical formula based on his concept that annual or seasonal run-off is the residual of rainfall after deduction of evaporation and transpiration losses and that the mean temperature is a complete measure of all the various factors affecting the evaporation and transpiration losses. The shape of the catchment, the slope and the vegetal cover would have an effect on the seasonal distribution of run-off, but not on the aggregate run-off. Dividing the country into six broad regions, Dr. Khosla calculated from his formula an aggregate annual yield of 1,356 million acre feet from the river catchments in India.

5.11. It is computed that the annual precipitation over the entire country represents about 3,000 million acre feet of water. As only 1,356 million acre feet are estimated to flow in the river systems, the rest 1,644 million acre feet is the loss due to evaporation and transpiration, assuming that whatever portion of the precipitation soaks into the ground ultimately re-appears as re-generation flow in the rivers. The latter contention is more or less true, unless there is some abnormal rise or fall in the water table, in some regions or there are some leakages from one catchment to another.

5.12. The above figure of 1,356 million acre feet does not take into account the return flow that may be expected in the form of re-generation or otherwise, of part of the water used for irrigation and other purposes. The return flow from the irrigation may amount to as much as 30 to 60 per cent of the irrigation water supplied at the source. The re-generated water can be used again on the projects located downstream. Thus the total resources of surface water actually available may be substantially more.

5.13. All the above water, however, cannot be put to beneficial use. The use of the available water resources is dependent on many factors even though there is cultivable area in the vicinity which needs irrigation. In the first instance, the topography should be suitable for diversion and conveyance of water to the land to be irrigated. Secondly, the river on the stream should have enough water during the period when it is required for the crops. Alternatively, the local geological and topographical features should offer possibility for construction of storage work. It happens at many a location that there is plenty of water in the rivers on the streams, but the local conditions, outlined above, are not conducive to its use.

5.14. In the printed report of the Third Five Year Plan and more recently in the Planning Commission's publication "Natural Resources of India", it has been estimated that 450 million acre feet out of the total available surface water resources can be utilised for purposes of irrigation. The basis of this estimate has not been given. It follows from this estimate that if, on an average, the over-all depth of water utilisation is reckoned as 2 feet, the area ultimately brought under irrigation from surface water resources would be of the order of 225 million acres. The long-term target set for major-medium irrigation is only 110 million acres. As discussed later, the long-term development on minor irrigation from surface water schemes may not exceed 30 million acres. It would thus follow that either the target set for major-medium irrigation is modest or the estimate of 450 million acre feet for utilisable water resources is on higher side.

5.15. Nevertheless, it appears from above that the gap between the aggregate water resources and the utilisable water resources is very wide. It may be concluded that the long-term perspective of irrigation development is not governed so much by the total availability of water resources as by the extent to which the available surface water resources can be physically utilised for irrigation purposes. A precise assessment of this, however, can only be made after all the possible sites for schemes have been located and investigated and basin-wise master plan prepared.

(ii) *Groundwater Resources*

5.16. Although groundwater resources of India are not as large as its surface water resources, from many considerations, they are no less important. In areas where there is paucity of surface water, groundwater resources assume special significance. No dependable assessment has yet been made of these resources. Certain part of the country, such as Indo-Gangetic basin with its water bearing stratum extending to a depth of several thousand feet are known to be rich in this resource. Explorations carried out by the Exploratory Tubewells Organisation of the Government of India, have established many groundwater worthy areas where large scale use of groundwater can be made. Explorations have been continuing and more such areas may be located. There are also prospects of locating numerous areas where, though large scale pumping by deep tubewells may not be feasible, yet appreciable use of groundwater may be made by shallow wells. There is also scope for making intensive use of groundwater in already proven areas. A more precise appraisal of aggregate groundwater resources available in the country can, however, only be made after groundwater potentialities of different regions have been carefully surveyed and investigated. Such investigations would cover study of groundwater table, location and extent of groundwater storage, yield, movement or distribution within the water-bearing formations and the determination of the changes that take place in the natural course of events or as a result of interference.

Potentialities for Development of Minor Irrigation.

5.17. Any precise estimate of the long-term potentialities for development of minor irrigation can be made only after the States have completed the assessment for such potentialities, region/basin-wise, based on systematic surveys and investigations. The States have already been asked to initiate studies in this direction. A broad assessment of the potentialities on all India basis, as carried out by the Working Group for a period of about 10—15 years after the Third Plan is indicated in the following paragraphs:—

(i) *Surface Water Schemes*

5.18. Although precise statistics is not available, it is roughly estimated that the irrigation potential lost due to derelict works still existing un-restored at the end of the Third Five Year Plan would be of the order of 3 to 4 million acres. It has to be appreciated that the gradual silting of tanks is an inevitable feature which cannot be entirely checked even with best measure and precautions in the fore-shore area. Hence some irrigation potential is being lost every year due to silting, inspite of best maintenance of the works. The actual position is that action towards creating satisfactory arrangements for maintenance of existing works has been initiated only recently by the States and there is yet plenty of room for improvement. Hence, while restoration work has been progressing in the Plan Period, some more works have been getting gradually into dis-use, adding to the aggregate lost potential waiting to be restored.

5.19. The priority and drive for restoration work, it appears, would have to continue during the Fourth Five Year Plan and also during the Fifth and perhaps the Sixth Plan. While priority is accorded to restoration, still greater priority needs to be given to strengthening the arrangements for maintenance so that the restored works and other existing or

new works do not get into dis-use for reasons of default in the maintenance.

5.20. Apart from restoration, there are also many possibilities of constructing new storage works and diversion works, particularly in the hilly and undulating regions covered by the Aravati, the Satpura, the Vindhya, the Deccan Trap and some tracts in the western and eastern Ghats and in the headwater regions of streams and rivers. Contiguous patches of cultivable lands available in such areas are generally small and, therefore, minor irrigation schemes are more feasible in order to avoid costly construction of long water channels over uneven topography. Moreover, the undulating nature of the topography offers good scope for construction of storage works and tanks.

5.21. Lift irrigation from streams and rivers has a good scope in many States and will become increasingly in vogue when suitable sites for gravity flow irrigation have gradually been exhausted and more and more and cheap hydro-electric power becomes available consequent on completion of numerous hydro-electric projects taken up under the Five Year Plans.

5.22. Taking into account the potentialities outlined above, the long-term development of minor irrigation from surface water schemes may be tentatively forecast as 30 million acres (gross) as against actual irrigation of about 20 million acres (gross) and 18.9 million acres (net) at the beginning of the First Five Year Plan. Reckoning the depth of water utilisation as 2 feet, total exploitation of surface water resources from minor irrigation would thus be of the order of 60 million acre feet.

(ii) *Groundwater Resources*

5.23. There were about 50 lakh open wells and 3,000 to 4,000 tube-wells (including private ones) existing in the country when the First Five Year Plan was taken up. Out of 50 lakh open wells about 7 lakhs were in disuse. Nearly 90,000 wells were installed with pumpsets. Statistics, however, is not available about the wells that had been bored or deepened. The total irrigated area from all these groundwater resources was 14.7 million acres (net) and about 16 million acres (gross). The area irrigated per well (in use) works out approximately as 3.70 acres (gross). There is considerable scope for construction of more wells in many areas. In some of the States which have less than a comparable share of surface water supplies, increasing reliance is being and will be placed on open wells. The Maharashtra Irrigation Commission has pointed out to the possibility of constructing 5 lakh open wells in those areas alone of Maharashtra State which would not be covered under surface water irrigation. In the Indo-Gangetic plains of the Punjab, Uttar Pradesh and Bihar, a large number of additional wells can be constructed. Taking a long term perspective, it should not be unrealistic or difficult to have about 80 to 90 lakh open irrigation wells in the country, particularly when lot of schemes for percolation tanks, rapats, nallah plugging, contour bunding, etc., which help to recharge groundwater are being increasingly taken up. Reckoning that about 75 lakh open wells would remain in use and each well would irrigate about 3.00 acres (gross) (taking into account the anticipated decrease in the irrigated area per well due to extension of wells construction programme in more difficult and drought-affected areas), the long-term potential for irrigation from wells may be forecast as 22.50 million acres gross (75 lakhs x 3.00 acres).

5.24. The scope for augmenting well discharge by boring and deepening is also considerable. Prospects for boring are particularly good in the Indo-Gangetic plains covering the States of Punjab, Uttar Pradesh and Bihar. Deepening has fairly good scope in parts of Rajasthan, Gujarat, Maharashtra and Andhra Pradesh where rock is frequently encountered at shallow depth in the sub-stratum. It is expected that by the end of the Third Five Year Plan about 1.65 lakh wells would have been bored and 1.20 lakh wells deepened. These figures do not take into account the number of boring and deepening of wells existing in the Pre-Plan period. Taking a long-term view it is expected to carry out boring of about 8 to 10 lakh wells and deepening of about 7 to 8 lakh wells. Additional irrigation potential from these may be forecast as about 2.8 million acres.

5.25. Installation of pumpsets on wells is gradually becoming increasingly popular. Pumpsets do not only help to extract more water from the wells but also to release bullock power required by the cultivator for the other agricultural activities. The number of pumpsets used for irrigational pumping had reached a figure of 3.9 lakhs at the end of 1960-61. Out of this number, about 3.0 lakhs must have been used for lifting water exclusively from wells. With the extension of rural lift irrigation programme and availability of cheap electric power consequent on completion of big hydro-electric projects under execution, the number of pumpsets installed on wells is bound to increase. It is expected that the number of these installations should reach a figure of 18 to 20 lakhs in a period of 10—15 years after the Third Five Year Plan. Besides, a large number of persian wheels are being installed to replace the old less efficient water lift appliances. The additional contribution to the irrigation potential from these installations is reckoned as 9.5 million acres.

5.26. In regard to the tubewells, it is felt that as against about 3,000 to 4,000 tubewells existing in the country at the beginning of the First Five Year Plan, the total number of tubewells after development of fresh groundwater worthy areas explored in the country, may rise to as under:—

State tubewells	..	20 to 25 thousand
Private tubewells	..	100 to 150 thousand
Filter-point tubewells	..	15 to 20 thousand

5.27. On an average a State tubewell may be expected to irrigate about 250 acres, a private tubewell about 30 acres and a filter point about 10 acres. On this basis, the total addition to irrigation potential from these sources would be about 9.5 million acres.

5.28. Thus the long-term potential from groundwater schemes may be forecast as under:—

	<i>Million acres (gross)</i>
Open wells	22.50
Boring and deepening of wells.	3.50
Pumpsets	9.50
Tubewells	9.50
Total	45.00

5.29. As groundwater scheme make comparatively more local use of water, losses in conveyance are less as compared to surface water schemes. Moreover, as the lift water is more costly, the cultivator is also more careful and economical in its use. The average depth of utilisation of groundwater for raising crops may, therefore, be reckoned as about 20 inches. The annual exploitation of groundwater resources may, therefore, be forecast as about 75 million acre feet.

(iii) *Water Conservation-cum-Groundwater Recharging Schemes*

5.30. There is excellent scope for undertaking progressively a large programme of these works in conjunction with minor irrigation constructions. Though these schemes do not bring about direct irrigation yet their contribution of food production potential is substantial. The cost of their initial construction is comparatively low. By virtue of the important role of water conservation that these works perform they form an important link of integrated programme for development of water resources in a region. They are essential counter-parts of the important minor irrigation schemes, such as wells, tubewells, tanks, etc., in as much as they improve discharge and performance of the wells by increasing recharge of groundwater and prolong useful life of the tanks by arresting the rate of their silting. Their contribution is significant in areas where groundwater recharge is precarious and the water table has a tendency to go down. They will have doubtlessly an increasing role to perform as the minor irrigation programme expands.

(iv) *Drainage, Flood Protection and Anti-sea Water Intrusion Works*

5.31. There is yet much work to be done on drainage and flood control. The magnitude of the problem can be judged from recurrent floods almost all over the country in recent years and from increasing menace of water-logging developing in many States, particularly in the Punjab. The problem of surface drainage congestion exists in most-parts of the country, but it is more acute in the Indo-Gangetic plains which have flat slopes and poor out-falls. The problem is urgent and pressing in the States of Punjab, Rajasthan, Uttar Pradesh, Bihar, Assam, West Bengal and in the lower deltaic regions of Cauveri, Krishna, Godavari and Mahanadi. In the Deccan, because of rolling topography, the drainage conditions are generally better. The problem does not very much exist except in some intensively irrigated tracts where it is more of sub-surface drainage. In the Punjab and Uttar Pradesh, the problem is greatly aggravated on account of inadequate water-way under roads, railways and canals and insufficient capacity of the existing drainage channels. In the northern parts of Bihar, there is an acute problem of draining out the low-lying areas called 'chaurs'. In large many low-lying areas in Kerala, the cultivation of second crop of paddy is dependent on the expeditious disposal of the flood waters accumulated during the monsoon season. In many areas while on the one hand, the drainage requirements have increased on account of more areas having come under irrigation, on the other hand, the existing drainage channels have silted up and deteriorated. In Assam and West Bengal, a large number of existing drainage channels required to be re-excavated and revived and sluices are required to be constructed in the embankments. In the coastal areas, there is need for providing adequate water-ways for drainage under the existing coastal embankments.

5.32. The need for sub-surface drainage to relieve water-logging exists in many States, but is most pressing in Punjab where alone there is an area of about 4 million acres under water-logging. Next comes Uttar Pradesh in the list with 0.5 million acres.

5.33. The importance of drainage and its existing inadequacy has been emphasised from time to time by various Committees and Commissions. More recently the Foodgrains Enquiry Committee emphasised the need for proper planning and designing of drainage in order to relieve water-logging and of constructing embankments after carrying out proper surveys so that the existing natural drainage of the area is not upset. The Agricultural Food Team sponsored by the Ford Foundation which examined the India's food problem in 1959 also laid a great stress on the improvement of natural drainage ways.

5.34. Drainage is very important in irrigated tracts as well as in humid non-irrigated lands for successful and sustained development of agriculture. The need for drainage has been increasing with development of irrigation and communication in the country. There is bound to be increased emphasis on this programme in years to come. Drainage schemes—minor as well as major—will increasingly be required to be taken up in a coordinated way.

5.35. Besides drainage, there is yet great need for construction of flood protection works to save agricultural land and crops in many vulnerable tracts. Long lengths of embankments have been constructed in the past, to start with by the private individuals mostly and later by Government also but quite many of these embankments have breached and by and large, the efforts made have not been commensurate with the magnitude of the problem. This is evident from the fact that in the country as a whole, the total damage from floods from 1950 to 1956 aggregated to Rs. 323 crores. Out of this, the crop damage alone accounted for Rs. 228 crores. The damage was most pronounced in the Ganges system and next in magnitude came in the Brahmaputra system. The annual *per capita* flood damage and the damage per acre of the net area sown was the highest in Assam. Although absolute or permanent immunity from flood damage is not physically attainable by known methods of flood control, much can yet be achieved by taking up well-planned flood protection measures on an integrated basis. The High Flood Level Committee appointed by the Government of India emphasised the urgency and importance of completing investigations and of preparing comprehensive basin-wise flood control plans. It was recommended that these plans should fit in with those for other water resource developments, such as irrigation and power, to the extent possible. While under the intensified programme now contemplated, major flood protection works are taken up on large rivers and streams, works of minor nature also would be required to be taken up in large numbers on small streams and rivulets. Increasing reliance would have to be placed on these types of works for sustained agricultural production in flood affected regions.

5.36. In the coastal areas of Gujarat, Maharashtra, Madras, Andhra Pradesh, Orissa and West Bengal, the problem of sea water inundation and sea water erosion are fairly acute and widespread. In the past, attempts have been made mainly by big landlords of a few places to construct embankments along the sea coast, creeks and rivers to protect the

problematic areas. Many of these embankments have either breached or are in a dilapidated condition. While the problems of sea water erosion are being tackled under the major-medium sector, adequate attention has yet been paid to the problem of inundation. At many locations, the anti-sea erosion and anti-sea water intrusion are likely to be very much inter-linked. Although precise data about the extent of the area affected by inundation of coastal saline water is not available, it is known that the cultivated areas annually inundated are large and much more attention than hitherto paid, is required to tackle this problem on a satisfactory basis.

Abstract of long-term potential for Minor Irrigation Development

5.37. (a) From surface water schemes	..	30 million acres
(b) From groundwater schemes	..	45 million acres
		<hr/>
Total	..	75 million acres
		<hr/>

CHAPTER VI

SURVEYS & INVESTIGATIONS

6.01. No irrigation programme can be implemented on a sound technical basis and with economy in cost unless it has been preceded with well planned and exhaustive surveys and investigations. The need for surveys and investigations has become all the more important now because of the following reasons:—

- (a) programme is being accelerated at a fast rate;
- (b) stock of the cheaper and more obvious schemes has more or less been exhausted; a fresh stock of technically sound and reasonably economic schemes has to be built up; and
- (c) cost of construction has been rising; the rise can be arrested to an appreciable extent by careful investigations and integrated approach in planning.

6.02. Intensified surveys and investigations are needed not only to project and prepare fresh schemes at a fast rate, but also to pick up and choose, at all stages of implementation, only those schemes which are most technically feasible and economical for a given region. Surveys and investigations are thus required to be intensified to serve two basic objectives:—

- (a) Preparation of regional master plans which would enable to take up the programme on a phased priority basis with a fairly long-term perspective in view and in coordination with different categories of schemes so that there is integrated development of irrigation resources without any duplication of efforts and
- (b) Collection of hydrological and geological data and preparation of contour maps for enabling projection and preparation of design and construction details of the individual schemes.

6.03. It is necessary that both these objectives should go hand in hand. If individual schemes only are surveys and taken up for implementation in isolation, without any long-term perspective in view and coordination with other feasible schemes, there would be considerable risk of duplication. The advantage of additional benefits that coordinated implementation can frequently bring, would be lost. On the other hand, the programme of implementation cannot be afforded to be suspended altogether or even reduced till long-term intergrated district/basin-wise plans are prepared. Moreover, these plans will not be in the nature of State plans holding good for all time to come. They would continually require to be modified in the light of developments taking place and as more knowledge and experience about the region is gained.

6.04. The need for integrated approach in planning minor irrigation schemes is urgently pressing. In the first instance, it is important to see that minor irrigation works are not unduly rushed through in the areas where adequate perennial irrigation is likely to be made available before long through major and medium irrigation works. At the same time, it will also not be desirable to put a complete ban for minor irrigation construction in areas where a major-medium irrigation scheme may be considered technically feasible but is not likely to come up during the next 10 to 15 years. It has also been recognised that minor irrigation works are frequently capable of playing an effective supplemental role even in areas irrigated by major and medium irrigation works. Keeping this in view, surveys and investigations are essential to ensure that the existing minor irrigation works which fall in the command of new major and medium irrigation projects continue to be utilised even consequent to completion of major-medium irrigation projects; and to encourage the construction of minor irrigation works in the command of existing major-medium works where there is acute shortage of water during crucial periods of irrigation demand.

6.05. Besides, minor irrigation schemes such as open wells, bored wells, tubewells, pumpsets, which enable the use of groundwater for irrigation can be very helpful in relieving water logged areas and in preventing development of this condition in new areas, where intensive irrigation from major-medium works is newly extended. A concerted and judicious programme of well construction, therefore, needs to be planned for such areas in close conjunction with the surface water projects.

6.06. Even among minor irrigation schemes, there is need for integrated approach in order to obtain maximum benefits. For instance, if a programme for well construction, particularly in low rainfall areas or in districts where the groundwater table has a tendency to go down, is scientifically linked up with such schemes as contour bunding, nallah plugging, percolation tanks, infiltration galleries, sub-surface dams, rapats, etc., the resultant irrigation benefits of wells would considerably increase and the risk of their falling due to lowering of the water table would be eliminated. The programme of surface water tanks and wells can, perhaps, also be similarly linked up with resultant gain in benefits.

6.07. Drainage and flood protection works form essential parts of an integrated and comprehensive programme for development of water resources in a region and cannot be left out in the plans that are prepared for this purpose. Similarly, anti-sea water intrusion works are important for development of water resources in coastal areas. Drainage and flood protection works are inter-related with irrigation in many ways. In fact, it is desirable that drainage schemes should form integral part of all sizeable irrigation schemes from the very beginning in order to prevent hazards of water-logging and salt precipitation. Storage schemes for irrigation play an important role in alleviating the flood problem in many areas. Even among drainage and flood control schemes themselves, there is great need for coordination to obtain effective results, particularly as these schemes are taken up in major-medium as well as minor sector.

6.08 The various aspects mentioned above need to be carefully knit together integrated in regional maps and plans that are prepared and the priorities that are set up for implementation of the programme. For preparing these plans, it is important not only to carry out surveys and investigations

for harnessing surface water irrigation resources, but also to conduct comprehensive explorations to ascertain groundwater potentialities on scientific lines. The Exploratory Tubewells Organisation of the Government of India has been carrying out exploration in various States with a view to locating the tracts which may be groundwater worthy for development of comparatively large-sized tubewells. It is urgently necessary that the State Governments should, on their own, organise supplemental efforts for delineating areas which may, though not contain potentialities for large scale groundwater pumping, yet may offer promise for groundwater use through construction of open wells and small tubewells. Surveys are also necessary to establish full potentialities of the already proven areas so that over-draft, with consequent lowering of water table and failure of wells, is avoided. Such surveys are particularly necessary in the regions where there are already indications of the water table being depressed, in order to regulate or restrict further construction of wells in the areas. In addition, investigations also need to be carried out on schemes like percolation tanks, rapats, check dams, nallah plugging, infiltration galleries, contour bunding, etc., which aim at recharging the sub-soil reservoir for sustained groundwater utilisation.

6.09. The need for undertaking surveys and investigations on intensive scale has been emphasised from time to time. The Regional Minor Irrigation Conference had, as early as 1958, made the following recommendations:—

- (a) Investigations and surveys should be undertaken on a systematic and organised basis.
- (b) Investigation units having definite jurisdiction should be set up for the purpose; they should be staffed with responsible and efficient personnel.
- (c) The units should be provided with adequate equipment and transport facilities.
- (d) Adequate funds should be ear-marked for the specific purpose of investigation and surveys.

6.10. Comprehensive recommendations more or less on the lines discussed above had been made by the Regional Minor Irrigation Conferences held in 1961. The need for intensifying surveys had also been emphasised by the Programme Evaluation Organisation of the Planning Commission in their 'study on the problems of minor irrigation'. The Annual Conference of Community Development (1960) had recommended that at district and the State level, officers of the Irrigation, Agriculture and Planning Departments should assess the irrigation requirements and possibilities in the Blocks and prepare plan of works to be undertaken. The Ministry of Food and Agriculture has recently sent to the State Governments, specimen maps on the lines of which district maps and plans giving long-term possibilities of development and indicating priorities may be prepared.

6.11. The present position obtaining in various States in regard to surveys and investigations is as under:—

Andhra Pradesh.—There are already two investigation circles of the Public Works Department functioning in the State for the investigations of minor irrigation schemes. Preparation of basin maps and the district plans first and detailed estimates next are being taken up according to a

definite programme. The Agriculture Department has also under consideration a proposal to set up a sub-division for investigations in regard to lift irrigation schemes and groundwater potential.

Assam.—Surveys of the schemes are carried out by the Public Works Department.

Bihar.—Necessary instructions have been issued to the local officers to carry out proper surveys and investigations before sending the schemes.

Gujarat.—Special establishment for investigation of minor irrigation works has been sanctioned by the Irrigation Department and is being maintained according to local requirements and plan of development in near future. The State has undertaken investigations of a large number of irrigation schemes and these schemes are at various stages of investigations. The State has also taken steps for preparing plans and maps for each district, which are likely to be published in the near future.

Jammu & Kashmir.—Surveys and investigations are undertaken by the Irrigation Department according to the programme implemented.

Kerala.—At present the investigation of minor irrigation works in the State is being attended to by territorial irrigation staff each with a specified jurisdiction to attend to. There is no separate investigation unit for minor irrigation works. The question of being a separate investigation unit is under the consideration of the State Government.

Madras.—The State Government holds the view that surveys for individual schemes and preparation of district plans must go side by side. The surveys of individual schemes and implementation of the programme cannot wait till completion of the district maps. In the office of the Chief Engineer (Irrigation) there is a superintending engineer (Planning) who exclusively looks after the surveys and investigations of minor as well as major-medium irrigation schemes. There are six divisions in this circle. Every one of the six food production engineering divisions in the Food Production Department has one sub-division exclusively for surveys and investigations. Besides three of the divisions have additional sub-divisions for surveys and investigations in connection with the re-modelling and repairing of feeder channels and anicuts. A proposal to set up another planning circle is under consideration of the Government. In regard to the survey of groundwater, the State Government thinks that there is no need to have special survey in view of the fact that the Geological Survey of India is taking up groundwater survey in an organised manner.

Madhya Pradesh.—Surveys are carried out by the territorial divisions of the Irrigation Department.

Maharashtra.—Schemes are being surveyed and investigated on the basis of the water quota reserved for minor irrigation schemes in the master plans for utilisation of water resources in the various river basins, at present under preparation.

Mysore.—The present organisation for carrying out surveys and investigations in the Public Works Department consists of 7 divisions and 23 sub-divisions. It is expected that the estimates to the extent of Rs. 400 lakhs would be ready every year. In order to support the accelerated programme of renovation of tanks, a proposal to strengthen the organisation by adding 15 more sub-divisions is under consideration of the Government.

Orissa.—The Chief Engineer, Rural Engineering Organisation has formed a number of investigation teams for intensifying the surveys and investigations and also assessing the possibility of minor irrigation development. Surveys, investigations and planning have been completed in 7 districts out of 13.

Punjab.—Surveys for surface water irrigation schemes are duly taken care of by Irrigation Department. Surveys locating groundwater worthy areas in the State, suitable for small tubewells are also being carried out.

Rajasthan.—Surveys and Investigation Organisation under the Superintending Engineer (Irrigation) with four executive engineers has been functioning since 1958 for surveys and investigations of all schemes including major, medium and minor. New minor irrigation schemes costing Rs. 2 crores have already been surveyed and estimates prepared. The surveys of more schemes is in progress. It is hoped that all minor irrigation schemes to be executed during the Fourth Five Year Plan will be ready by the end of the Third Five Year Plan.

Uttar Pradesh.—The Irrigation Department has already a local surveys and investigation circle which is being strengthened further to explore the possibilities of all sorts of irrigation schemes including the minor ones. With the help of these investigations, maps are also being prepared for each Irrigation Division. These maps are intended to be passed on to the executive engineers in the Planning set up for determining the scope of private minor irrigation works so that the district/block maps may be prepared.

The investigation circle of the Irrigation Department selects and makes lists for all these schemes which are either selected by the public or which look possible from a perusal of the survey maps and then their feasibility and economics are explored by the team of engineers under him.

West Bengal.—The matter of intensifying surveys and investigations is under the consideration of the Minor Irrigation Board.

6.12. It would appear that, by and large, the State Governments have strengthened their existing organisations for surveys and investigations in the Public Works/Irrigation Departments of the States. These survey organisations, however, take care of only surface water resources and that too also mostly for projecting comparatively big sized schemes which come within the purview of these departments. Adequate attention has generally not been given to the surveys for establishing groundwater potentialities and to the preparation of the integrated maps and plans for development of minor irrigation in co-ordination with likely major-medium irrigation schemes. It is felt that to attain an effective progress in the preparation of these integrated master plans, the State Government would have to entrust the work to a single technical agency, preferably to one which has already been handling major part of the minor irrigation programme. Only then it would be possible to prepare these plans and maps expeditiously and efficiently.

6.13. In order that the Fourth Five Year Plan may be implemented with full vigour from the very first year, it is essential that the State Governments should take advance action by undertaking intensified surveys and investigations during the remaining period of the Third Five Year Plan. According to the present practice, most of the States do not ear-mark any specific

provision for surveys and investigations in their annual State Plans for minor irrigation. The Working Group is strongly of the view that for effective orientation and intensification of the programme for surveys and investigations on sound technical lines and on a scale commensurate with the programme proposed for implementation during the Fourth Five Year Plan, this work may be sanctioned and taken up as a specific scheme under the minor irrigation programme during the rest of the Third Five Year Plan.

6.14. During the First and the Second Five Year Plans, survey schemes of minor irrigation were eligible for a Central subsidy upto 50 per cent of the total cost of the scheme on the merits of each case. It was further provided that in the case of really backward States which did not have well organised Public Works Department but were keen to undertake surveys of the possibilities of minor irrigation programme, higher rate of subsidy might be allowed for really deserving cases. During the Third Five Year Plan, all survey schemes have been eligible for 50 per cent subsidy. The Working Group is strongly of the view that in order to encourage surveys and investigations by the State Governments, 100 per cent Central subsidy should be made available for survey schemes during the remaining two years of the Third Five Year Plan as an advance action for the Fourth Five Year Plan. The subsidy may be approved after a scrutiny of the detailed specific schemes received from the State Government. After a start has been made on a comprehensive scale, the pattern of Central assistance during the Fourth Five Year Plan could then be reverted to 50 per cent grant and 50 per cent loan.

6.15. To sum up, the following actions need to be initiated forthwith for intensifying the programme of surveys and investigations:—

1. Strengthening the existing organisation for surveys and investigations of surface water areas in order to keep pace with the fast accelerating programme.
2. Undertaking surveys for establishing groundwater potentialities with a view to delineating fresh groundwater worthy areas and to regulating well construction in the already proven areas, so that the over-draft and failure of wells is avoided.
3. Undertaking integrated surveys for preparation of district-wise and basin-wise maps and plans for development of minor irrigation in co-ordination with major-medium irrigation scheme.
4. Entrusting the above work of preparing maps and plans to a single technical agency which may be better equipped for the purpose.
5. Preparing specific detailed schemes for undertaking surveys and investigations on an intensified scale and co-ordinated basis from the next financial year.
6. 100 per cent Central subsidy may be made available during the remaining period of the Third Five Year Plan for specific schemes of surveys and investigations received from the State Governments.

CHAPTER VII

PLANNING AND IMPLEMENTATION

(Technical Considerations)

7.01. The pace of implementation of minor irrigation programme has gone up considerably in recent years and is likely to be accelerated further. In order to ensure that outlay incurred on this fast accelerating programme is utilised properly and made to yield maximum benefit, it is necessary to pay increasing attention to its technical aspects. There is need for greater technical bias in planning and implementation of the programme and for this purpose there should be greater dissemination and appreciation of technical knowledge. Production and distribution of technical literature on important schemes and organisation of short-term refresher and specialised training courses would go a long way in this direction. The urgent need for those measures cannot be over-stressed. In order to keep down the rising cost, efforts are also needed to be made to evolve and introduce cheap designs of works that make best use of local materials and talent. The existing criteria adopted for design of works may also be reviewed to see if they are not unduly rigid, over-safe or lacking in certain directions.

7.02. The Minor Irrigation Committee, 1957, had examined various technical aspects and issues pertaining to the programme in detail. Similar examination on State-wise basis is being carried out by the Minor Irrigation Team of the Committee on Plan Projects. Many important specific technical issues had been discussed at the Regional Minor Irrigation Conferences held in 1961. Important measures and technical considerations pertaining to individual schemes which require urgent attention and action are as under:—

(1) Technical Bias in Planning & Implementation

7.03. The fundamental need in planning and implementation are that schemes or works taken up for execution in a region should be selected on technical grounds and not on *ad hoc* basis. The scheme-wise district and State plans should be rigidly based on technological possibilities and regional master plans prepared after due investigations and surveys. In no case, there should be concerted drive for any category of scheme without proper technical assessment of its utility and/or in disregard of other more feasible schemes.

7.04. The Working Group is strongly of the view that the annual or five-year district and State plans on minor irrigation should be composed of scheme-wise details for outlays and targets. Achievements should also be watched, assessed, recorded and reported on scheme-wise basis. The present trend in many States is that the minor irrigation plans just furnish break-up for certain groups being handled by a separate department or of some cost or acreage criterion. For instance, it is quite common that the schemes of Irrigation or the Public Works Department are lumped together. Thus separate details for storage schemes, diversion schemes or for new works constructed or old works repaired are not maintained and furnished.

In West Bengal, all different categories of schemes costing below Rs. 10,000 each are included under the group classified as "small irrigation". Similarly, in Kerala, the schemes irrigating less than 200 acres are classified as 'minor schemes' and those above 200 acres as 'medium schemes'. Somewhat similar practice is followed in Bihar and many other States. This way of classification is not conducive to efficient planning and implementation of schemes on sound technical basis. The Working Group recommends strongly that the State Governments should formulate the Fourth Five Year Plan proposals on strictly scheme-wise basis adopting the same uniform classification as given in Chapter II. There is no harm in having department-wise plans provided there is adequate co-ordination in planning and implementation between the Departments but the plans of each Department should give scheme-wise details.

(2) Preparation of Technical Manuals

7.05. During the Regional Minor Irrigation Conferences held in 1961, recommendations had been made that the design criteria and practices in vogue in different States should be examined with a view to pooling and deriving benefits from collective experience. The Heads of Technical Departments in the states were, for this purpose, asked to prepare notes on design criteria and practices adopted in their respective regions. In pursuance of this recommendation, Chief Engineer (General) in charge of minor irrigation in the Mysore State has been preparing a technical manual on minor irrigation works such as tanks, anicuts, etc. An executive engineer has been deputed exclusively for the purpose of drafting this manual. The manual is in the final stage of preparation. The manual would be useful for implementation of minor irrigation works not only in Mysore but also in other States where tanks form an important part in irrigation development.

7.06. The Technical Officers on minor irrigation in the Ministry of Food & Agriculture have brought out a hand-book on boring and deepening of wells. This covers all the technical aspects involved in the operation of boring and deepening of wells. Another manual on water lifting appliances is being prepared by the technical staff.

7.07. It is necessary that the State Governments should make full use of these publications. Besides, it is necessary that the State Governments should get technical hand books of their own prepared on important minor irrigation schemes, giving design practices and construction features which are most suitable for their respective regions. This would not only provide much needed technical orientation in execution but also greatly help inter-State exchange and pooling of knowledge on important technical issues.

(3) Training and Research

7.08. The Regional Minor Irrigation Conferences in 1961, had emphasised the need of undertaking intensified programme of training and research on the techniques of design and construction of minor irrigation works with a view to introducing technical competence in execution and bringing down the cost consistent with efficiency and safety requirements. The programme can progress on sound technical lines only when the staff handling it at the field and district levels had adequate technical insight and competence. Short-term courses specially oriented to the technicalities involved in the minor irrigation programme, therefore, need to

be initiated and then multiplied. To encourage new ideas and invigorate technical thinking, applied research aiming at improvement of design and construction practices in vogue is also necessary. This applied research having dynamic contact with outstanding problems in the field would not only improve the technical standards in execution but also bring about economy in initial cost.

7.09. In response to the recommendation of the Regional Conferences, the Ministry of Food & Agriculture has introduced a centrally sponsored scheme of training and research to set up training centres, one in each State and encourage the applied research on Minor Irrigation in the existing Irrigation and Agricultural Institutes. The details and progress achieved on these schemes is discussed in Chapters XIV and XV. The States should pursue these training and research schemes in close collaboration with the work of execution at the field level.

(4) Important Technical Consideration in Planning & Implementation

7.10. (A) Wells Schemes

- (i) Construction of more new wells should be taken up in a region after careful surveys of the groundwater potentialities of the region. New wells should not be permitted if the groundwater recharge is precarious and the water table has a tendency to go down. In no case, groundwater extraction should be allowed to reach a stage which results in overdraft from the local groundwater formation. The behaviour of the water table in every region where groundwater extraction is in vogue, should be carefully and regularly watched with a view to timely detecting if there is any sustained lowering of water table.
- (ii) If the water table is observed to be gradually lowering in groundwater irrigated tracts, prompt measures should be taken to arrest this tendency. Feasibility of undertaking groundwater recharge scheme should be explored.
- (iii) Programme for construction of wells should be linked up as far as possible with soil conservation activities, like contour bunding, nallah plugging and also water conservation-cum-groundwater recharging schemes, like ahars, bundhies, rapats, percolation tanks, headwater tanks, etc.
- (iv) Construction of wells should be encouraged in areas around tanks to make use of the additional groundwater recharge usually available in these areas.
- (v) While encouraging construction of wells in a region, due attention should be paid to the location, spacing and size of the wells. Too near spacing of wells is known to result in interference and depletion of supplies in existing wells in some region. This should be avoided. Construction of additional wells due to fragmentation of holdings or family quarrels should be discouraged. It would be desirable that efforts may be made to determine near-safe range of spacing of wells in each region.

- (vi) If a well is intended to be bored subsequently, it may not usually be necessary to having a large diameter well; a small diameter well just big enough to accommodate the water lifting appliance may be sufficient. If a well is intended to be bored and then fitted with a pumpset, it would be cheaper to construct a tubewell straightaway.
- (vii) In case the bottom of the well is left in sandy strata, it is highly desirable that the bottom of the well may be filled up with 2 ft. to 3 ft. thick layer of graded brick or stone ballast or shingle with finer grade of material at the bottom and thicker at the top. This would ensure the stability of the well by filling up the cavity as it is formed below the steining in course of time due to lifting of sand particles with water.
- (viii) If the steining or lining of the well is found cracked or in a bad condition, it should be promptly repaired without waiting for a complete collapse. While carrying out the repairs, it should be checked whether cracking has been due to the formation of cavity in the bottom, if so, the cavity should be filled with ballast as indicated in (vii) above along with the repair jobs.
- (ix) If the boring and deepening is found to augment the discharge of wells in the region, the operations should be greatly encouraged under the minor irrigation programme. Boring and deepening not only helps to utilise part of the local groundwater sources which may otherwise remain untapped but also brings about additional benefits at a comparatively lower cost.
- (x) The boring and deepening operations should be so organised that they are carried out in one compact block at a time. This would save unnecessary transport of the equipment and the crew, and speed up the operations.
- (xi) Cavity bores are much cheaper than those installed with strainers. Hence it is necessary that the local strata should be explored to see if conditions are favourable for cavity development.

7.11. (B) *Tubewell Schemes*

- (i) Tubewell should normally be located at the interception of watersheds in its commanded area so that advantage is taken of natural gravitation to facilitate distribution of water.
- (ii) Commanded area of tubewells should be fixed in relation to water output. Unnecessary large commands should be avoided.
- (iii) Time lag in completion of different items should be minimised by careful planning. Particularly the energisation of the tubewells and the construction of field channels should be arranged to synchronise with the completion of the tubewell. Co-ordinated planning in regard to timely supply of power should be ensured with the Power Department so that the completed tubewells do not lie idle for want of electricity.

- (iv) With a view to minimising percolation losses of costly tubewell water, lining of the channels should be done as far as possible.
- (v) Earth work formation on water channels should be scientifically compacted on optimum moisture content basis, before lining is carried out.
- (vi) On tubewells, power connections and transmission lines should be so maintained that there is no undue drop of voltage at the tubewell, which impairs the efficiency of the tubewell operation.
- (vii) A periodical stock-taking of sub-soil water resources should be made in respect of areas served by tubewells.
- (viii) Policy of relative emphasis on State, private and co-operative tubewells should be decided after carefully taking into account the merits and demerits of each type in the context of local conditions, such as size of holdings, spirit of co-operation among the farmers, etc., Too much emphasis on private tubewells may not be laid in areas where individual land holdings are not large enough to justify installations of tubewells by individual farmers.
- (ix) In case of filter-point tubewells, the desirability of installing the filter-points inside the bore holes in preference to driving them into position, for obtaining greater discharge and increasing their lives should be examined.
- (x) It is necessary that construction of artesian tubewells should be regulated so that there is neither mutual interference nor general depletion of supplies in the artesian source. Care must be taken that the source does not get wasted through indiscriminate exploitation. Detailed records of the geological and hydrological characteristics should be collected and maintained. A record of piezometric heads should also be kept.
- (xi) The supplies from the artesian wells should be conserved. They should be sealed against side leakage.

7.12. (C) *Water Lift Appliances*

- (i) Power pumpsets are no doubt the most efficient means of water lifting and should be encouraged. However, while encouraging their use, care should be taken that the discharge of the well and irrigation requirements of the cultivator are adequate to ensure reasonable utilisation of the capacity of the pumpsets. It will normally not be desirable to go in for installation of pumpsets on the wells which have total recuperation of less than 25 to 30 thousand gallons per day (24 hours).
- (ii) It will be desirable usually to give preference to installation of pumpsets in those wells of which discharges have been augmented by boring or deepening.

- (iii) Electrical pumpsets are cheaper to operate and easy to maintain than diesel engine pumpsets and they should be preferred in all irrigated areas where electric power is available nearby or is likely to be extended shortly.
- (iv) As far as possible, electrical pumpset installations should be taken up in compact blocks to reduce the cost of extending transmission lines.
- (v) In case of persian wheels, the size of the bucket and the drum, gear ratio, the length of the driving beam, etc., have to be varied and adjusted in accordance with the lift involved and the discharge requirement for obtaining best performance, of the persian wheel. It is, therefore, necessary to ensure that the persian wheels distributed to the ryots should be carefully selected to suit their requirements.

7.13. (D) *Storage Schemes*

- (i) Under this scheme priority should be given to renovation of derelict tanks. For this purpose an inventory should be prepared if not already done, of all irrigation tanks in the State and then a master plan prepared for renovation of the derelict ones on phased basis.
- (ii) Priority should be given to renovation of those derelict tanks which are in the chain system, as the breach in one tank in the series is likely to jeopardise the safety of other tanks.
- (iii) While carrying out the renovation of tanks, the responsibility and feasibility of releasing and reclaiming of land from the tanks for cultivation should be examined.
- (iv) Design of the spillway and also of the breaching section, if provided, should be given adequate attention, particularly in case of tanks which are in series. Unit hydrograph method should be adopted if not already done, for computing the requirements of surplusing capacity.
- (v) The tank bunds should be compacted carefully in layers and under optimum moisture. They should be adequately protected by means of revetments, stone pitching, turfing, etc. The slope on the water side should not be steeper even to 2.1.
- (vi) Preventive measures should be taken to arrest silting by construction of silt traps along the valleys and undertaking soil conservation measures in the catchment area and fore-shore lands of the tanks. Cultivation in the fore-shore area should be regulated to minimise silting. Encroachers may be punished with a heavy punitive tax.
- (vii) Adequate provision should be made for dead storage to account for silting up in the course of time. It is desirable to undertake silt observations on the tanks so that dead storage capacity may be worked out on a scientific basis.

7.14. (E) *Diversion Schemes*

- (i) Construction of these schemes should be taken up only after ascertaining the adequate supply of water from established hydrological studies and not on *ad hoc* basis. It is necessary that the minimum flow of streams and its duration are invariably ascertained especially of streams that are flashy and whose discharge dwindles very much in the post-monsoon period.
- (ii) Possibility of creating storages in upper reaches of diversion schemes should be examined with a view to making the available supplies more stable and perennial and improving the irrigation utility of these schemes.
- (iii) The structure of putting temporary earthen bunds across the schemes for diverting water should be replaced by construction of masonry anicuts on all sizeable diversion schemes.
- (iv) With a view to minimising the incidence in silting up of channels from diversion weirs adequate provision of scour sluices near the canal take-off is necessary. Also, wherever feasible, piers and gates may be preferred to solid weirs.
- (v) All irrigation channels should be provided with proper gauges masonry bed bars and foolproof water regulating arrangements.

7.15. (F) *Lift Irrigation Schemes*

- (i) In selecting sites for lift irrigation, it is important to ascertain all the year around availability of the water source. It is desirable that lift irrigation may be limited to places where ample water is available for at least 200 days in a year so as to avoid over-capitalisation and unduly large over-head expenditure.
- (ii) Electricity operated pumping installations should be given priority over diesel operated pumps as the former are cheaper in initial cost as well as in operation and maintenance.
- (iii) The pumpsets for installation should be selected as carefully as possible with a view to rendering most optimum performance under the particular conditions of discharge and lift involved. For lifting considerable discharges over comparatively smaller head axial flow or mixed flow types of pumps may be found more satisfactory than the centrifugal pumps.
- (iv) Distribution of water should be effected as far as possible either by piped conduits or lined channels in order to minimise loss of costly lift water.

7.16. (G) *Water Conservation-cum-Groundwater Recharging Schemes, (Ahars, bundhies, rapats, percolation tanks, headwater tanks etc.)*

- (i) These works are very useful but a major handicap is that they get breached very frequently during the monsoon season. It is, therefore, essential, particularly on those works which are of sizeable capacity that the flank escape provided is properly designed and is of adequate capacity to pass the computed flood discharge.

- (ii) The end of the bund on the escape side should be protected with stone or brick pitching laid over graded ballast or shingle. The pitching should be extended sufficiently on the upstream as well as downstream side and should be done upto 1.5 ft. above high flood level. The pitching should be adequately protected by means of a deep toe wall, concrete blocks or wire crates filled with boulders.
- (iii) The bundhies sometimes result in deterioration of land. It is, therefore, desirable that any tracts where such deterioration of land is apprehended as a result of construction of bundhies, the local Soil Conservation authorities in the State should be consulted prior to taking up these works.

7.17. (H) *Drainage, Flood Protection and Anti-sea Water Intrusion Schemes*

- (i) These works should be taken up under the minor irrigation programme in close co-ordination with works under the major-medium sector. If there are a number of small works over a wide-spread area which may together constitute a single scheme from the point of view of obtaining results it would be desirable to deal with them under the major-medium sector.
- (ii) Under the drainage programme priority should be given to—
 1. clearance and re-excavation of drainage channels which have deteriorated.
 2. widening of bridges and culverts which are tight, and
 3. provision of proper drainage crossing works wherever they are needed but are absent.
- (iii) Drainage should form an integral part of all sizeable irrigation schemes from the very beginning. It is not only convenient but also far more economical if the drainage of the tract is attended to at the time of implementation of the project. If the problems are over-looked initially and once the tract has become water-logged and salt infested, its subsequent reclamation is bound to be much more complicated and expensive.
- (iv) The field drains form an integral part of a sub-surface drainage scheme aiming at lowering the water table in water-logged areas. Unless these field drains are excavated simultaneously along with the construction of laterals and main drains, the drainage scheme may hardly be expected to result in appreciable lowering of water table and provide relief. The project of sub-surface drainage, therefore, should take special care of constructing field drains.
- (v) Whenever field drainage work is taken up under the soil conservation programme or the area development programme, proper coordination should be ensured between the construction of main and lateral drains and the field drains.

- (vi) Although the construction of field drains may be entrusted to the beneficiaries, it is necessary that their alignment is clearly marked and other data in regard to their spacing and size furnished in the project report. The project authorities should thereafter ensure that their construction is completed in time.
- (vii) With a view to reducing the cost and improving efficiency of the drainage system, it is desirable that in the water-logged areas, the programme of constructing open/title drains may be supplemented by encouraging groundwater pumping from open wells and shallow tubewells for irrigation purposes. Irrigation by groundwater pumping may be given priority over surface water irrigation and the latter where existing may be substituted by groundwater pumping to the extent it is practicable. The open well and the tubewell construction programme should be given priority in water-logged areas.
- (viii) Very little has so far been done in India on the use of tile drains for improving sub-surface drainage. This is primarily due to the higher initial cost of the tile drains. However, considering the superiority of the tile drains for sub-surface drainage, it is desirable that the work of tile drains may be taken up on pilot basis on some selected areas in order to work out their economic feasibility under the Indian conditions. With a view to reducing the initial cost, indigenous tiles locally called 'colabas' may be tried at some of the places. It is felt that if manufacture of these tiles is standardised in regard to the length, size of the gap, diameter, number of perforations, etc., they may be conveniently adopted for use on a large scale.
- (ix) Apart from designing and projecting specific drainage schemes, interlinking of existing borrow pits along the roads, railway lines, canals, embankments, etc., so as to form side channels may also at some locations be found to be satisfactory and economic means for facilitating movement and disposal of surface water. It may be desirable that the proposals formulated may include work of this nature. While interlinking the borrow pits they may be properly shaped to form fairly well aligned and graded channels.
- (x) While embankments are constructed along rivers, streams, drainage channels, etc., it is very necessary that they should be provided with adequate regulators to pass the drainage water and also to provide flood irrigation and controlled deposit of fertile silt wherever feasible.
- (xi) Besides providing adequate section and free board (above the high flood level) for the embankment, it is necessary that they should be adequately protected by revetment, pitching, spurs, etc., in reaches subject to heavy wavewash or erosive action of water.

CHAPTER VIII

PLANNING AND IMPLEMENTATION

(Administrative Measures)

8.01. Minor irrigation programme includes a large variety of schemes which differ widely in their technical features and scope. Some require specialised technical knowledge while others may just depend on local skill and talent for satisfactory completion. The schemes also differ vastly in many other ways. Some of these are private, some belong to the community and some others are State managed. Several of these schemes are amenable to public participation in the form of individual enterprise, co-operative venture, or popular contribution; but on some others public participation is difficult. Because of this diversity in their nature, minor irrigation schemes in the States have come to be handled by a number of departments and agencies, such as the Public Works Department, Irrigation Department, Agriculture Department, Revenue Department, Planning Department, the Panchayats and the Block agencies. Funds for these schemes are also made available from different sources as; plan fund under the G.M.F. Sector; schematic budget provision of the C.D. Blocks and Land Mortgage Banks and other agencies under the Cooperative Sector. Due to these multiplicity of agencies, integration of the activities at the district or the field level, frequently becomes difficult. This also stands in the way of preparing integrated district-wise plans and maps for implementation of the programme according to the phased priorities. Besides, organisational problems, there are also other bottle-necks and delays which have usually been experienced in the implementation of the programme.

8.02. For smooth and accelerated implementation, it is necessary that the schemes should be executed in a coordinated manner and concerted efforts made to identify the problem and the bottle-necks that may come up in the way of and resolve them as far possible by advance planning and through simplification and rationalisation of the procedures involved. Important steps required to be taken are as under:—

(1) Coordinated Implementation

8.03. The minor Irrigation Conferences (1961), examining this problem in detail, had recommended that with a view to bring about greater coordination and technical competence in planning and implementation of the minor irrigation programme, an engineering minor irrigation cell should be set up in all the States to deal with technical aspects of minor irrigation schemes in an unified and integrated manner. The recommendations of the similar nature have also been repeatedly made by the Annual Conferences of the Community Development & Panchayat Raj. The Programme Evaluation Organisation of the Planning Commission in its study on the programme of minor irrigation had also emphasised the need for reviewing fairly regularly the existing arrangements for achieving administrative coordination in the field of execution, improvement, restoration

and maintenance of minor irrigation works, in the light of the field situation as it develops.

8.04. Quite many States have taken action on the above items. The organisational position now obtaining in each State for execution of minor irrigation works is summarised below:—

Andhra Pradesh.—There is a separate chief engineer for looking after all minor irrigation works. Minor irrigation sources having an ayacut of 200 acres and below in Andhra area and 100 acres and below in Telangana area have been transferred to the administrative control of the Revenue Department. At the district level the Collector as the Chairman of the various Sub-Committees and the Zilla Parishads has been administering the minor irrigation programme along with the Community Development programmes and there is sufficient coordination. A unified engineering organisation with two services—(i) Local Administrative Engineering Service and (ii) Local Administrative Engineering Subordinate Service, has been set up to serve the common needs for Panchayats, Panchayat Samities and Zilla Parishads.

Assam.—Public Works Department deals with the works costing over Rs. 10,000 each. Smaller schemes costing upto Rs. 10,000 are executed by the beneficiaries under the supervision of the Agriculture Department. The scheme of power pumps is also handled by the Agriculture Department.

Bihar.—A unified minor irrigation agency has been set up under the Agriculture Department with a chief engineer as the head, one superintending engineer in each division and one executive engineer in each district. There is one assistant engineer for 5 blocks. This agency deals with all minor irrigation works costing less than Rs. 30,000 each. The larger works are dealt with by the State Irrigation Department. Electric motors are distributed by the Electricity Department.

Gujarat.—There is a separate chief engineer in the Public Works Department for dealing with works with irrigation potential of more than 250 acres and tubewells. Works irrigating less than 250 acres are handled by the Revenue Department in association with the Panchayats. The schemes for wells and pumpsets are dealt with the Agriculture Department.

Jammu & Kashmir.—All schemes of minor irrigation are dealt with by the State Irrigation Department.

Kerala.—There is one unified agency in the State for minor irrigation programme financed from the various sources. The agency is under the Chief Engineer (Irrigation). At the State and district level, irrigation requirements and potential are considered by the officers of the Irrigation, Agriculture and Planning Departments.

Madhya Pradesh.—There is a unified control of the Chief Engineer (Irrigation) for handling minor irrigation programme financed from different sources. There is a superintending engineer in his office for minor irrigation works of the block areas. At the block and district levels there are special minor irrigation sub-divisions which look after the minor irrigation programme in block areas. These sub-divisions work under the control of the executive engineers and the superintending engineers of the Irrigation Department at the district and divisional levels. The schemes of wells and pumpsets are executed under the technical guidance of the Agriculture Department.

Madras.—Chief Engineer (Irrigation) attends to minor irrigation schemes having more than 200 acres of ayacut. The Board of Revenue exercise an over-all control in respect of other minor irrigation schemes. There is Food Production Department headed by a superintending engineer, under the Board of Revenue, to handle surface water schemes upto 200 acres. The scheme of artesian tube-wells and bored wells are handled by the technical cell of the Agriculture Department.

Maharashtra.—The Directorate of Minor Irrigation headed by a chief Engineer has been set up in this State to execute all surface water schemes irrigating above 250 acres. The surface water schemes irrigating below 250 acres are looked after by the Revenue Department and the Panchayats. Agricultural Engineering Section in the Agriculture Department deals with the scheme of wells, boring and deepening of wells and pumpsets. The Zilla Parishads have been equipped with the full-fledged engineering works departments and each panchayat samiti with a full-fledged engineering works section.

✓ *Mysore.*—Execution of all surface water schemes irrigating above 10 acres is in charge of the Chief Engineer (General) in the Public Works Department. The scheme below 10 acres are dealt with by the Taluka Boards, under the technical supervision of the staff of the Public Works Department posted in the blocks and the districts. The scheme of wells is handled by the Revenue Department under the technical guidance of the Director of Agriculture. The Agriculture Department deals with diesel pumpsets and boring of wells. The electric pumpsets and the power lines are handled by the Electricity Board.

Orissa.—There is a unified agency in the State for handling all surface water minor irrigation schemes financed from various sources with an engineering establishment headed at the State level by Chief Engineer who is under the Administrative control of the Development Commissioner. Rationalisation of the engineering personnel has been made at the district and block levels for dealing with all irrigation and other works in the blocks. Lift irrigation schemes including tubewells are handled by the Directorate of Lift Irrigation in the Agriculture Department.

Punjab.—Irrigation Department deals with tubewells and surface water schemes. The schemes of wells, pumpsets and private wells are handled by the Agriculture Department under the supervision of their engineering staff. Under the Panchayat Raj, Zilla Parishads nad Panchayat Samities have been duly equipped with the engineering staff.

Rajasthan.—Schemes costing more than Rs. 25,000 each are handled by the Irrigation Department. All minor irrigation works upto Rs. 25,000 are being executed by the Panchayat Samities and Panchayats. One assistant engineer has been provided in each district to survey and prepare estimates for all such works. The work of the assistant engineer is being technically supervised by the concerned executive engineers. There is Groundwater Board in the State which looks after the schemes of boring and deepening of wells and construction of tubewells. The scheme of open wells is dealt with by the Agriculture Department at technical level.

Uttar Pradesh.—All sizeable surface water schemes and State tubewells are dealt with by the Irrigation Department. Other minor irrigation schemes financed from various sources are handled at the State level by the Additional Development Commissioner who is assisted by an irrigation officer of the rank of superintending engineer designated as Deputy Development Commissioner. The superintending engineer has five executive engineers under him. He also works as Liaison Officer between the Irrigation and Planning Departments.

West Bengal.—The State Government has decided that the Agriculture Department shall take up execution of all minor irrigation schemes individually costing upto Rs. 1 lakh. The Agriculture Department is dealing with small irrigation schemes including pumpsets, small drainage schemes, tubewells schemes, schemes of lift irrigation from rivers and streams, etc. There is an engineering cell in the Agriculture Department. The schemes costing Rs. 1 lakh to Rs. 10 lakhs are dealt with by the Irrigation & Waterways Department. A Tank Improvement Department has been created to look after renovation of derelict tanks.

8.05. It would appear from the organisation set up now obtaining in the State conforms, by and large, to the following pattern:—

1. Surface water schemes of sizeable irrigation capacity above specified acreage or cost—in charge of irrigation/public works department with or without a separate chief engineer for minor irrigation.
2. Surface water schemes of smaller size—in charge of Revenue Department/Agriculture Department/Panchayat Samities with technical staff support of engineering cell or agency/rural engineering department/engineering cell in the Agriculture Department.

3. Groundwater schemes (including or excluding State tubewells) —in charge of Revenue Department/Agriculture Department/Planning Department with technical staff support of engineering cell in the Agriculture Department/special engineering cell or agency.

8.06. The above pattern still leaves much room for integration or co-ordination. The following steps are considered urgently necessary:—

- (a) At the district level only one technical agency should specifically be charged with the responsibility of planning and preparing annual State plans on integrated basis and according to phased priorities indicated in the long-term master plan. This agency should get full cooperation of other technical agencies in preparing these plans;
- (b) All concerned agencies should be strictly guided by these integrated annual plans in implementing the programme during the year;
- (c) Funds available from different sources should be pooled at the district level and utilised in a coordinated way and in accordance with the annual district plans;
- (d) Much greater emphasis should be given by senior departmental officers on mutual cooperation and coordination in all activities at the district and the field level.

(2) Strengthening Organisation for greater technical guidance on groundwater schemes

8.07. For deriving maximum and sustained benefits from groundwater schemes, such as open wells, pumpsets, tubewells, etc., not only it is essential to carry out a systematic survey of groundwater potentialities but also to extend much greater technical guidance to the cultivators in the execution of these schemes. Location, design, size and spacing of open wells and tubewells are factors which have an important bearing on the success, performance and water output of the wells and on the optimum utilisation of available groundwater resources. The cultivators need active guidance in these matters. Such guidance is particularly important to prevent over-draught and consequent failure of not only new wells but also of the existing ones.

8.08. Suitable technical advice and guidance to the cultivators is also necessary in the selection and installation of water lifting appliances including the power pumpsets. The type and the capacity of the lifting appliances should, in every case, be related to the water output of the irrigation source and the area to be irrigated, to obtain best efficiency at minimum cost. Left to themselves, the cultivators would not be able to exercise proper choice in this matter. Programme Evaluation Organisation has in its report pointed out to many cases where the capacity of the pumpsets installed are much in excess of the needs of the farmers. There are also many cases where pumpsets have been installed but water output is not commensurate for their optimum utilisation.

8.09. Besides, boring or deepening of wells which is an important scheme for bringing about additional benefits at low cost, requires specialised knowledge for execution. Increased facilities need to be provided by the Government in many States for accelerated implementation of these schemes.

8.10. The existing technical set up in most of the States is not adequate to meet the above mentioned requirements. The Working Group strongly recommends that urgent action should be taken by the State Governments to suitably strengthen the existing technical organisation dealing with utilisation of groundwater. The need for this strengthening is all the more urgent due to the fact that there is now much more emphasis on development of groundwater under the minor irrigation programme.

(3) Advance Planning & Action

8.11. Quite many bottle-necks and delays can be prevented or reduced by careful planning and taking timely measures ahead of the construction schedule. Advance planning and action is particularly necessary in respect of the following items:—

- (a) *Arrangement of Key materials.*—There is usually wide gap between placing of indents for key materials, such as coal, cement, steel, etc., and their actual supplies. It is, therefore, necessary that the requirements of the key materials should be worked out carefully much in advance of the construction schedule and proper steps taken to obtain their timely supplies.
- (b) *Procurement of Equipment and Machinery.*—The indigenous industry is usually heavily booked in respect of many key items. There is, therefore, great time lag between placing of orders and receiving the supplies. There is, therefore, need for taking advance measures. In respect of such items as diesel engines, motors, pipes, etc., which are required to be purchased in large numbers, it may often help the industry to adjust their manufacturing programme and meet these requirements more adequately if these requirements are phased and intimated to them sufficiently in advance.

On items which are required to be imported, need for advance action is all the more necessary because of foreign exchange difficulties and the length of the procedure involved.

- (c) *Synchronising lift irrigation, small scale industries and electrification programme.*—For pushing up lift irrigation programme, it is very essential that this programme should be properly integrated with those of small scale industries and rural electrification so that power lines can be extended at minimum cost and more area is covered under rural electrification.
- (d) *Land acquisition.*—Timely acquisition of land is necessary to ensure full use of the working season. Much of the delay in land acquisition can be eliminated if the land plans are prepared and formal proceedings for land acquisition initiated sufficiently in advance.

(e) *Synchronising execution of all appurtenant parts of the works.*—

In order that the works are completed early and there is no delay in their utilisation, it is necessary that construction schedule of all the appurtenant parts of the work should be so planned that all parts are completed early and simultaneously. Even if one part or job relating to the works lags behind while all others are completed, it will not be possible to bring the work into functioning. This would mean blocking of capital without reaping any benefits. It is frequently observed on tubewells or pumpsets that the installation has been completed but the power lines have not been laid; similarly, it happens on canal systems that the head-work is completed but the distribution system has not been constructed. In all such cases, there is an avoidable delay in utilisation of the works. Advance planning and timely action can go a long way in improving the matters.

(4) **Liberalising terms and conditions for sanction of electric power to irrigators and charging concessional rates for the electricity consumed**

8.12. In order to encourage the increasing use of electric power for irrigation, it is necessary that the power should be made available to the cultivators at convenient terms and reasonably cheap rates. It has been worked out, on all India basis, that a rate of electric supply in excess of 9 nP per unit would not provide much incentive to the cultivators for taking to lift irrigation. It is, therefore, necessary that the rate of electric supply for irrigational pumping should be fixed within the ceiling of the economic rate. It is also desirable that the terms and conditions in regard to minimum consumption, line rental, length of extension line to be constructed at irrigator's cost etc. should be liberalised as much as possible in favour of the irrigators. These steps are particularly called for in view of the fact that there is increased emphasis on lift irrigation from groundwater during the Third Plan and this trend would continue during the Fourth and subsequent Plans.

(5) **Simplification and Rationalisation of procedure involved**

8.13. Many delays and bottle-necks in the implementation of the programme can be cut down considerably if the lengthy procedures involved, are simplified, and rationalised. Keeping this objective in view, steps are particularly necessary in the following directions:—

- (a) *Delegation of adequate powers to field officers.*—It is noticed that the old financial limits and rigidity of rules for accepting tenders, executing contracts, making payments, disbursing loans, imposing or waiving of penalties, placing indents, making purchases, entertaining staff, etc., are still continuing though the price of material and labour wages have gone up considerably. Even if some relaxation has been permitted, it is not commensurate with the rise in the price index. There is need for greater decentralisation and more flexible rules in these matters for obtaining technical efficiency and avoiding delays in execution.

(b) *Sanction of financial assistance to cultivators.*—There is still considerable scope for streamlining the process of sanction and grant of loans and other financial assistance to the cultivators. The Programme Evaluation Organisation in its study observed many cases of delays and procedural bottlenecks in the sanction of financial assistance to the cultivators. In some cases, the sanction was delayed even beyond the period it was needed for.

(6) Expeditious sanction of Annual Programmes and Funds

8.14. It is essential that the programme drawn up for a particular year should be sanctioned well in advance of the construction season and the sanction should be conveyed to the execution staff in time to enable them to take up the work without loss of construction period. Budget allotment should also be conveyed expeditiously to the field officers.

CHAPTER IX

MAINTENANCE OF COMPLETED WORKS

9.01 While new minor irrigation works are being built at a rapid pace, it is of particular importance that satisfactory arrangements should be made for maintenance of completed works in order to ensure their sustained usefulness. The fact that adequate attention has not been paid in the past to the maintenance of completed minor irrigation works is reflected in a large number of derelict tanks channels and other works that exist in almost all the States. Quite a large number of works originally belonging to zamindars and malguzaridars have suffered on account of neglect of repairs for several years due to lack of interest on the part of their erstwhile owners. The pace of new arrangements for looking after these works has not been commensurate with the magnitude of the problem involved. Arrangements for satisfactory maintenance need to be more broad-based and comprehensive.

9.02 From the point of view of arrangements for maintenance, minor irrigation works may be divided in three categories:—

- (i) works owned by individual cultivators;
- (ii) State managed works; and
- (iii) community works which provide benefits to a number of cultivators residing in one village or more than one village and are not maintained as State works.

9.03 The problem of maintenance is particularly acute in case of works under category (iii) above. This category of works in different States would include works, such as embankments and drainage channels in Assam, drainage and small irrigation channels in West Bengal, Zamindar and malguzaridar and other tanks in Andhra Pradesh, Madhya Pradesh, Madras, Maharashtra, Orissa, Rajasthan and West Bengal; zamindar canals and kuhls in Uttar Pradesh, Punjab and Jammu & Kashmir; check dams and rapats in Rajasthan, bandharas in Gujarat and Maharashtra, bundhies in Madhya Pradesh and Uttar Pradesh; and ahars and pynes in Bihar.

9.04 A number of Conferences, Committees, Teams and other authorities which have discussed minor irrigation development plans during the last five years have laid stress on the need for improved arrangements for maintenance of minor irrigation works. The Regional Minor Irrigation Conferences held in 1958 and in 1961, had considered the problems in great detail and pin-pointed certain important aspect desired to be taken by the State Governments for effective tackling of the problem. The matter was once again gone into at length during the annual Conference of Ministry of Community Development, Co-operation & Panchayat Raj in 1962 and then again in the Joint Conference of Ministers of Agriculture, Community Development & Cooperation in 1963. Study of the problem of minor irrigation works carried out by the Programme Evaluation Organisation of the Planning Commission has also discussed the problem in details.

9.05 The important steps that have been reiterated from time to time are enumerated below:—

1. *Fixation of responsibility for maintenance.*

- (a) Maintenance of the individually owned works would be the responsibility of the individuals owning these works.
- (b) In regard to community works benefiting groups of cultivators, responsibility of maintenance should be increasingly placed on the local institutions.
- (c) In cases in which it is not feasible to transfer the works to Panchayats or where it is otherwise considered desirable, special irrigation cooperatives of beneficiaries should be organised for maintenance.

2. *Financial Resources for maintenance.*

- (a) Adequate provision of funds for maintenance of State owned works, should be made in the annual budget of the Departments concerned.
- (b) Wherever, necessary, arrangements should be made for levy of a maintenance cess which should be credited as a non-lapsable fund exclusively for the purpose of maintenance.
- (c) Local institutions should be empowered to levy irrigation rates and/or a suitable cess to defray the maintenance charges.
- (d) Necessary funds required for maintenance of works transferred to the Panchayats should be made available to these local bodies in the same way as they were available to the Technical Department handling maintenance in the past.
- (e) In case of protective works hitherto not maintained by the State Technical Department and in whose case the levy of irrigation charges by the panchayats may not be adequate to defray the maintenance cost, the State Governments should consider providing necessary additional funds to the panchayats for satisfactory maintenance of these works.

3. *Enforcement of Customary Obligations.*

- (a) Government/Local Institutions should enforce the customary obligations on the part of the beneficiaries in regard to maintenance of certain parts of the works.
- (b) Customary obligations should be clearly defined through a legislation making it incumbent on the part of the beneficiaries to fulfil these obligations.

4. *Laying down Technical Standards.*

Proper technical standards for maintaining the works should be prescribed by the concerned Departments for strict adherence by the agency responsible for maintenance.

5. *Circle System of Periodical maintenance.*

The circle system of periodical maintenance in vogue in the States of Madras and Andhra Pradesh should be introduced in States where periodical maintenance has not yet been a regular procedure.

6. *Technical Guidance.*

Local institutions should be equipped with adequate technical staff for maintenance of the works. Technical guidance should be made available to these agencies by the concerned State Technical Departments.

7. *Repairing Facilities.*

There should be adequate arrangement for servicing and repairing of mechanical water lifting appliance particularly in areas where the number of these appliances is large. The multi-purpose workshops set up in the blocks should be provided with mobile units for servicing and repairing of pumpsets. A stock of spare parts for pumps may also be maintained at these multi-purpose workshops.

8. *Training of Farmers.*

Intelligent young farmers should be trained in handling mechanical equipment, such as engines, pumpsets, etc. This training should be provided as part of the higher training programme for the gram sahayaks.

Introduction of suitable Legislation.

A suitable legislation which may

- (a) define the duties and obligations of the beneficiaries with regard to the maintenance of certain parts of the works;
- (b) enable Government to entrust responsibility of maintenance of works to local institutions.
- (c) authorise the local institutions to levy cess on the beneficiaries; and
- (d) empower the Government to carry out repairs/maintenance at its own cost in the event of default in carrying out these repairs/maintenance by the beneficiaries/local institutions and to recover the cost from the beneficiaries/local institutions at a later date,

is necessary. A tentative draft for a suitable legislative enactment on these lines had been sent to the State Governments by the Ministry of Food and Agriculture.

10. *Punitive tax to stop the practice of fore-shore and bed cultivation of tanks.*

A high penalty tax should be imposed in order to put an effective disincentive to the practice of cultivation of fore-shore and bed of tanks which leads to rapid silting of tanks.

11. *Periodical Inspection.*

All completed minor irrigation works whether State managed or private should be periodically inspected by Government agency to check and advise on maintenance, to take effective remedial measures wherever and whenever any tendency towards deterioration is noticed. For this purpose an inventory of minor irrigation works should be prepared on a prescribed proforma and maintained by the village Panchayats concerned and also by the Government agency.

9.06 Although several States have initiated some action on the above lines, much yet remains to be done. The present position obtaining in different States is broadly as under:—

Andhra Pradesh.—Works irrigating 200 acres and above in Andhra Region and over 100 acres in Telangana Region are maintained by the Public Works Department. Works irrigating lesser acreage are in charge of the Revenue Department which has its own technical staff for attending to the maintenance and repair of these works according to the Circle system, whereby all works in a taluk are inspected by rotation and repairs executed periodically. The State has decided in principle to entrust the maintenance of these works to the Panchayat Samities, which have been suitably equipped with the engineering personnel. The State has introduced an Irrigation Bill for compulsory maintenance of irrigation works by the villagers so far as *khudi muramat* work is concerned. It has been laid down that the Government would execute the maintenance work in default and then recover the cost from the beneficiaries.

Assam.—Works costing more than Rs. 10,000 each are executed and maintained by the Public Works Department. Their maintenance is financed by the Government but the cost is contemplated to be recovered from the beneficiaries. The maintenance of works costing less than Rs. 10,000 each which are executed by the beneficiaries themselves under the supervision of Agriculture Department and from funds provided on subsidised basis by the same Department, is left to the beneficiaries. In some cases, when high expenditure is involved, the Government pays 40 per cent cost of the maintenance leaving the remaining 60 per cent to be met by the beneficiaries. The Government has decided to transfer the maintenance of these works to the Panchayats and provision to this effect has, probably, been incorporated in the Panchayat Enactment introduced.

Bihar.—The State Government has decided in principle that minor irrigation works (other than those dealt with by the irrigation Department) should be entrusted to the Panchayats for maintenance. The Bihar (Private) Irrigation Works Act provides for the enforcement of maintenance of community as well as private works in the event of failure of the concerned agencies. With a view to making the provisions more effective and simpler, an amendment of this Act is under consideration of the State Government.

A proposal to place a suitable Revolving Fund at the disposal of the Panchayats and to vest them with necessary powers to enable them to maintain the minor irrigation works and recoup the Revolving Fund through recoveries from beneficiaries is under examination.

Workshop and mobile repairing unit facilities for spot repair of pump-sets are being increasingly provided.

Gujarat.—Minor Irrigation Works irrigating less than 250 acres are under Revenue Department at the district level while those irrigating a higher acreage under the Public Works Department. These Departments look after the maintenance of works in their charge. Since the introduction of Panchayat Raj in the State with effect from the 1st April, 1963, responsibility for maintenance of works under the Revenue Department devolves on the Panchayats.

Jammu & Kashmir.—The State Government has passed the Jammu and Kashmir Valley Panchayat Act, 1958, whereunder the Panchayats have been empowered to maintain minor irrigation works within their jurisdiction.

Kerala.—The State Irrigation Department is responsible for the maintenance of certain minor irrigation works (medium and lift irrigation works according to State classification). In regard to other works, the State has decided that Panchayats will carry out operational part of the maintenance at their own cost and would also attend to routine maintenance on payment of cost by Government at the rate of Rs. 2.50 nP per acre of land benefited.

Madhya Pradesh.—Maintenance of former Jagirdari, Zamindari and Malguzari works restored by the State Irrigation Department is also the responsibility of the same Department. Funds are provided in the Annual Budget. Their regular inspection and supervision is also arranged.

The maintenance of works irrigating less than 100 acres, which are constructed or renovated on grant-in-aid basis by the blocks has been entrusted to the Panchayats. Government is considering to entrust the maintenance of all tanks irrigating less than 100 acres, to Panchayats.

Madras.—Works irrigating more than 200 acres each, and those which are inter-linked in chain systems are restored as well as maintained by the Chief Engineer (Irrigation) in the Public Works Department. Adequate funds at the rate of Rs. 8 to Rs. 9 per acre are being ear-marked annually in the departmental budget for maintenance of these works.

The maintenance of minor irrigation works irrigating less than 200 acres, in charge of the Revenue Department, has been transferred to the Panchayat Union Councils. The Panchayats have been statutorily enabled to take up *khudi muramat* wherever necessary. Services of the Panchayat Union Engineers under the Chief Engineer (General) of the Public Works Department are available to the Panchayats for obtaining the necessary technical guidance in maintenance of works. Special annual grant referred to as 'local irrigation grant' varying in amount of Rs. 1.50 nP to Rs. 2.50 nP per acre is made available to the Panchayats to meet the cost of maintenance.

The State Irrigation Department offers to repair the pumpsets by charging extra supervision charges at the rate of 16½ per cent.

Maharashtra.—Works under the administrative control of the Irrigation and Power Department are being properly maintained by Government. The Organisation has been strengthened for the purpose. Works irrigating 250 acres or less have been transferred to Zilla Parishads for maintenance. The Parishads have been equipped with adequate engineering personnel.

Mysore.—The maintenance of about 200 big size tanks is looked after by the Public Works Department. Maintenance of Irrigation works having ayacut of 10 acres and below has been transferred to the Taluka Boards under the Panchayat Raj Organisation. All other irrigation works are in charge of the Revenue Department for maintenance. Provision has been made in the Mysore Irrigation Bill for taking over all the works irrigating above 100 acres gradually for maintenance by the Public Works Department. It is proposed to gradually transfer the maintenance of all the works irrigating below 100 acres to Taluka Boards.

Customary obligations of the ryots in maintenance are enforceable as per provisions of Chapter IV of Mysore Irrigation Act, 1932.

Orissa.—As per Orissa Irrigation Act, 1959, the State Government is responsible for proper maintenance of all Government minor irrigation works. Maintenance of other minor irrigation works is done through the agency of the Panchayat Samities for which necessary funds have been placed at their disposal for expenditure.

Under the Orissa Government Zilla Parishad Act and the Gram Panchayat Act, the State Government can transfer any minor irrigation works to the control of the Zilla Parishads or Panchayat Samities for a more convenient maintenance. The proposal to transfer all minor irrigation works irrigating less than 60 acres to Panchayat Samities is under consideration of the State Government. The Gram Panchayat would maintain the minor irrigation works at their own resources which they are prepared to augment by levy of cess for such maintenance.

The Agriculture Department has set up Zonal Servicing Centres in different parts of the State for repair of pumpsets and other agricultural implement belonging to individual cultivators.

Punjab.—The works constructed by the Irrigation Department are maintained by that Department. Maintenance of other minor irrigation works is being entrusted to village panchayats, block samities and zilla parishads under the new set up of Panchayat Raj. These local institutions have been equipped with adequate engineering personnel.

Rajasthan.—Small irrigation works with potential of 50 acres and below have been transferred to Panchayat Samities and for their maintenance 21 Assistant Engineers have been posted. Works executed by State Irrigation Department are maintained by that Department.

Uttar Pradesh.—All irrigation works constructed by the State Irrigation Department are maintained by that Department. It is proposed that minor irrigation works irrigating upto 50 or 100 acres may be transferred to the Gaon Sabhas for maintenance.

West Bengal.—The minor irrigation schemes already executed or to be executed hereafter by the Government will be maintained by them. The maintenance of works constructed under small irrigation schemes, costing less than Rs. 10,000 each rests at present with the beneficiaries. It is proposed that those works out of these which are not owned by private individuals but benefit a group of cultivators would be gradually made over to Panchayats for maintenance as and when they are set up. As for tanks, there is no difficulty of maintenance under the Tanks Improvement Act. As and when the Panchayats are set up, it is proposed that the Panchayats may be made the 'authorised persons' under the Act and these tanks may be made over to them for re-excavation and maintenance and the realisation of water rates and lease rent, etc.

9.07. It would appear that in regard to small community works having irrigation potential below a certain specified acreage most of the States have decided in principle to entrust the maintenance to Panchayats and some States have already taken action in this direction. This step alone, however, is not sufficient. In order to ensure proper and sustained maintenance of these works by these bodies, it is essential that the transfer of maintenance responsibility to the Panchayats should further be followed by the following steps:—

- (a) Panchayats should have adequate finances either raised by themselves through levy of cess, etc., or obtained as grants from Government;
- (b) They should have adequate support of technical staff;
- (c) Some Government departments, preferably the one which deals mostly with the types of works transferred to the Panchayats should maintain an inventory of all such works at the district level and the officers of this Department should be clearly charged with the responsibility of inspecting these works periodically and taking prompt measures wherever any default or neglect in repairs is noticed;
- (d) The Department should be statutorily empowered to carry out the repairs at its own cost in the event of default and to recover the same later from the beneficiaries.

9.08. Some States have already initiated action to provide finances to the Panchayats and also to provide technical staff support. However, the efforts made so far are not commensurate with the magnitude of the problem and need to be intensified.

9.09. Till such time that the responsibility for maintenance of smaller community works is transferred to the Panchayats, it is highly essential that the responsibility for maintenance of such works completed under the minor irrigation programme should squarely rest on the State Technical Department executing the works.

9.10. For State-owned works, there is need and scope for improving the extent and standards of maintenance carried out. Annual budget allocation for this purpose in many States is still not adequate and needs to be increased.

9.11. When minor irrigation works like tanks and bandharas (diversion schemes) are linked up in a chain system in a valley, it is highly desirable in the interest of their proper maintenance and optimum utilisation that all the works, irrespective of their irrigation capacity, should be in charge of one agency for maintenance.

9.12. Much attention has not been paid to the sustained maintenance and utilisation of individually owned works like wells, pumpsets, private tubewells, filter-points, etc. While the responsibility for maintenance of these works, no doubt, rests with individual cultivators, Government agency is still required to play an important role to ensure continued maintenance and utilisation of these works. The Working Group is strongly of the view that the Government Departments, preferably the one which deals mostly with these schemes and provide technical guidance in their initial construction, should maintain an inventory of all these works at district/block levels. The officers of this Department should keep a close and regular watch on the maintenance and utilisation of these works and take prompt measures wherever any deterioration is noticed. A regular record of water table fluctuations in the region should also be kept and wherever any undue lowering is observed, adequate measures should be taken to stop further groundwater tapplings in the region and to augment groundwater supplies by taking up suitable schemes for the purpose.

9.13. With the increase in the number of diesel engine pumpset installations at a fast rate, it is urgently necessary that proper facilities for repair of these appliances should also be made available in nearby places on a commensurate scale. Greater attention than that hitherto paid is necessary in this direction.

9.14. In regard to maintenance of drainage system, it is desirable that the responsibility for maintenance of field drains should rest with individual cultivators owning the fields. Proper maintenance of the drains should be ensured by legislation empowering Government to repair them in case of default and to recover the cost from the beneficiaries afterwards. Responsibility for maintenance of small lateral drains may either be squarely placed on the Panchayats or the Government Department in charge of Planning and Implementation of the drainage schemes. Responsibility for all bigger lateral drains and main drains should preferably rest with the Government Department executing these schemes. Government Department/Panchayats may recover from the beneficiaries a suitable drainage cess to defray the maintenance charges.

CHAPTER X

UTILISATION OF IRRIGATION POTENTIAL

10.01. When large sums of money are being spent in providing new irrigation facilities at an unprecedentedly fast rate, it has become very important that the irrigation potential created should be utilised fully and expeditiously. By and large, on minor irrigation works, the time lag between creation and utilisation of benefits is short: irrigation potential on most of the works is utilised within a year or two after their completion. There is, however, a degree of delayed or under-utilisation on some categories of works, such as, tubewells and other State-managed works which are comparatively of bigger size and extend irrigation in new areas.

10.02. Broadly speaking, the causes for non-utilisation or under-utilisation may belong to one or more of the following categories:—

- (i) Time lag between completion of various appertinent parts of the works, for instance, between completion of a tubewell and its energisation;
- (ii) Capacity of the work may be larger than the irrigation command available either due to limited holding or topographical features;
- (iii) Reduction in the irrigation water output due to depreciation of works; and
- (iv) Factors pertaining to water management beyond delivery points on the irrigation works.

10.03. The causes under categories (i) and (ii) above usually relate to bad planning in execution of the irrigation scheme and have already been dealt with under that head. The reason for causes under category (iii) is either poor maintenance or the inevitable depreciation inherent in the nature of the work. In a more rigid sense the causes under category (i) to (iii) above pertain to delayed or non-creation of irrigation potential or its loss due to depreciation, rather than to its defective utilisation. These are only the causes under category (iv) above, which strictly speaking are responsible for delayed or under-utilisation of irrigation potential created.

Water Management beyond outlets—its different phases and aspects.

10.04. Water management beyond outlet points of the irrigation source/canal systems comprises the following five phases :—

- (i) *Conveyance of Water.*

10.05. This phase consists of alignment construction and maintenance of field channels for carrying the water from the delivery points to the fields of the cultivators. The construction of channels includes insertion of falls (drops) wherever needed to prevent bed erosion and provision of

suitably designed cheap structures at the crossings with roads and drainage channels, to avoid wastage of water at these crossings. Proper construction and maintenance of field channels is an essential requisite for both expeditious as well as economic utilisation of irrigation water. In some States, water is carried from field to field. This practice is highly wasteful of water and should not be encouraged.

10.06. Field channels are expected to be constructed and maintained by the beneficiaries themselves. This, however, is not always done. Association of Panchayats with this work and intervention by Government in case of prolong default may, therefore, be necessary.

10.07. Field channels being mostly katcha, there is considerable loss of water during transit. It has been estimated that of the total quantity of water let into a canal system about 20 to 22 per cent is lost in field channels. Considering this vast magnitude of loss there is a good scope for economising the use of irrigation water by lining the field channels. Even if only the main branches of these channels are lined, there may be considerable saving in the loss of irrigation water. It is, however, difficult to persuade the cultivators to invest on lining their channels unless some cheap method is devised. There is great need for evolving and extending the use of such methods.

(ii) *Distribution of Irrigation Water.*

10.08. Distribution of irrigation water from the channel to the individual fields of the cultivators is included in this phase. The water is distributed equitably among the farmers according to the turn system either agreed upon mutually by the cultivators or enforced by Government. This phase provides scope for introduction of cheap portable water control equipment such as canvas dams, wooden regulators, syphon tubes, bamboo spouts, etc., in order to keep the field channels in proper form and avoid wastage of water at the diversion points.

(iii) *Application of Water in a proper manner.*

10.09. This phase comprises weed eradication and levelling and preparing the fields for receiving irrigation water. For optimum utilisation of irrigation water, it is essential that fields should be prepared according to sound irrigation methods consistent with the crops to be raised and the local soil conditions. There is a good scope for improvement in this phase through proper research, training and extension measures. There is particular need for introducing cheap bullock drawn implements for levelling and preparing fields at low cost.

(iv) *Application of Irrigation Water in right quantity and at proper intervals.*

10.10. This phase consists in application of irrigation water at the right time and in proper quantities with a view to obtaining maximum production. There is a great need for providing adequate technical guidance to the cultivators in regard to this phase. Extensive research and extension on agronomic aspects of irrigated agriculture is necessary.

(vi) *Planning of crop and other agricultural activities in relation to agriculture.*

10.11. This phase of water management consists in planning of crops, crop rotations and other agricultural activities, such as, use of fertilizers, manures, etc., in relation to the quantity and pattern of available irrigation supplies, with a view to obtaining maximum benefits. As for the previous phase, considerable research and extension work is needed to introduce improved practices relating to this phase of water management.

Causes pertaining to Water Management responsible for under or delayed utilisation.

10.12. The causes for delayed or under-utilisation of irrigation facilities have been investigated in detail by a number of authorities. There is a general agreement that these causes usually comprise:—

- (a) delay in construction of field channels;
- (b) excessive wastage of water in field channels;
- (c) delay in proper preparation of fields;
- (d) lack of technical knowledge and guidance in regard to cropping pattern, irrigation practices and allied agricultural practices;
- (e) inadequate arrangements for supply of good seeds, fertilizers, manures and for provision of storage, transport and marketing facilities; and
- (f) inadequacy of financial resources available to the farmers in general for changing from dry to irrigated farming.

Measures for expeditious and fuller utilisation of irrigation potential.

(i) *Advance planning and action.*

10.13. When new area comes under irrigation, considerable improvement in the form of weed eradication, levelling, construction of field channels and provision of drainage becomes necessary before the area is rendered in a fit condition for receiving water. The magnitude of the work involved in these operations becomes very substantial when the new command under the project includes wasteland lying un-cultivated. In some cases, amelioration of land by lime or gypsum also becomes necessary. To ensure that irrigation facilities created are utilised promptly, it becomes essential that advance action may be taken to develop the ayacut simultaneously as the work on the project progresses.

(ii) *Expeditious completion of field channels.*

10.14. This can be achieved by persuasion, providing technical guidance and help in aligning, etc., associating village panchayats and finally by execution at Government cost in the event of prolonged default and later recovering the cost from the beneficiaries. In States, where appropriate legislative enactment enabling intervention by Government in the event of default does not exist, the measure needs to be introduced without further delay.

(iii) *Improvement of field channels.*

10.15. Losses on field channels can be minimised by their proper alignment and grading, provisions of falls and drainage crossing works wherever needed and introduction of simple portable water control equipment. Lining can also be thought of, particularly in very porous reaches and on lift irrigation schemes where water is comparatively very costly and cannot be afforded to be wasted. Technical guidance would need to be provided to the cultivators in these matters. Cost of lining in difficult reaches may also be considered to be subsidised to some extent by Government.

(iv) *Helping the cultivators in levelling and preparing fields.*

10.16. While on major-medium irrigation works, tractorisation may be desirable, levelling by manual labour may be sufficient on most minor irrigation works. The cultivators, however, require to be assisted in two ways—(a) technical guidance and assistance in introducing improved animal driven implements for levelling and preparation of fields at low cost, and (b) extension of credit facilities for meeting the expenditure involved.

(v) *Obtaining and extending reliable data and information on irrigation practices, cropping patterns and use of implements, etc., specially suitable for local conditions.*

10.17. For expeditious and fuller utilisation of available irrigation potential, it is necessary to evolve and introduce: (a) intensive cropping pattern suited to the local conditions of soil and climate, and (b) irrigation and allied agricultural practices which are most suitable for the proposed cropping patterns under the local conditions. This data can either be obtained by actual requirements taken up in the commanded area sufficiently in advance or collected from other research centres where reliable work has already been carried out under representative conditions.

(vi) *Setting up of Demonstration Plots.*

10.18. The age-old practice of dry farming or farming based on rainfall cannot be changed without persistent efforts. Besides, persuasion and publicity, actual demonstrations in the fields are considered very essential to bring home to the cultivators the merits and advantages of the methods and the techniques suggested. Under each project suitable number of holdings dispersed over the commanded area should be developed on demonstration basis in order that these holdings could serve as example to be emulated by the neighbouring farmers. The Extension Staff in the Blocks and the minor irrigation staff should utilise every demonstration holding for an active educational effort among the farmers of several villages around the holding and create in them the needed motivation to secure adoption of the ideas demonstrated. The cost of demonstration including the cost of land development, lining of channels, purchase of equipment, etc., should be borne by the Government.

(vii) *Making proper arrangements for complementary facilities—establishment of warehouses and godowns.*

10.19. Advance action should be taken in all new areas brought under irrigation, to fully meet the requirements for improved seeds, fertilizers, improved implements and storage, communication and marketing facilities, which are enormously increased consequent on introduction of irrigation.

(viii) *Extension of credit facilities.*

10.20. Shortage of finances is one of the major bottle-necks that the cultivators have to face with a change-over from dry to wet cultivation. The cultivator is required to level his land, eradicate weed, construct field channels and drainage channels and also to arrange increased requirements of seeds, fertilizers, manures, livestock, etc. He also needs finances and bullock power for operating the irrigation source, if it is a well. All these activities may involve investment varying from Rs. 100 to Rs. 400 per acre depending on the conditions of the area. Most of the cultivators are hardly able to muster up finances of this order from their own resources. Extension of credit facilities on liberal terms is, therefore, an essential step towards expeditious utilisation. Increasing efforts have to be made in this direction by the State Cooperative Departments.

(ix) *Fixing Responsibility.*

10.21. It would appear from the items mentioned above that the area development programme for expeditious and optimum utilisation of the irrigation works completed would involve activities of three Departments: the Irrigation Department, the Agriculture Department and the Community Development & Cooperation Department. Fixing of the position of the outlets and marking the alignment of the field channels would be the responsibility of the Irrigation Department. The Agriculture Department would be responsible for (a) helping the cultivators in levelling and preparing the fields, (b) obtaining and disseminating information on the irrigation practices, cropping patterns, use of implements, etc., especially suitable for local conditions, (c) setting up of demonstration plots, and (d) making proper arrangements for complementary facilities, such as improved seeds, fertilizers, implements, marketing, storage, etc. The Community Development & Cooperation Department should help in mobilising community efforts for construction and maintenance of field channels and in making available sufficient credit facilities to the cultivators for various purposes.

10.22. For effective and timely implementation of the various measures, it would be necessary that one specific Governmental agency, preferably the Agriculture Department may be clearly charged with the over-all responsibility of planning and timely undertaking of all measures with the help and cooperation of other Departments concerned.

CHAPTER XI

ASSESSMENT OF IRRIGATION BENEFITS

(Methodological Problems)

11.01. For realistic planning and implementation and obtaining effective, concrete results, proper assessment of the physical benefits accruing from different schemes taken up under the programme is a basic essential requirement. It is only through progressive statistics of these benefits that it become possible to make a critical view of the past performance, watch the progress of a fast developing programme and project future plans on sound and scientific lines. If the basic statistics and assumptions on which the plans are formulated are defective, it would be difficult to obtain the desired results.

11.02. Irrigation programme under all the Sectors, major, medium and minor, has been progressing at an unprecedentedly fast rate since the beginning of the First Five Year Plan. It is likely that its pace of implementation would further be accelerated considerably in the future Five Year Plans. It is, therefore, of utmost importance that a precise assessment of physical benefits accruing from different schemes executed under this important and fast accelerating programme is carried out regularly on proper lines.

Present Methods of Assessment and Collecting Statistics.

11.03. Progressive statistics in regard to development of irrigation resources in the country is available from two sources. One source is the Land Utilisation Statistics which compiled annually in every State as a regular practice continuing from the Pre-Plan period. This statistics is collected by the State Governments mostly through the village revenue agency on the basis of field to field enumeration. Besides furnishing information on various other items relating to Land Utilisation, this source gives figures of net area irrigated, in a particular year, under five different sources, namely, Government canals, private canals, tanks, wells and other sources. The figure of gross area irrigated under various crops is also given but its break-up under the above mentioned sources is not furnished.

11.04. The other source of information is the progress reports that are periodically furnished by the State Governments on the schemes taken up under the Five Year Plans. Such reports on major-medium irrigation schemes give the figures of progressive irrigation potential created and utilised project-wise from year to year. In some States, such as Punjab and Uttar Pradesh, where the Irrigation Department is in charge of assessment of irrigated area for levy of irrigation rates, the figures of utilisation from year to year are based on this assessment. In other States, these are based on the assessment carried out by the Revenue Department. In the progress reports relating to minor irrigation schemes, the gross area benefited from various types of schemes executed under the programme from year to year is furnished.

Disparity between the two sets of figures—causes thereof

11.05. It was revealed in 1957, that there existed wide discrepancies between the two sets of statistics as regards the additional irrigation benefits accruing during the First Five Year Plan. The total additional benefits under the irrigation programmes as reported in the progress reports were not reflected in the Land Utilisation Statistics at the end of the Plan. Letters were consequently addressed to the State Governments indicating the discrepancies between the two sets of figures and requesting them to reconcile the same. Subsequently, a type study for the reconciliation of statistics from the two sources was carried out in the Punjab jointly by the Directorate of Economics & Statistics, Central Ministry of Food & Agriculture, and the Statistician, Department of Agriculture, Punjab. On the basis of this type study and critical examination of the problem in general, the following causes appear to be mainly responsible for the discrepancies:—

- (i) The statistics of acreage benefited by minor irrigation reported in the progress reports do not wholly represent addition to irrigated area for they include—
 - (a) old irrigated area over which irrigation has been made more certain or established as a result of renovation of old works;
 - (b) area benefited by water conservation-cum-groundwater re-charging schemes, such as ahars, bundhies, rapats, head-water tanks, percolation tanks, etc.; and
 - (c) area benefited by drainage, flood control and anti-sea water intrusion works.
- (ii) While additional areas are brought under irrigation through large and small irrigation schemes, the existing areas may be going out of irrigation due to depreciation of existing works. This applies particularly to storage works and wells, pumpsets, tubewells, etc. It has to be realised that these works have a span of life and even in spite of best regular maintenance some irrigation potential is lost on these works due to gradual silting up in the case of storage schemes and depreciation or failure in the case of wells, pumpsets, tubewells, etc.
- (iii) The irrigation data reported under Land Utilisation Statistics relate to areas actually receiving irrigation in a particular year, which is dependent on rainfall and other climatic conditions in a particular season and the availability of water in irrigation sources. Hence, the increase in the irrigation facilities created are not necessarily reflected in the irrigation benefits actually utilised in any particular year.

11.06. There are other factors which have to be taken into account in comparing the two sets of figures:—

1. While reporting progress, the individual minor irrigation schemes may not always be properly classified and their names may sometimes be confused with the result that the figures may be reported against the wrong categories.

2. Due to inadequate appreciation of the concept of the figures reported in the progress report, the figures reported in some cases may relate to irrigation potential in terms of gross area and in others to irrigation potential in terms of net area. Further in some cases, the additional areas benefited from the schemes during the period under report may be indicated while in others cumulative totals since the inception of these schemes may be repeated each year.
3. There may be lack of coordination at the district and lower levels between the agencies responsible for furnishing the two sets of figures.
4. There may be over-lapping of benefits from major-medium irrigation and minor irrigation schemes. If an area receives benefits from two sources, the area is usually reported under one major source only. After the introduction of irrigation from major-medium sources some of the minor irrigation works in the area may go out of use.
5. There may be some time lag between the completion of works and actual utilisation of irrigation potential even on minor irrigation schemes, such as tubewells and comparatively large-sized gravity flow irrigation schemes. In the progress reports the area is reported as soon as the works are completed.
6. In the case of private works, such as wells, pumpsets, etc., the irrigation benefits are calculated on the basis of average yard-stick of benefits for each unit of work. The accuracy of the estimated benefits from such works depends on the reliability of the yard-stick.

11.07. Apart from the above factors, the possibility, in general, of under-estimation in Land Utilisation Statistics and over-estimation in the areas furnished in the progress cannot be ruled out unless actual benefits are assessed on the basis of random sample surveys. The Land Utilisation data is not very much reliable, particularly in the States of Assam, West Bengal, Bihar and Orissa. While statistics of irrigation according to Land Utilisation data have now become available for the year 1960-61, the data in this statistics in Assam relates to the year 1953-54 and for Rajasthan, Kerala and West Bengal, the data relating to the year 1958-59 have been repeated.

11.08. Yet another inherent short-coming of the Land Utilisation Statistics is that the source-wise classification adopted for reporting the irrigated area does not afford separate estimates in respect of major, medium and minor irrigation works. Further for the gross irrigated area no source-wise break-up at all is furnished. This makes comparison all the more difficult, particularly because the area benefit given in the progress reports is gross.

Measures taken for Improvement and Reconciliation

11.09. The problem of proper assessment of benefits accruing under the minor irrigation programme was discussed at length during the three Minor Irrigation Regional Conferences held in 1958. Attention was

focussed in short-comings, limitations and ambiguities inherent in the procedure adopted. As a result of the deliberations during these Conferences, apart from some important classifications being made, several measures had been recommended for improving, the collecting and reporting of statistics. These recommendations were communicated to the State Governments for implementation. The Ministry followed it up by addressing a number of letters, from time to time, suggesting some additional measures and stressing the need of implementing the various recommendations already conveyed.

11.10. The matter, then, was once again considered during the next three Regional Minor Irrigation Conferences held in 1961. Important recommendations earlier made were reiterated and a few additional suggestions made.

11.11. The important recommendations that have, since, repeatedly been stressed on the State Governments may be enumerated as under:—

1. A standard classification should be followed for categorising different types of minor irrigation schemes for the purpose of collecting and reporting statistics.
2. There should be clear appreciation of the concepts of irrigation targets in terms of gross irrigated area or net irrigated area and of other terms used in collecting and reporting statistics.
3. The progress of minor irrigation schemes should be maintained and reported in terms of physical units of works completed as well as the areas benefited.
4. It should be ensured that the figures reported in the progress reports represent the additional area benefited during the period under report and not the cumulative benefits since the inception of the scheme, because for assessing annual progress what it is relevant is the figure of additional area covered during the year.
5. The figures of area benefit of different types should be accounted for and furnished separately in the periodical progress reports.
6. Proper sample surveys should be undertaken from time to time with a view to evaluating yard-sticks of benefits adopted for reporting the progress of different schemes.
7. Data relating to the area going out of irrigation each year should be compiled in order to have an idea of the extent of discrepancy resulting from physical deterioration of existing irrigation works.
8. Checking of certain percentage of completed works and of the areas actually irrigated from time to time should form part of the inspection work of supervising officers at all levels of the Departments concerned.
9. Periodical meetings may be convened of the heads of the various Departments in charge of execution of minor irrigation schemes with a view to reviewing the progress made and

assessing the irrigation benefits achieved in the minor irrigation sector as a whole and reconciling the discrepancies, if any, between the figures of additional irrigation facilities created as a result of the programme as reported in the progress reports and those obtained on the basis of irrigation statistics reported as per Land Utilisation Statistics.

10. A single agency may be made responsible for collecting and reporting statistics of irrigation and this agency should be provided with adequate statistical staff to assist in the discharge of the prescribed functions.

Important aspects relating to Methodology—Recommendations for—
Further action.

11.12. Though the quality of statistics furnished in the progress reports has appreciably improved during the last few years, yet much remains to be done for further improving the methodology in collecting and reporting statistics on irrigation development. The recommendations of the Working Group on important aspects involved are as under:—

(i) *Clear classification of minor irrigation schemes.*

11.13. For correct reporting of statistics, it is very necessary that different types of schemes implemented under the minor irrigation programme should be properly classified and the distinctive scope and technical nature of each scheme is clearly defined. This has already been done by the Working Group, *vide* Chapters II and III of this Report, for the purpose of formulating Fourth Five Year Plan Proposals. The Working Group is strongly of the view that the same standard classification should be uniformly adopted by the State Governments for drawing up their minor irrigation programme as well as for recording and reporting progress thereon. In the revised classification, the various local expressions used for denoting different types of schemes have also been mentioned so that no ambiguity remains in understanding the scope and technical nature of these schemes. There should be full appreciation of this classification on the part of the offices responsible for planning the programme and for collecting, scrutinising and reporting statistical data on the progress made.

(ii) *Proper appreciation of different types of benefits accruing from minor irrigation schemes.*

11.14. As has already been discussed in Chapter II, the benefits accruing from minor irrigation schemes may be divided under the following four categories: (a) new irrigated area, (b) old irrigated area over which irrigation is made more assured or stabilised, (c) benefits in the form of water conservation, submergence of land or recharge of groundwater, and (d) benefits by way of drainage, flood protection or anti-sea water intrusion. It would appear that whereas in the case of (a) above, benefits accrue both in the form of extension of irrigated area and contribution to additional production, in the case of other categories, *viz.*, (b), (c) and (d), implementation of schemes does not result in increasing the irrigated area though there would be increase in production. It is, therefore, of fundamental importance that the benefits accruing from minor irrigation schemes should be collected, compiled and reported separately

under the above four categories. It is felt that if this procedure is adopted in all cases, much of the present confusion and ambiguity about irrigation statistics would be cleared.

(iii) *Clear concept of various terms used.*

11.15. To avoid confusion and ambiguity in collecting statistics and reporting figures, it is very important that the various terms used in this connection should be clearly defined and understood. To fulfil this objective, the Working Group suggests the following standard definitions for the important terms used:—

1. *Gross area irrigated.*—This might be defined as the total area irrigated under various crops during the year, including the area irrigated under more than one crop during the same year as many times as the number of crops grown.

2. *Net area irrigated.*—This might be defined as the area irrigated during a year where, if two or more crops were irrigated on the same area during the year, the area was counted only once.

3. *Works completed.*—The works completed might be defined as the works on which all construction work had been satisfactorily completed and the works were in a position to yield full water output of which they were capable.

4. *Irrigation potential created.*—Irrigation potential created from a work or a group of works might be defined as the area which would be possible to be irrigated by such works, taking into account the irrigation capability of the work/group of works completed on the basis of their water output and irrigable command.

5. *Estimated utilisation.*—Estimated utilisation of irrigation potential created might be defined as the area which could, according to the estimates framed at that time, be actually brought under irrigation, during a specified period of time, after completion of the work/group of works.

6. *Actual utilisation of irrigation potential created.*—Actual utilisation of irrigation potential created might be defined as the actual area which received irrigation during the specified period of time, after the completion of work/group of works.

(iv) *Procedure for collecting and furnishing figures in the progress reports.*

11.16. Achievements under the minor irrigation programme are reported in terms of financial outlay, physical unit completed and acreage obtained. Minor irrigation works are generally of two types: (a) private works owned by individual cultivators and (b) State works or community works. As far as the reporting of the financial outlay is concerned for both these categories of schemes, figures of achievement are compiled and reported on the basis of actual expenditure incurred during the period under report and there is no difficulty or ambiguity about it. Similarly, the practice in vogue for reporting achievements in terms of physical units in respect of both the categories of works is that the figures reported pertain to the actual number of works completed during the period under report. As regards benefits in terms of acreage, in case of private works, it is arrived at by multiplying the number of physical units completed by

a standard yardstick which is supposed to represent the average area benefited per unit of work in the region concerned. In the case of State works, the benefits in terms of acreage are worked out by taking into account the water availability from the schemes, intensity of irrigation and cropping pattern proposed and the standard duty factors applicable to the region concerned.

11.17. The Working Group concludes from the above procedure that the achievements reported in terms of acreage relate to benefits in terms of potential created and not to their actual utilisation. Also, as the figures reported related to works completed, it will not always be possible to link up outlays incurred and the benefits achieved on a scheme-wise basis. However, if the carry-over benefits at the end of each year are more or less of the same order the magnitude of the discrepancy may not be appreciable.

(v) *Verification of yardsticks and other norms used for forecasting irrigation.*

11.18. It is clear from the above procedure that the accuracy of the figures of benefits reported for the individually owned private works depends on the correctness of the yardsticks adopted. There is, therefore, need for evolving these yardsticks on a realistic basis, with due regard to regional variations, and constant verification and checking of yardsticks by random sample surveys organised on scientific lines.

11.19. It is also necessary that the irrigation potential on State works or community works should be worked out by the authorities concerned, after careful investigations and on a realistic basis, taking into account the water requirements of crops, water availability and also local soil and climatic conditions. The various norms or factors applied, such as water allowance, duty factor, outlet factor, capacity factor, intensity of irrigation, etc., should be carefully reviewed in the light of the latest scientific knowledge available on water and irrigation requirements of crops.

(vi) *Factor of delay in utilisation.*

11.20. As mentioned earlier, the achievements reported relate to benefits in terms of potential created and not their actual utilisation. However, the Working Group is of the view that there is usually not much delay in utilisation of benefits from minor irrigation schemes. On all such works as wells, pumpsets, small tanks, diversion schemes, etc., the potential created was utilised almost immediately or within a year at the most. Delay in utilisation occurs mainly in the case of either tubewells or of comparatively larger storage and diversion schemes. It is estimated that in respect of about 80 per cent of the total minor irrigation programme, there is no appreciable delay.

(vii) *Allowance for depreciation.*

11.21. As already mentioned earlier, some area goes out of irrigation every year, particularly on storage works and works such as wells, tubewells, pumpsets, etc.,—due to silting up in the case of storage schemes and due to depreciation or failure in the case of other schemes. This factor has, therefore, an important bearing in the calculation of the net additional

benefits and needs to be given adequate attention by the State Governments in working out the net increase in the irrigated area. A precise assessment of this factor on all India basis is very difficult, particularly because the incidence of silting up or of depreciation would widely vary from region to region and scheme to scheme. It is highly desirable that the States may initiate detailed studies for making a precise appraisal of the yearly loss of irrigation potential due to this factor. One way of calculating the depreciation in irrigated area from a particular category of irrigation works may be to work out and apply an annual depreciation percentage factor on the entire area irrigated from that category of works during the year. For example, if 'B' is the irrigated area during the base year, 'X' is the additional area brought under irrigation during the Five Year Plan period subsequent to the base year and it is reckoned that the depreciation is of the order of 1 percent per annum, the total area lost due to depreciation during the corresponding Five Year Plan period would be—

$$\left(B + \frac{X}{2} \right) \frac{1 \times 5}{100}$$

(viii) *Procedure for calculating food production potential.*

11.22. The question arises how the food production potential may be calculated on the basis of the figures of achievement reported according to the methods outlined above. The Working Group is of the view that basically there could be two approaches for calculation of the food production potential. The first approach was that the potential benefit created during the particular year from the works completed during the year might be considered to be fully utilised during the next year. It would mean that for calculation of food potential created during a particular year, the benefits reported for the previous year should be taken into consideration. The other approach would be that the food production potential during a year might be calculated on the basis of the potential benefits created on the works completed during that very year. The first approach would be more realistic although still not wholly accurate but the second approach would be simpler though comparatively less accurate.

(ix) *Division of reported benefits under foodgrain and non-foodgrain crops.*

11.23. For purpose of creating food production potential, the Working Group suggests that the State Governments should estimate on an overall basis, for the State as a whole, the percentage of the aggregate benefit, reported under all the schemes, that is likely to be devoted to foodgrains. The foodgrains production potential could then be calculated by applying this percentage and the yardstick of foodgrains production per acre on the benefit of different categories.

(x) *Standard proforma to be prescribed for reporting benefits.*

11.24. The Working Group is of the view that there should be two proformas for reporting progress of benefits—one pertaining to financial outlay and the other to the physical achievements in terms of units and acreage benefited. The classification of minor irrigation schemes adopted in these proformas would strictly conform to the standard classification discussed in (i) above. The benefits under schemes which aim at restoration of existing irrigation works would be given separately for new irrigated

area and stabilised area. The progress reports would be submitted by the State Governments on quarterly basis. The progress reports for the fourth quarter would give the progress for the whole year.

(xi) *Improvement in collecting and reporting Land Utilisation Statistics.*

11.25. It is felt that the utility and effectiveness of the Land Utilisation Statistics in checking and comparing the figures of irrigation development furnished in the progress report would very much improve if the scope of this statistics can be broadened to furnish the following additional information:—

- (a) The area irrigated from different sources may be classified into—(i) irrigated from minor works, and (b) major-medium works.
- (b) Source-wise break-up may also be given for the gross irrigated area as is given at present for the net irrigated area.

CHAPTER XII

TARGETS PROPOSED FOR THE FOURTH FIVE YEAR PLAN

(In the perspective of development over a ten-years' period)

Perspective and Approach

12.01. An assessment of the long-term potentialities for development of minor irrigation in Chapter V places the potential as 75 million acres made up of 30 million acres from surface water resources and 45 million acres from groundwater resources. The level of minor irrigation development likely to be attained by the end of the Third Five Year Plan is estimated at about 50 million acres composed of about 24 million acres from surface water resources and about 26 million acres from groundwater resources. Thus from the technological point of view, there would be ample potentialities for further development of minor irrigation during the Fourth Five Year Plan. The size of the Fourth Plan on minor irrigation would, therefore, be mainly determined by the extent of financial, material and organisational resources that can be mobilised for implementation of the programme.

12.02. Recognising the need for development of minor irrigation facilities as quickly as possible, it has been desired that the physical target for minor irrigation during the Fourth Five Year Plan should be set as high as is considered feasible from the techno-economic and organisational considerations. The Working Group is required to indicate the administrative and technical measures, financial and material resources, and advance action that would be necessary to realise the proposed physical target.

Technical Possibilities and Priorities

12.03. The scope for long-term development from different categories of minor irrigation schemes, on country-wide basis, has been indicated in Chapter V. The scope for individual items would vary from region to region. In formulating State-wise Plans, it is important that only those schemes which are technically and economically feasible for the regions covered are included. Local technological considerations which have been kept in view in formulating State-wise targets are given in the Annexure.

12.04. In general, from techno-economic considerations on all India level, there would be special emphasis on the following schemes during the Fourth Five Year Plan:—

1. Renovation of derelict tanks which still remain unrestored at the end of the Third Five Year Plan;
2. Construction of open wells;
3. Boring and deepening of existing wells to augment their discharges;
4. Installation of power pumps, particularly the electrical pumpsets in areas where cheap hydro-electric power is extended;

5. Construction of small tubewells;
6. Lift irrigation from rivers and streams in areas where cheap hydro-electric power is available; and
7. Groundwater re-charge schemes.

12.05. It is anticipated that in spite of high priority being accorded to renovation of tanks, quite a large number of tanks would still remain derelict at the end of the Third Five Year Plan, particularly in the States of Mysore, Maharashtra and Madhya Pradesh. A special feature of the tank irrigation is that some additional tanks get into dis-use every year due to gradual silting up in spite of sustained regular maintenance being assured. Although arrangements for maintenance are now gradually being improved generally, some tanks would still get into dis-use every year. It is, of course, desirable on technical and economical grounds that priority should be given to restoration of existing tanks over construction of new ones.

12.06. Open wells form a very popular item under minor irrigation programme. They are the only means of irrigation in many tracts. Besides, open well irrigation has definite advantages over Government canals and tubewell irrigation: they are well suited to meet the requirements of small land holdings of individual farmers; they provide a greater degree of flexibility to the cultivator in planning his cropping and timing his irrigation applications; the cultivator fully appreciates the value of the water lifted from his well as he himself meets all the expenditure and labour involved and has thus sufficient incentive to use this water as expeditiously and economically as possible.

12.07. Boring and deepening of wells as explained earlier in Chapter III is a very useful scheme. It not only enables utilisation of local groundwater source which may otherwise remain untapped but also brings about additional benefits economically. It needs to be given maximum emphasis in such areas where boring and deepening operations are likely to augment well discharge.

12.08. Installation of power pumpsets on wells does not only result in increasing the water output on the wells thus bringing additional area under irrigation on the same well, but also enables releasing of the bullock power which is required by the cultivator for other important agricultural operations. In order to promote lift irrigation at a fast rate, there is need to undertake a crash programme for installation of pumpsets, particularly the electrical ones. There is indication that much increased emphasis will henceforth be given on power development and aggregate power generation in the country may increase during the Fourth Five Year Plan to double of what it is likely to be at the end of the Third Five Year Plan. Thus many new areas will be opened up where lift irrigation can be promoted by installing large number of electrical pumpsets. The scope and technical feasibility of pump installations can be enhanced considerably by integrating the programme of rural industries and irrigational pumping, so that not only the load factor is improved, but also cost of transmission lines is minimised.

12.09. Small tubewells catering for the needs of small irrigation commands are technically superior to dug-cum-bored wells in many areas

where groundwater availability is assured. As small tubewells can be owned and operated, in most cases, by individual cultivators, the problems of delayed utilisation of irrigation potential and realising adequate charges from the cultivators, as experienced on large-sized State tubewells, are largely eliminated. It is thus desirable that a larger programme of small tubewells may be taken up in the Fourth Five Year Plan.

12.10. There are many areas where adequate supplies—almost all the year round—are available in streams flowing nearby, but gravity flow irrigation from these sources is not possible due to topographical features. With the extension of cheap hydro-electric power, it is necessary that lift irrigation from such resources may be arranged on a large scale.

12.11. With expanded use of groundwater through open wells, boring and deepening of wells, installation of power pumpsets and construction of tubewells, it is important that proper replenishment of groundwater should be assured in all such areas where its availability is precarious. This would mean that the schemes such as percolation tanks, rapats, bundhies, ahars, etc., which help to recharge groundwater should be taken up in large numbers.

Increased Accent on Groundwater Development

12.12. While minor irrigation aims at developing both surface and sub-surface water resources, there has been increased emphasis on groundwater development during the Third Five Year Plan. The area expected to be benefited from the groundwater schemes during the Third Five Year Plan is estimated at 6.71 million acres (51.6 per cent of the total achievement) as against an actual achievement of only 3.0 million acres (33.3 per cent of the total achievement) during the Second Five Year Plan. This trend is accounted for mainly by the following reasons:—

- (a) Overall potentialities for development of minor irrigation are more from groundwater than surface water;
- (b) Groundwater use provides the only means of irrigation in many tracts in the country;
- (c) Conjunctive use of surface and groundwater in many areas results in important advantages, such as, increased intensity of irrigation in the tract; and control of water table within the safe limits, thus avoiding waterlogging hazards;
- (d) Groundwater supply is more valuable in years of drought when it is less liable to failure than surface water sources which are more directly affected by the rainfall;
- (e) Lift irrigation from groundwater stimulates and mobilises efforts of the individual cultivators to a greater extent in making full and economic use of irrigation water and obtaining maximum results. The standard of levelling and preparing fields and other irrigational and agricultural techniques adopted are better than in flow irrigation.

12.13. The above considerations would weigh in favour of continuing the trend towards increased groundwater development during the Fourth and the subsequent Five Year Plans.

Administrative and Organisational Factors

12.14. From the organisational point of view, the following factors need to be taken into consideration in deciding the size of the minor irrigation programme during the Fourth Five Year Plan:—

- (i) The administrative and organisational arrangements obtaining in various States for surveys and investigations, execution, maintenance and utilisation of minor irrigation works;
- (ii) The directions in which fresh or increased efforts need to be made to strengthen and gear up the existing organisation for taking up implementation of larger programmes during the Fourth Five Year Plan;
- (iii) Tempo of the programme likely to be built up at the end of the Third Five Year Plan;
- (iv) Appropriate rate at which the tempo may further be accelerated during the Fourth Five Year Plan keeping in view items (i) and (ii) above.

12.15. The technical and organisational aspects on various phases of minor irrigation programme have already been discussed in detail in Chapters VI to XI. The up-to-date position obtaining in different States has been indicated. The important measures or directions in which concerted efforts are required to be made by most of the States are as under:—

1. Strengthening the existing organisations for surveys and investigations, particularly for assessing groundwater potentialities and opening out fresh groundwater-worthy areas and preparing basin-wise/district-wise integrated master plans—formulating specific schemes for surveys and investigations.
2. Imparting greater technical bias in planning and implementation of minor irrigation schemes by (a) intensifying research and training programmes, (b) undertaking preparation of technical manuals and literature on minor irrigation schemes and arranging increased dissemination of technical knowledge on the subject, and (c) follow-up action on all important technical recommendations on various schemes that have been made from time to time and summarised in Chapter IX.
3. Arranging greater coordination in planning and implementation of minor irrigation schemes at the district and the field levels;
4. Strengthening the existing organisations for providing technical guidance on groundwater schemes, particularly on such items as design, size and spacing of open wells and tubewells and selection of water lifting appliances;
5. Entrusting the work of planning and preparing annual State Plans on integrated basis and according to phased priorities indicated in the long-term master plans, only to one technical agency at the District level and ensuring full cooperation of other technical agencies in preparing these plans;
6. Liberalising the terms and conditions for sanction and expansion of electric power to irrigators and charging concessional rates for the supply of electricity;

7. Making advance arrangements for procurement of key materials, equipment and materials according to properly worked out phased requirements;
8. Synchronising execution of all appurtenant parts of the works;
9. Simplification and rationalisation of the procedures involved—delegation of more powers to field officers, streamlining the procedure for expeditious sanction of financial assistance to the cultivators;
10. Improving arrangements for maintenance of completed minor irrigation works—need for departmental maintenance of small groups of work until they are transferred to the panchayats and the panchayats are equipped with financial, statutory and technical requisites for carrying out the maintenance;
11. Expeditious utilisation of irrigation potential created on works—advance planning and action; expeditious completion of field channels; helping out cultivators in levelling and preparing the fields; dissemination of data on irrigation practices, cropping patterns, use of implements, etc.; setting up demonstration plots; arranging complementary facilities; extension of credit facilities; fixing responsibility, etc. etc.;
12. Improving assessment of irrigation benefits adopting standard classification of schemes; clear appreciation of various terms used; undertaking regular sample surveys for evaluation of yardstick adopted; improvement in collecting and reporting Land Utilisation Statistics, etc.

12.16. The minor irrigation programme has expanded at a fast rate during the Third Five Year Plan. As against the actual outlay of Rs. 28 crores in the first year of the Third Five Year Plan, the projected outlay for the year 1965-66 i.e. the last year of the Plan is Rs. 70 crores. This accelerated implementation of the programme has been throwing up many administrative, organisational and technical problems. The need for better organised survey and investigations, particularly for assessment of groundwater potentialities and opening out new groundwater worthy areas has become acute. The planning and implementation of the programme requires greater technical orientation and bias at all levels. An intensive programme for training is required to be initiated for turning out trained technical hands who may carry out surveys and investigations for groundwater utilisation and also provide the much-needed advice and technical guidance on such matters as designs, size and spacing of open wells and tubewells and selection of water lifting appliances. Trained hands are also needed in increasing numbers for operating the additional drilling and earth moving equipment which is being procured to cope with the additional targets. The existing arrangements for maintenance of completed works and for collecting and reporting statistics on irrigation benefits accruing from the programme leave much room for improvement. The magnitude of efforts needed to be made by the State Governments to overcome the shortcomings in all these spheres would be considerable.

12.17. After taking into consideration the organisational problems as above and the volume of efforts that would have to be made for effecting improvements, the Working Group is of the view that pace of acceleration of the minor irrigation programme during the Fourth Five Year Plan

should not be too fast in order that the organisational efforts needed catch up with the accelerating tempo and technical and administrative control is assured in implementation of the programme.

Targets set for the Fourth Five Year Plan

12.18: Scheme-wise targets for different States and Territories for the Fourth Five Year Plan have been worked out in the light of broad considerations outlined above. Classification of schemes for the purpose has been adopted as indicated in Chapter II. The regional possibilities and priorities have been given due weight in framing the targets. Scheme-wise targets for different States and Territories are given in Appendices 1—23 to this Report.

Physical target in terms of Units—Acceleration Provided

12.19: The following figures would show the order of acceleration that has been provided over the estimated achievement during the Third Five Year Plan on some of the important minor irrigation schemes.

Sl. No.	Name of the Scheme	Estimated achievement during the Third Five Year Plan	Target set for the Fourth Five Year Plan
		Nos.	Nos.
1.	Construction of new wells	4,33,090	6,88,600
2.	Restoration of old wells	49,400	1,58,200
3.	Boring of wells	1,25,687	2,07,920
4.	Deepening of wells	99,549	1,99,000
5.	Private tubewells	11,925	38,880
6.	Electric motor pumpsets	72,961	2,40,580
7.	Diesel engine pumpsets	76,306	1,27,960
8.	Lift irrigation from rivers and streams	2,75,990 (acres)	4,46,750 (acres)

Yardsticks

12.20. Yardsticks adopted for assessing the irrigation potential for different types of smaller works, such as, wells, pumpsets, tubewells, etc., in projecting the Fourth Plan targets of the States and the Territories, have been indicated in Appendices 1—23. In some cases, the yardsticks currently in vogue during the Third Five Year Plan have been scaled down. This revision has been necessary as the programme has now been advancing generally in more difficult and problematic areas where benefit per unit may not be of the same order as before in more favourable areas. Moreover, the investigations carried out by the National Sample Survey Organisation of the Government of India and by the State Governments themselves also indicate the need for such revision. In some cases, the basis of revision has been the agreement between the technical officers concerned of the State Governments and the Government of India as a result of their observations and experience. The Working Group strongly feels that there is need for undertaking well-organised and regular sample survey for re-evaluation of yardsticks but till such time these surveys are conducted, the revised yardsticks now adopted for projecting the Fourth Plan targets are considered more realistic.

Estimation of Outlay—Average cost per acre

12.21. The requirements of financial outlay for realising the proposed targets in respect of private schemes, such as, wells, pumpsets, tubewells, etc. have been estimated on the basis of quanta of financial assistance that are being currently sanctioned for these schemes in different States with such marginal increases that are considered appropriate in view of the past experience and the present trends.

12.22. For other schemes, the outlay has been estimated on the basis of average cost of construction of such schemes per acre of benefit. The average cost per acre has been assessed State-wise after taking into account the latest trends and other factors that may influence the cost structure in future. The following factors have been taken into consideration:—

- (a) average cost of construction per acre as working out at present;
- (b) likely increase in cost due to general rise in labour rates and prices of material and equipment;
- (c) increase in cost due to extension of programme in more difficult areas;
- (d) possibility of arresting the rise in cost by careful selection of schemes after proper surveys and investigations and introducing greater technical element and merit in planning and implementation of all types of schemes whether private or State-owned; and
- (e) likely increase in irrigation benefits with resultant reduction in cost per acre due to greater in-put of efforts and improvements in the sphere of water use.

12.23. In making assessment of cost per acre to be adopted for the Fourth Five Year Plan, the State technical officers who visited Delhi in connection with the Annual State Plan discussions for the year 1964-65 were also consulted in most of the cases.

Rise in the Cost Benefit Ratio

12.24. The cost benefit ratio (cost in rupees per acre) during the Fourth Five Year Plan works out to 417 for the groundwater schemes and 377 for surface water schemes including groundwater recharge, drainage, flood protection and anti-sea water intrusion works. The corresponding figures of cost benefit ratio for the Third Five Year Plan work out as 290 and 276 respectively. It would appear that there is increase of about 45 per cent in the cost benefit ratio for groundwater scheme and about 35 per cent in that for the surface water schemes.

12.25. The increase of 45 per cent in the cost benefit ratio for groundwater schemes is accounted for by the following factors:—

- (a) increase in the quanta of financial assistance per unit of work to cover construction in more difficult areas and rise in the price index of materials and labour—responsible for about 15 per cent;
- (b) downward revision of yardsticks as indicated in para 12.20—responsible for about 30 per cent.

12.26. The rise in the cost benefit ratio for the surface water schemes is due to the following reasons:—

- (i) increase in the cost due to (a) construction in more difficult areas (b) rise in price index of materials and labour and (c) more precise and realistic assessment of benefit on the basis of recommended sample checks and surveys—responsible for about 30 per cent;
- (ii) comparatively greater provision during the Fourth Five Year Plan over new construction (which is costlier) than the renovation of old works (which is cheaper)—responsible for about 5 per cent.

Linked-up Outlay under Cooperative Sector

12.27. During the Third Five Year Plan, in Maharashtra and Gujarat, the loan assistance for schemes of wells and pumpsets is being made available by the Land Mortgage Banks. Only subsidy and the differential rate of interest between the loans granted by the Land Mortgage Banks and the State Governments are being made available from the Government funds. Consequent on establishment of Refinancing Corporation, it has been suggested that other States may also encourage financing of minor irrigation schemes through the Land Mortgage Banks on similar lines. It is envisaged that this arrangement of financing would increasingly be introduced in other States in proportion to the development of their co-operative banking institutions. On this basis, the outlay that is estimated to be available from the Cooperative Sector in different States for financing some of the schemes has been worked out and indicated in Statement 'A'. The physical targets provided for the Fourth Five Year Plan would thus be linked up with financial resources to be made available under the G.M.F. Sector as also under the Cooperative Sector.

Targets—Acreage and Financial—under GMF Sector

12.28. The all-India total of the State-wise and scheme-wise targets under the G.M.F. Sector as worked out in Appendices 1—23 comes to 14·80 million acres. This target would be linked up with the total of all-India financial provision of Rs. 460·36 crores from Governmental funds under the G.M.F. Sector and Rs. 125·00 crores to be made available from the Land Mortgage Banks. The State-wise and scheme-wise break-up on all-India basis for these targets is given in Statement 'A' and 'B' respectively. The total of 14·80 million acres would include 11·24 million acres of new irrigation, 3·34 million acres from surface resources and 7·90 million acres from groundwater resources, 1·78 million acres of improved irrigation, 0·89 million acres benefited from water conservation-cum-groundwater recharging schemes and 0·89 million acres from drainage, flood control and anti-sea water intrusion works. The State-wise break-up of different categories of benefits is given in Statement 'C'.

Targets—Acreage and Financial—under the C. D. Sector

12.29. In addition to the outlay made available from Governmental funds under the G.M.F. Sector and the Land Mortgage Banks, it is expected that about Rs. 45·62 crores would be available for Minor Irrigation under the schematic budget of the C.D. Blocks. The State-wise break up of the outlay is given in Statement 'D'. Under the C.D. Sector, as far as scheme of private nature, such as, wells, pumpsets, etc. are concerned,

the financial assistance given is usually of the same order as granted under the G.M.F. Sector. In addition to these private works, the programme under the C. D. Sector also includes some small works belonging to groups of cultivators, on which somewhat greater measure of public participation in the form of shramdan or voluntary labour is available. The overall cost benefit ratio of the works completed under the C. D. programme is, therefore, somewhat lower in the States than that obtained for these works under the G.M.F. Sector. Keeping this in view, the physical targets under the C. D. Sector for different States and Territories have been worked out on the basis of overall cost per acre of benefit which is somewhat lower than that for targets under the G.M.F. Sector. The State-wise break-up of the physical targets is given in Statement 'D'. The total target of 1.20 million acres will include 0.82 million acres of new irrigation, 0.56 million acres from surface water resources and 0.26 million acres from groundwater resources, 0.14 million acres of improved irrigation, 0.13 million acres benefited from water conservation-cum-groundwater recharging schemes and 0.11 million acres from drainage, flood control and anti-sea water intrusion works. The State-wise break-up of different categories of benefits is given in Statement 'D'.

Combined Targets—Acreage and Financial under the G.M.F. and C.D. Sectors

12.30. The total physical target set for the minor irrigation programme during the Fourth Five Year Plan works out to 16.00 million acres. Its break-up into different categories of benefits would be as under:—

	Million acres
1. New irrigation—	
(a) surface water resources	3.60
(b) groundwater resources	8.46
TOTAL	12.06
2. Old irrigated area over which irrigation is improved, i.e., made more certain and assured	
	1.92
3. Area benefited by water conservation-cum-groundwater recharging schemes	
	1.02
4. Area benefited by drainage, flood control and anti-sea water intrusion works	
	1.00
TOTAL	16.00

12.31. The total physical target would be linked up with an outlay of Rs. 460.36 crores to be made available from Governmental funds under the G.M.F. Sector; Rs. 125.00 crores from the Land Mortgage Banks and Rs. 45.62 crores from the C. D. Sector.

Phasing of Outlay

12.32. The year-wise phasing of proposed Governmental outlay of Rs. 460 crores under the G.M.F. Sector is envisaged to be as under:—

Year	Rs. in crores
1966-67	76
1967-68	83
1968-69	91
1969-70	100
1970-71	110
TOTAL	460

12.33. Out of the target of 16.00 million acres proposed for the Fourth Five Year Plan, the area under new irrigation would be about 12.06 million acres. The level of minor irrigation development at the end of the Third Five Year Plan would be 49.84 million acres. Thus, the average of the levels of irrigation development for the five successive years of the Fourth Five Year Plan would be 49.84 million acres + half of 12.06 million acres = 55.87 million acres. Reckoning a rate of depreciation of 1 per cent per annum over the area irrigated during the year, the area lost due to depreciation during the five years of the Fourth Five Year Plan would be $\frac{5 \times 1 \times 55.87}{100} = 2.80$ million acres. Thus the net addition to

the irrigation area during the Fourth Five Year Plan would come to 9.26 million acres. This would raise the level of minor irrigation development from 49.84 million acres at the end of the Third Five Year Plan to 59.10 million acres at the end of the Fourth Five Year Plan.

Perspective for the Fifth Five Year Plan

12.34. During the Fifth and the subsequent Five Year Plans, the Working Group envisages that the following factors would increasingly affect the progress of minor irrigation development:—

- (a) Increasing attention would have to be paid to proper maintenance and utilisation of new minor irrigation works completed at a fast rate. This would mean diversion of efforts from the implementation;
- (b) construction would gradually extend through more difficult and problematic areas; and
- (c) as more irrigation potential is created, the area lost annually due to depreciation would increase.

12.35. Notwithstanding the above factors, the Working Group is of the view that as a result of implementation of the organisational and technical measures recommended for the Fourth Five Year Plan, it would be possible during the Fifth Five Year Plan not only to maintain the tempo of development attained at the end of the Fourth Five Year Plan but also to accelerate it further. Against the overall target of 16 million acres set for the Fourth Five Year Plan, the Working Group visualises a target of 18 to 20 million acres for the Fifth Five Year Plan. This would include about 14 to 15 million acres of additional new irrigation.

12.36. On the basis of the above projection, the following picture emerges for the perspective development of minor irrigation during the Fourth and the Fifth Five Year Plans.

Period	Gross irrigated area (Million acres)		
	Surface water	Ground water	Total
1950-51	19.91*	16.14*	36.05*
1960-61	22.86*	20.21*	43.07*
Third Five Year Plan anticipated achievement	2.44	6.71	9.15
Deduct depreciation for 5 years at 1% per annum over averaged irrigated area per year during the Third Plan	1.20	1.18	2.38
Net addition during the Third Plan	1.24	5.53	6.77
1965-66	24.10	25.74	49.84
Target for Fourth Plan	3.60	8.46	12.06
Deduct depreciation for 5 years @ 1% per annum over average area irrigated per year during Fourth Plan	1.30	1.50	2.80
Net addition during the Fourth Plan	2.30	6.96	9.26
1970-71	26.40	32.70	59.10
Projected target for the Fifth Plan	3.80	10.70	14.50
Deducting depreciation for 5 years @ 1% per annum over averaged irrigated area per year during period 1971-76	1.42	1.90	3.32
Net addition during the Fifth Plan	2.38	8.80	11.18
1975-76	28.78	41.50	70.28

*Note : These figures have been obtained from the Land Utilisation Statistics, reckoning the area from all the different sources except Government canals under minor irrigation and calculating break-up of gross irrigated area from break-up of net irrigated area on proportionate basis.

ANNEXURE

Local Technological considerations in formulation of State-wise Targets.

The local technological considerations which have been kept in view in formulating State-wise targets are as under:—

ANDHRA PRADESH

Andhra Pradesh had about 40,000 tanks in a derelict condition. It is, however, anticipated that as a result of the present drive and the priority being accorded to renovation, the restoration of these tanks, by and large, would have been completed by the end of the Third Five Year Plan. On new constructions, there is yet a considerable scope in the State for taking up more schemes particularly those of storage works. Diversion schemes are also possible on streams which are perennial. Comparatively speaking, there is more scope for storage works in the Andhra region and for diversion works in the Telengana region. The State Public Works Department has been undertaking systematic basin-wise surveys to bring out the possibilities of minor irrigation constructions in coordination with major-medium irrigation schemes. Besides this surface water programme, there is scope as well as need for constructing head-water tanks in the region with the dual purpose of arresting siltation of the tanks and recharging groundwater.

On the groundwater side, there is scope for construction of more surface wells as well as for augmenting their discharges by boring and deepening, particularly the latter in areas where rocky sub-stratum is encountered at shallow depth below the ground level. The State needs to increase its activity considerably on deepening of wells by arranging and putting into action some compressor units. The power development and the rural electrification programmes are likely to be vigorously followed in the State during the remaining years of the Third Five Year Plan and the Fourth Five Year Plan. This should throw up great possibility of expansion of lift irrigation from ground as well as surface water through installation of electrical pumping equipment.

ASSAM

In spite of heavy rainfall in the State, the need for irrigation is felt even during the monsoon season for the Abu and Sali crops of paddy. The need for supplementary irrigation is particularly prominent in Lanka and Golaghat areas and is also felt acutely in the sub-mountainous areas with porous soil, particularly to the north of Brahmaputra in Golpara, Kamrup and Darrang districts. There are yet good possibilities in the State for taking up more diversion schemes and also arranging lift irrigation by pumping equipment. According to the tentative master plan prepared by the State Chief Engineer, there are immediate possibilities available for bringing about 3 lakh acres under irrigation from diversion minor irrigation

works. Besides, diversion schemes, power pumps are getting increasingly popular in the State for cultivation of Boro paddy. There is scope and need for enlarging this programme.

Possibilities of ground water development are few. Development of irrigation has not yet been satisfactory on the tubewells so far completed.

BIHAR

There is yet good scope in the State for taking up diversion schemes as well as inundation canals called "pynes"; also for taking up large scale development of ground water through construction of more surface wells, tubewells, boring of surface wells and installation of pump sets. In Chhota Nagpur region, there are also possibilities of constructing some storage schemes. There is need for greater activity on boring of existing wells and construction of tubewells owned by the cultivators themselves. With the expansion of power development and rural electrification programme, the State should be able to take up a much larger programme for distribution of pumpsets. The State Government, however, needs to bring down its present rate of electric supply for irrigational pumping in order to push up the rate of pumping installations.

Apart from irrigation schemes, water conservation-cum-land submerging works, like ahars, are very popular in the State and have good potentialities for further development. The activity on construction of these works needs to be accelerated but with due emphasis on the construction being arranged on sound technical lines. There is need for taking up drainage schemes for reclamation of 'chaurs' in the river basins of North Bihar.

GUJARAT

While there is keen demand for irrigation in Gujarat, particularly in North Gujarat where the rainfall is not only inadequate but erratic, the State is deficient in irrigation facilities. Only about 7% of the cultivated area is at present provided with irrigation. Surface wells have been the prominent source of irrigation providing above 80% of the total irrigation. There is good scope for construction of more surface wells and also for construction of tubewells in localised areas already established to be ground-water worthy for the purpose. There is, however, great need for linking up the well programme with contour bunding, nallah plugging and construction of percolation tanks, etc. particularly in the northern arid zone. A bolder programme needs to be taken up for augmenting water output of open wells by boring in the alluvial tracts and by deepening in the rocky terrain and by installation of pumpsets in the bored and deepened wells. There is also scope for constructing more tanks in the peninsula tracts of Saurashtra and more 'bandharas' in the southern districts. Lift irrigation from streams and rivers on cooperative basis, particularly by electrical installations needs to be pushed ahead as more electric power is made available in the State.

JAMMU & KASHMIR

The bulk of irrigation in the State is provided by irrigation kuhls which are mostly owned by private cultivators. A large number of these kuhls was in an unsatisfactory state of maintenance and needed remodelling and other repairs for giving sustained irrigation benefits. Many of these kuhls still remain to be restored. There are possibilities for constructing more

kuhls. In the Kashmir Valley, there are a large number of plateaus called "Karewas" which are fertile lands and are in need of irrigation facilities. There are many areas in the State where irrigation can be provided by lifting water from streams down below. Besides construction of new kuhls and repair of old kuhls, the State needs to concentrate on bringing more efficient regulation and utilisation of the supplies available on the existing works.

KERALA

Although Kerala has a heavy annual rainfall ranging from 60 to 200 inches, the need for irrigation is extensive, because of erratic rainfall during the crop seasons, particularly the second crop season which exists from September to December and is dependent on the north-west monsoon obtains only 40—50% security from rains. The water resources are bountiful in the State. In the eastern region of the State comprising mountainous terrain of the Western Ghats, the scope for irrigation is confined to flat lands in the neighbourhood of Palghat and other passes. In other regions of the State, there is good scope for taking up more diversion schemes. The topography in the State is eminently suitable for taking up lift irrigation schemes. Perennial water supplies are available in the streams. The State needs to lay more emphasis on lift irrigation as power availability in the State improves. In the coastal region, there is need for construction of suitable projects that would act as salt water barriers and prevent the in-rush of salt into low-lying paddy fields. There are no possibilities of ground water use in the State.

MADHYA PRADESH

At present, only about 7% of the cultivated area is under irrigation in the State. There is keen demand for irrigation and only one watering during the crucial period of rabi crop makes all the difference between a good or a bad crop. Except a few districts of Chattarpur, Tikamgarh, part of Panna, Bhind, Morena and part of Gwalior, etc., the rest of the region is underlaid with rock. Deepening of wells is, therefore, a very useful scheme for the State and must be given maximum priority. There is no scope for taking up any further tubewell construction. The State should lay stress on installation of pumpsets as the power availability in the State improves. Simultaneously it should take steps to reduce the rate of electric supply for irrigators to 9 nP. per unit.

There are a large number of ex-Malguzari tanks in the State in a derelict condition. Although the State Government is giving priority to renovation of tanks in the Third Five Year Plan, a large number of them would still remain to be restored during the Fourth Five Year Plan. Besides, there is also substantial scope for taking up more storage and diversion schemes during the Fourth Plan. There is also scope for encouraging lift irrigation from rivers and streams on cooperative basis.

MADRAS

It is anticipated that about 4,000 to 5,000 tanks would still remain to be restored at the end of the Third Five Year Plan. It is, however, likely that the cost of renovation of these tanks may not be commensurate with the resultant benefits. The State Government needs to carefully investigate the possibility of renovating these tanks at economic cost. The possibilities for taking up new storage and diversion schemes may not be many.

There are good prospects in the State for taking up accelerated construction of private tubewells (called bored wells in the State). Economic running of the State tubewells, however, has not been found feasible. The scheme has, therefore, been abandoned during the Third Five Year Plan. There is also no scope for further construction of artisan wells. More surface wells can be constructed but there is need to keep a close watch on the water table as it has already a tendency to go down in some districts. The well programme should be linked up with such schemes as percolation tanks, contour bunding, nallah plugging etc. The State has maximum number of electrical pumpsets in the country. There is still scope for further installation on such wells as have adequate water supply. The possibility of increasing supplies in the existing open wells by boring needs to be explored in the State.

MAHARASHTRA

At present, hardly 6% of the cultivated area in the State is under irrigation. The Maharashtra Irrigation Commission, however, has indicated possibilities for increasing this percentage to 30. It is estimated that full development of the available minor irrigation in the State would require about Rs. 200 crores, Rs. 90 crores for surface water and diversion schemes, Rs. 60 crores for renovation of malguzari tanks, percolation tanks, old wells, etc. and Rs. 50 crores for new well construction. The State needs to accelerate its tempo on these schemes. While there are possibilities for construction of new wells it is necessary in most parts of the State that this programme should be accompanied with contour bunding, nallah plugging, construction of percolation tanks, etc. for augmenting the recharge of ground water. There are also possibilities in the State for installation of power pumpsets to lift water from wells as well as from streams and nallahs. With the expansion of electric power and rural electrification, the emphasis should shift from diesel pumpsets to electrical pumpsets. To provide a fillip to the lift irrigation programme, the State Government needs to review its present policy of electricity tariff and make available electric supply to irrigators at lower rates, not exceeding 9 nP. per unit.

MYSORE

The State has about 38,000 irrigation tanks, of which about 14,000 needed restoration very badly at the beginning of the Third Five Year Plan. It is expected that there would still be about 11,500 tanks requiring urgent restoration at the end of the Third Five Year Plan. The State would, therefore, need to give priority to restoration works during the Fourth Five Year Plan. Besides, there is also good scope for construction of new irrigation tanks, percolation tanks, anicuts, feeders and also carrying out improvement to existing anicuts and feeders. As the State is deficient in irrigation facilities while undulating topography is predominantly suitable for minor irrigation schemes, there is need to take up accelerated implementation of minor irrigation during the Fourth Five Year Plan.

The State Government has been making efforts to push up well construction programme at a rapid pace during the Third Five Year Plan. Wells are the only means of irrigation in many scarcity areas. Before taking up further accelerated construction of wells, it is necessary to watch the performance of the wells already completed. The State needs to lay emphasis on deepening of wells by blasting. There may be good scope for

installation of power pumpsets on all such wells which have adequate yield or storage of ground water. With greater power availability and expansion of rural electrification programme, emphasis should shift from diesel operated pumps to electrical pumps.

ORISSA

The State has fairly good rainfall ranging from 50 to 60 inches; yet a widespread demand for irrigation is felt,—particularly in areas where bulk of the rainfall is confined to the monsoon season alone. The ground-water does not hold out much promise for irrigation except in localised belts, but the undulating topography of the State is well-suited for surface works in the State and there is need that a precise survey of these may be carried out so that a systematic programme of renovation is taken in hand. Shallow tubewells have been found very successful in the coastal areas and lift irrigation by installing electric pumpsets on rivers and streams are also getting popular particularly in the Ganjam and Cuttack districts. The State needs to accelerate the tempo on these schemes as much as possible subject to optimum use being made by the irrigators of the costly lifted water. In the hilly tracts of the State, there is good scope for construction of head water tanks for the dual purpose of moisture conservation in the top soil and arresting siltation of the tanks lower down. The State needs to pay adequate attention to this scheme.

PUNJAB

Being comparatively much more advanced in power availability and rural electrification, the State needs to step up its activity considerably on construction of private tubewells and installation of electrical pumpsets. These works would also help in controlling water logging menace developing in the State. Construction of open wells needs to be encouraged freely even in the canal commanded areas. Possibilities of undertaking lift irrigation scheme from jheels, streams and nallahs also need to be investigated. A concerted programme of systematic drainage construction including major as well as minor schemes need to be undertaken in the irrigated tracts to arrest the rise of water table and help in relieving water logging.

RAJASTHAN

Rajasthan can accelerate its wells construction programme but should keep a close watch on the water table. The programme should be linked up with adequate measures to increase the groundwater recharge. Deepening of wells being a useful scheme for augmenting discharge of wells in rocky terrain should be carried out at a faster rate. Private tubewells in area, proven to be ground water worthy for the purpose, need to be constructed on an increasing scale. With more electric power available installation of pumpsets should increase.

There is also scope for construction of more storage schemes. Care has to be taken that the reservoirs constructed get filled up in most of the years. Diversion schemes can also be taken up in some tracts but to a limited extent. The State needs to lay increasing emphasis on such schemes as rapats, head water tanks, percolation tanks, etc. to conserve moisture in the top soil as well as to replenish ground water.

UTTAR PRADESH

Having an extensive alluvial tract, there is considerable scope and need in Uttar Pradesh for taking up an accelerated programme of boring of wells, construction of private tubewells and installation of electrical pumpsets. More wells and tubewells can also be constructed. To provide fillip to this programme, the State needs to review its present policy of electricity tariff and charge concessional rates for electric supply to irrigators.

More 'kuhls' can be constructed in the northern mountainous region, more 'bundhies' in the southern Bundhel Khand region and more storage schemes in the undulating south-eastern region. Lift irrigation from rivers and streams needs to be encouraged vigorously wherever feasible. The State should also pay increasing attention to drainage construction.

WEST BENGAL

In spite of heavy rainfall in West Bengal, there is great need for supplementary irrigation, particularly in the western region where comparatively soil is less retentive and topography is undulating. As far as availability of water is concerned, there is a good scope in the State for construction of tubewells in established ground water worthy areas in the central region of the State and also for undertaking lift irrigation from rivers and streams. However, as these schemes are likely to be costly in nature for meeting supplementing demand of irrigation, there is need that the State accelerates its activity on these schemes after due consideration of the actual performance obtained on the schemes completed. The installation of pumpsets for lifting water from tanks, ponds, streams, rivers, etc. by individual cultivators should be encouraged as much as possible. The pace of distribution of pumpsets for this purpose may be considerably accelerated as more electric power is available in the State and with the expansion of rural electrification programme.

There are a large number of small tanks in the State which serve the purpose of irrigation as well as pisciculture. Quite a number of these tanks are still in a derelict condition. There is need for accelerating the tempo on renovation of these tanks.

In many districts of the State, particularly in the southern region, there is need for stepping up the activity on drainage construction.

STATEMENT 'A'

Proposed Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan (State-wise Outlays and Targets)

Sl. No.	Name of State/Union Territory	Financial (Rs. in lakhs)			Acreage ('000)	Cost per acre of benefit (In Rs.)
		From Government resources	From land mortgage banks	Total		
1	2	3	4	5	6	7
1.	Andhra Pradesh	5,500.00	1,000.00	6,500.00	1,297.16	501
2.	Assam	1,000.00	..	1,000.00	421.57	237
3.	Bihar	3,500.00	500.00	4,000.00	1,414.00	283
4.	Gujarat	2,850.00	2,150.00	5,000.00	1,137.50	440
5.	Jammu & Kashmir	300.00	..	300.00	52.08	576
6.	Kerala	1,400.00	..	1,400.00	374.50	374
7.	Madhya Pradesh	3,750.00	500.00	4,250.00	905.19	470
8.	Madras	2,750.00	250.00	3,000.00	741.67	404
9.	Maharashtra	4,000.00	5,000.00	9,000.00	1,802.91	499
10.	Mysore	5,500.00	1,000.00	6,500.00	715.83	908 ✓
11.	Nagaland	25.00	..	25.00	6.25	400
12.	Orissa	1,100.00	100.00	1,200.00	375.00	320
13.	Punjab	2,300.00	400.00	2,700.00	1,307.00	207
14.	Rajasthan	1,500.00	100.00	1,600.00	357.30	448
15.	Uttar Pradesh	7,750.00	1,500.00	9,250.00	3,180.00	291
16.	West Bengal	2,500.00	..	2,500.00	626.25	399
TOTAL STATES		45,725.00	12,500.00	58,225.00	14,714.21	395
1.	Andamans	..	..	..	..	..
2.	Delhi	66.00	..	66.00	18.70	353
3.	Goa	42.00	..	42.00	10.95	384
4.	Himachal Pradesh	100.00	..	100.00	25.00	400
5.	Manipur	20.00	..	20.00	7.50	267
6.	N.E.F.A.	10.00	..	10.00	2.50	400
7.	Pondicherry	22.00	..	22.00	6.74	326
8.	Tripura	51.00	..	51.00	15.00	340
TOTAL TERRITORIES		311.00	..	311.00	86.39	360
GRAND TOTAL		46,036.00	12,500.00	58,536.00	14,800.00	395

STATEMENT 'B'

Proposed All-India Minor Irrigation Programme under G.M.F. sector during Fourth Five Year Plan (Scheme-wise Details).

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Cost per acre of benefit	
A. WELL SCHEMES						
1.	Construction of new wells	6,88,600	2,250.80	15,073.00	670	
2.	Restoration of old wells	1,58,200	234.60	1,206.00	514	
3.	Boring of wells	2,07,920	503.25	1,458.00	290	
4.	Deepening of wells	1,99,000	326.00	605.00	186	
TOTAL GROUP 'A'			3,314.65	18,342.00	553	
B. TUBEWELL SCHEMES						
5.	State tubewells	3,320	834.50	3,097.00	371	
6.	Cooperative tubewells	350	35.00	210.00	600	
7.	Private tubewells	38,880	1,571.30	3,781.50	241	
8.	Filterpoint tubewells	2,687	26.77	80.50	301	
9.	Artesian tubewells	400	8.00	20.00	250	
TOTAL GROUP 'B'			2,475.57	7,189.00	290	
C. WATER LIFTING APPLIANCES						
10.	Electric motor pump sets	2,40,580	1,787.90	4,906.60	274	
11.	Diesel engine pump sets	1,27,960	1,091.18	4,568.40	419	
12.	Persian wheels	50,535	106.70	266.00	249	
TOTAL GROUP 'C'			2,985.78	9,741.00	326	
TOTAL GROUNDWATER SCHEMES			8,776.00	35,272.00	403	
D. STORAGE SCHEMES						
13.	Construction of new tanks and reservoirs			1,046.00	7,626.00	729
14.	Restoration of old tanks and reservoirs			1,263.88	4,933.00	390
TOTAL GROUP 'D'			2,309.88	12,559.00	544	
E. DIVERSION SCHEMES						
15.	Hilly channels-kuhls/dongs and lowkhongs, etc.		158.15	760.00	481	
16.	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas, etc.		1,332.49	4,840.00	363	
TOTAL GROUP 'E'			1,490.64	5,600.00	376	

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Cost per acre of benefit
F. SURFACE WATER LIFT IRRIGATION SCHEMES					
17.	State lift irrigation . . .		376.75	1,184.00	314
18.	Cooperative lift irrigation . . .		70.00	210.00	300
TOTAL GROUP 'F'			446.75	1,394.00	312
G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES					
19.	Rapats, submerging dams, ahars, bundhies, percolation tanks		887.50	1,675.00	193
TOTAL GROUP 'G'			887.50	1,675.00	193
H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS					
20.	Drainage works		669.00	1,311.00	196
21.	Embankment and flood protection works		124.00	297.00	240
22.	Anti-sea water intrusion works		96.83	428.00	442
TOTAL GROUP 'H'			889.83	2,036.00	229
TOTAL SURFACE WATER SCHEMES			6,024.60	23,264.00	386
GRAND TOTAL			14,800.60	58,536.00	395

STATEMENT 'C'

Category-wise Break-up of the Target Set under G.M.F. Sector during the Fourth Five Year Plan

(Acreage ,000)

Serial No.	Name of State/Union Territory	New area brought under irrigation		Old irrigated area over which irrigation is stabilised or restored.	Benefits in the form of submerging land or recharging ground-water.	Benefits by way of drainage, flood control or anti-sea water intrusion works.	Total
		Ground water schemes	Surface water schemes				
1	2	3	4	5	6	7	8
1.	Andhra Pradesh	435.00	497.33	211.50	32.50	120.83	1,297.16
2.	Assam	3.00	189.28	129.29	..	100.00	421.57
3.	Bihar	648.00	205.00	161.00	300.00	100.00	1,414.00
4.	Gujarat	693.00	263.00	54.00	75.00	52.50	1,137.50
5.	Jammu & Kashmir	..	17.71	34.37	..	..	52.08
6.	Kerala	..	237.00	50.00	..	87.50	374.50
7.	Madhya Pradesh	320.85	254.34	290.00	40.00	..	905.19
8.	Madras	269.67	114.00	248.00	100.00	10.00	741.67
9.	Maharashtra	1,166.25	383.33	113.33	90.00	50.00	1,802.91
✓ 10.	Mysore	183.00	223.66	201.67	50.00	57.50	715.83
11.	Nagaland	..	3.12	3.13	..	..	6.25
12.	Orissa	60.00	211.00	104.00	..	..	375.00

13. Punjab	1,139.00	104.00	4.00	..	60.00	1,307.00
14. Rajasthan	150.37	129.39	27.54	50.00	..	357.30
15. Uttar Pradesh	2,510.00	340.00	10.00	150.00	170.00	3,180.00
16. West Bengal	304.00	142.85	113.40	..	66.00	626.25
TOTAL STATES	7,882.14	3,315.01	1,755.23	887.50	874.33	14,714.21
1. Andamans	..	..	..	..	..	..
2. Delhi	13.57	2.63	..	..	2.50	18.70
3. Goa	2.45	3.90	3.60	..	1.00	10.95
4. Himachal Pradesh	..	12.50	12.50	..	..	25.00
5. Manipur	..	2.50	2.50	..	2.50	7.50
6. N.E.F.A.	..	1.25	1.25	..	..	2.50
7. Pondicherry	0.70	1.79	1.75	..	2.50	6.74
8. Tripura	1.50	5.30	1.20	..	7.00	15.00
TOTAL TERRITORIES	18.22	29.87	22.80	..	15.50	86.39
GRAND TOTAL	7,900.36	3,344.88	1,778.03	887.50	889.83	14,800.60

STATEMENT 'D'

The Target Set under G.D. Sector during Fourth Five Year Plan and its Category-wise Break-up

(Financial — Rs. in lakhs)
(Acreage — '000 acres)

Serial No.	Name of State/Union Territory	Third Plan target		New area brought under irrigation		Old irrigated area over which irrigation is stabilised or restored	Benefits in the form of submerging land or recharging ground water	Benefits by way of drainage, flood control or anti-sea water intrusion works
		Financial	Acreage	Ground water schemes	Surface water schemes			
1	2	3	4	5	6	7	8	9
1.	Andhra Pradesh	350.70	70.50	31.00	24.50	5.00	2.00	8.00
2.	Assam	175.10	75.50	..	35.50	18.00	..	22.00
3.	Bihar	479.63	173.20	86.00	17.00	10.70	4.00	19.50
4.	Gujarat	196.91	45.60	22.10	9.15	3.95	8.00	2.40
5.	Jammu & Kashmir	10.40	1.85	..	0.45	1.40	..	..
6.	Kerala	117.82	32.20	..	18.50	5.20	..	8.50
7.	Madhya Pradesh	329.24	71.65	32.50	22.65	12.00	4.50	..
8.	Madras	336.47	85.10	33.20	12.40	25.50	12.00	2.00
9.	Maharashtra	373.64	76.55	43.25	12.40	6.90	10.00	4.00
10.	Mysore	228.32	25.65	7.15	6.00	9.50	1.00	2.00
11.	Nagaland . . . . .	..	..	..	..	..	..	..
12.	Orissa	280.11	80.55	17.20	38.35	30.00	..	..

13. Punjab	.	.	.	.	.	178.29	88.20	76.00	7.20	..	..	5.00
14. Rajasthan	.	.	.	.	.	201.95	46.10	17.60	14.00	4.50	10.00	..
15. Uttar Pradesh	.	.	.	.	.	820.97	282.95	186.95	25.00	1.00	40.00	30.00
16. West Bengal	.	.	.	.	.	380.30	9.75	1.00	3.25	3.50	..	2.00
TOTAL STATES	.	.	.	.	.	4,459.85	1,165.35	553.95	246.35	137.15	127.50	105.40
1. Andamans	.	.	.	.	.	101.86	29.05	6.45	11.25	6.25	..	5.10
2. Delhi								
3. Goa								
4. Himachal Pradesh								
5. Manipur								
6. N.E.F.A.								
7. Pondicherry								
8. Tripura								
TOTAL TERRITORIES	.	.	.	.	101.86	29.05	6.45	11.25	6.25	..	5.10	
GRAND TOTAL	.	.	.	.	.	4561.71	1,199.40	560.40	257.60	143.40	127.50	110.50

CHAPTER XIII

PROPOSED PATTERN OF FINANCIAL ASSISTANCE TO MINOR IRRIGATION SCHEMES DURING THE FOURTH FIVE YEAR PLAN

13.01. For the purpose of sanctioning financial assistance, minor irrigation schemes may be divided into five broad categories:—

1. Private works like wells, pumpsets, etc., belonging to individual cultivators;
2. Community works like tanks, anicuts, drainage, flood protection works, lift irrigation schemes, etc., belonging to a group of cultivators executed on cooperative or community basis;
3. State works constructed and maintained by the State Government Departments;
4. Tubewells; and
5. Schemes for surveys and investigations.

13.02. Financial assistance for taking up these works began to be extended by the Government since launching of the Grow More Food Campaign in 1943. Financial assistance had been sanctioned in the form of loan and grants. The pattern of financial assistance has, however, varied from period to period. The broad changes in the pattern of financial assistance from time to time have been as under:—

1. *Private works like wells, pumpsets, etc., belonging to individual cultivators.*

13.03. Prior to 1952, all works of private nature were entitled to a subsidy not exceeding 50 per cent of the total expenditure on these schemes. It was envisaged that the individual cultivators who benefited from these schemes should contribute 50 per cent of the total expenditure on these schemes. The cultivators, however, could obtain Governmental loan for meeting the cost to be borne by them. The grants sanctioned were shareable between the State Governments and the Government of India on 50 per cent basis in case of States in Parts A and B of the First Schedule of the Constitution except Assam and Orissa. In case of Assam and Orissa, the Government of India's share was 2/3rd and in that of Coorg, it was 3/4th. The entire expenditure in case of Part C States other than Coorg was to be borne by the Government of India.

13.04. On the recommendation of the Grow More Food Enquiry Committee, 1952, the Government of India decided that financial assistance for G.M.F. Schemes should be given as far as possible on the basis of loans or recoverable expenditure, subsidies being gradually reduced and ultimately abolished. Accordingly, the maximum amount of subsidy eligible on private schemes was reduced from 50 per cent to 25 per cent of the total expenditure on these schemes, from the year 1952-53.

13.05. During the Second Five Year Plan, however, a proviso was introduced that in exceptional cases, where the schemes were for the benefit of backward and under-developed areas or where the schemes were good but the cost was substantially high, the subsidy might be increased upto 50 per cent of the total cost.

13.06. In the pattern decided for the Third Five Year Plan, the element of subsidy was deleted for all private schemes except wells. Later on, however, on the recommendation of the Regional Conferences on Minor Irrigation held in October 1961, subsidy was also made eligible for the schemes of boring and deepening of wells. The maximum subsidy is restricted to 25 per cent of the total cost of the scheme, to be shared by the Centre and the States equally.

13.07. Although Central subsidy is not eligible for the schemes of installation of pumpsets, some States like Maharashtra and Gujarat have been making available subsidy for these schemes. Punjab has come up with a proposal that subsidy to the extent of 50 per cent may be made eligible for pumpsets in the under-irrigated district of the State, namely Mohindergarh.

13.08. In Gujarat the subsidy to the extent of 25 per cent of the total cost on wells is allowed on a sliding scale according to the land holdings of the cultivators. Fifty-six acres of good fertile land is reported to be the ceiling for the land holding. To cultivators with land holdings between 1/3rd and 1/2 of the land ceiling only 25 per cent subsidy is allowed, to those from 1/3rd to 1/4th, 50 per cent, from 1/4th to 1/6th, 75 per cent and to those less than 1/6th, full.

13.09. In the case of Mysore State, it has recently been recommended that the amount of subsidy may be linked up with the time that the cultivators take in completion of the wells. With a view to encouraging expeditious construction of wells, it has been suggested that the full amount of subsidy may be given only to those persons who complete the well in one season. The amount of subsidy may be gradually reduced as the time taken in completion is increased.

2. Community works like tanks, anicuts, drainage, flood protection works, lift irrigation schemes, etc., belonging to group of cultivators executed on cooperative or community basis.

13.10. Like private works belonging to individual cultivators these works were eligible to a subsidy of 50 per cent shareable half and half between the State Governments and the Central Government, prior to 1952-53. From 1952-53, the quantum of maximum subsidy was reduced from 50 per cent to 25 per cent.

13.11. During the Second Five Year Plan, higher quantum of subsidy upto 50 per cent was made eligible for these works located in backward areas or areas where the cost was exceptionally high.

13.12. Also construction or repair of kuhls in the hilly areas where they are the only possible means of providing irrigation was also made eligible for an over-all subsidy not exceeding 50 per cent of the total cost.

13.13. The revised pattern of financial assistance in vogue during the Third Five Year Plan is that subsidy is eligible only for the following two schemes under this category:—

- (a) For renovation of tanks—subsidy of 25 per cent to be shared equally by the Centre and the States.
- (b) for kuhls which are the only means for providing irrigation in hilly areas—subsidy of 50 per cent to be shared equally by the Centre and the States.

13.14. Although some of the States have been granting subsidy for other types of schemes also, but these schemes are not eligible for any Central subsidy.

3. *State works constructed and maintained by the Government Departments.*

13.15. Prior to 1952-53, all works under this category were not eligible for a subsidy if they were remunerative, *i.e.* if they paid back their cost during a period of 20 years. If they were un-remunerative, the only un-remunerative portion of the expenditure was to be subsidised. For judging the remunerativeness or otherwise of these schemes, the following basis was adopted:

Total cost minus 20 times the additional gross revenue equals net cost. The net cost would be shared by the Government of India and the State Government in proportion as mentioned for different types of States in respect of the schemes under category 1. The gross additional revenue may be in the form of either increase in assessment due to irrigation or charging of extra water rates. For example, if a scheme of tank irrigation costs Rs. 1 lakh and irrigates; say 500 acres and if the extra revenue is Rs. 2 per acre, the total additional revenue per year is Rs. 1,000 and 20 times of this revenue is the capitalised value of this improvement. Rs. 20,000 should be deducted from Rs. 1 lakh and the balance of Rs. 80,000 would be shared between the Government of India and the State Government on the accepted basis.

13.16. From 1952-53, however, this proviso was deleted and all public schemes on minor irrigation were made eligible for financial assistance only in the shape of loans. The proviso in somewhat revised form was again introduced during the Second Five Year Plan. It was stipulated that a scheme yielding a return of 4-1/2 per cent per annum, thus reimbursing 90 per cent of the expenditure incurred over a period of 20 years would be considered as economical deserving no subsidy from the Centre. However, if a scheme yielded less than 4-1/2 per cent the subsidy would be worked on the difference between the return at the rate of 4-1/2 per cent and the actual return over a period of 20 years. As for example, if a scheme costs Rs. 1,000 and the return is say 4 per cent, the yield over a period of 20 years would come to Rs. 800 and the total shareable subsidy would work out to Rs. 100 (Rs. 900—Rs. 800).

13.17 In addition, kuhls even though State owned, were made eligible for a Central subsidy of 25 per cent.

13.18. The revised pattern in vogue during the Third Five Year Plan is that Central subsidy for State owned schemes is eligible only for the following two types:—

(i) Renovation of State owned irrigation tanks—Central subsidy 12-1½ per cent.

(ii) State owned kuhls—Central subsidy of 25 per cent.

4. Tubewells.

13.19. Construction of private tubewells has, at no stage, been entitled to any Central subsidy. Prior to the Second Five Year Plan, tubewells constructed on cooperative basis and benefiting a large number of cultivators were eligible for subsidy in the same manner as private schemes like wells, pumpsets, etc. From the beginning of the Second Five Year Plan onwards, however, even tubewells constructed on cooperative basis have not remained eligible for Central subsidy. State tubewells were entitled to a subsidy like public schemes of minor irrigation (basis described above) prior to 1952-53. Since 1952-53, however, State tubewells have not remained eligible for any subsidy. Some State Governments have been pressing that in order to push up their programme of tubewells construction, Central subsidy may be made available.

5. Schemes for Surveys & Investigations.

13.20. During the Second Five Year Plan, surveys and investigations which were necessary before undertaking minor irrigation schemes were made eligible for Central subsidy upto 50 per cent of the total cost of the scheme on the merits of each case. However, in the case of really backward States which did not have well-organised Public Works Departments, but were keen to undertake surveys of the possibilities of minor irrigation programmes, even a higher rate of subsidy could be allowed in really deserving cases. During the Third Five Year Plan, all survey schemes have been eligible for 50 per cent subsidy.

PATTERN OF FINANCIAL ASSISTANCE PROPOSED FOR THE FOURTH FIVE YEAR PLAN.

13.21. Considering such factors as (a) two to four times expansion in the targets proposed for the Fourth Five Year Plan, (b) rise in the cost of pumping equipment, (c) increase in the cost of diesel oil due to imposition of higher excise duty, and (d) comparatively unfavourable economics of lift irrigation in general due to high recurring cost, the Working Group strongly recommends that a more liberal pattern of financial assistance should be made applicable for lift irrigation schemes during the Fourth Five Year Plan. This would mean that in addition to the schemes of open wells and boring and deepening of open wells, which are already entitled for subsidy during the Third Five Year Plan, benefit of subsidy should also be extended to such schemes as diesel engine pumpsets, tubewells and lift irrigation from rivers and streams. In regard to electrical pumpsets, the proposal for subsidising the rates for electric supply is already under consideration of the Government of India, and, therefore, it may not be necessary to subsidise the initial cost of the pumpsets. Subsidising the energy part is considered a better alternative as it would ensure intensive running of the pumpsets.

13.22. In order that the programme of minor irrigation may progress satisfactorily in the backward areas and the poorer cultivators in these areas may be encouraged to take to irrigation works, it is considered necessary that the quantum of subsidy should be increased to 50 per cent in such areas. The State Governments would be sharing the subsidy on 50 : 50 basis and the discretion about demarcation of backward areas would be entrusted to them.

13.23. There is great need for intensifying surveys and investigations, particularly for enabling systematic and controlled exploitation of the groundwater. The urgency for investigations has already been explained in detail in Chapter VI. The need for groundwater surveys and investigations has become all the more urgent now due to the fact that there has been increasing emphasis on groundwater development during the Third Five Year Plan and the trend would continue in the Fourth and the subsequent Plans. In order that the Fourth Five Year Plan may be implemented effectively from the very first year, it is imperative for the State Governments to take advance action by planning and undertaking intensive surveys and investigations during the remaining period of the Third Five Year Plan. For this purpose, the State Governments should at once initiate specific schemes for surveys and investigations and preparing basin-wise and district-wise integrated master plans and maps. The Working Group is strongly of the view that for encouraging the State Governments to take up these surveys and investigations, 100 per cent Central subsidy should be made available for survey schemes during the remaining two years of the Third Five Year Plan as an advance action for the Fourth Five Year Plan. After a start has been made on a comprehensive scale, the pattern of Central assistance during the Fourth Five Year Plan could then be reverted to 50 per cent grant and 50 per cent loan.

13.24. In regard to the research and training schemes, the Working Group is of the view that 100 per cent Central assistance as at present should continue to be given for these schemes during the Fourth Five Year Plan.

13.25. The Working Group considered the suggestion that in order to confine the benefit of subsidy only to poorer section of the community, subsidy might be allowed only to those cultivators who had annual income below a certain specified amount. The Working Group felt that it would be difficult to properly assess the income of the cultivators and such provision might, therefore, lead to a considerable amount of corruption. The Working Group recommends that the subsidy may be made available to all the cultivators irrespective of their economic status.

13.26. In the light of the above considerations, the Working Group recommends the following pattern of subsidy for minor irrigation works during the Fourth Five Year Plan:—

1. *Private and Community/Cooperative Works.*

(Owned by individuals, cooperatives or the village institutions such as Panchayats.)

Name of the Scheme	Proposed subsidy to be shared on 50 : 50 basis by Govt. of India & State Govts.	
	Normal areas	Backward areas
	(Percentage)	
1. Open wells	25	50
2. Boring of wells	25	50
3. Deepening of wells	25	50
4. Persian wheels	25	50
5. Diesel engine pumpsets	25	50
6. Tubewells	25	50
7. Lift irrigation	25	50
8. Renovation of tanks	25	50
9. Kuhls	50	50

II. <i>State Works (including tubewells)</i>	Central Assistance (Grants)
1. Renovation of tanks	25
2. State tubewells	25
3. Lift irrigation	25
4. Kuhls	50

III. <i>Schemes for Surveys & Investigations</i>	Central Assistance (Grants)
(a) For the years 1964-65 and 1965-66 as advance action	100
(b) For the Fourth Five Year Plan	50%
IV. <i>Schemes for Research & Training</i>	100

CHAPTER XIV

PROGRAMME FOR RESEARCH

14.01. Realising the need for applied research on various items connected with minor irrigation and water use, a research programme covering these items was introduced in the Third Five Year Plan, for the first time. It was felt that in order to make more economic use of the outlay incurred on the fast accelerating minor irrigation programme, it was essential that efforts should be made to effect improvements in the design, construction and operation of minor irrigation works. So far the methods and practices adopted in these matters had mostly been allowed to be governed by the age old traditions and there appeared, therefore, ample scope for effecting improvements. Similarly, in order that the cultivators may make better and more prompt use of irrigation water, it was considered necessary to evolve irrigation methods, practices, implements, farm structures, equipment, etc., that may enable the farmer to achieve greater efficiency in distribution and application of irrigation water.

14.02. The matter was discussed with the State Governments and all of them stressed the need for taking up this programme. It was agreed that 100 per cent grant would be made available by the Centre for implementation of the schemes under the programme. A provision for Rs. 40 lakhs was approved for the Third Five Year Plan.

Details of the Programme.

14.03. The programme envisaged applied research on specific items to be selected from the following broad subjects:—

- (1) Earth movement and compaction—evolving design of implements such as wheel barrows, pounders, rollers, floats, scrapers, ridgers, ditchers, etc.,—mainly bullock drawn—which may improve the efficiency and turn out of labour in fields for irrigation and may be suitable for working under local conditions come across in different parts of the country.
- (2) Open wells and tubewells—improving their designs and construction methods, undertaking studies on groundwater, yield in wells, etc., with a view to evolving criteria for location and spacing of wells for sustained discharge including proposals for recharge of groundwater.
- (3) Water lifting appliances including power pumptesting of existing designs, with a view to having a correct appraisal of their comparative performance—evolving new improved designs.
- (4) Tanks, weirs and channels—evolving a fresh set of standards for design, construction and maintenance of such small works irrigating less than 500 acres or so.
- (5) Water distribution and application—development of : (a) cheap designs for farm structures, like field channels, crossings,

falls, wooden regulating boxes, canvas dams, syphon tubes and gated pipes, etc.; (b) cheap methods for lining of field channels; (c) suitable irrigation methods for preparing fields for different crops under varying conditions of soils and climate.

- (6) Water requirement of main irrigated crops under varying conditions of soil, fertilizers and climate and for different stages of crop growth.

14.04. It was proposed that the applied research on the selected items would be taken up on regional basis under actual field conditions representative of each region. The research was envisaged to be undertaken at the existing research institutes belonging to the States/Government of India, which were considered competent for the purpose. It was also envisaged that the field studies on some of the items could be entrusted to the State Technical Departments if the State Governments so desired and considered that the Technical Departments were competent to handle the problem. The responsibility for implementation of the scheme rested with the State Governments and/or Heads of the Institute.

Preparation & Scrutiny of Individual Schemes under the Programme.

14.05. The State Governments/Research Institute were required to prepare a detailed scheme on each specific item proposed for research. Every scheme of research was to have a specific objective which could be accomplished by a well-planned programme of research within a specified limited period. The State Governments/Research Institutes were required to prepare these detailed schemes after they had made thorough investigations about the work already done or being done in this country as well as in other countries, examined the data, literature and other information available on the subject and had been fully convinced about the urgency as well as scope for further research work proposed under the scheme.

14.06. At the Centre, the detailed schemes received from the State Governments were examined by a Technical Committee comprising representatives from the Central Board of Irrigation & Power, Ministry of Community Development & Cooperation, Indian Council of Agricultural Research, Extension Directorate and Irrigation Unit in the Ministry of Food & Agriculture.

Progress during the Third Five Year Plan.

14.07. The programme was introduced, for the first time, during the Third Five Year Plan. The State Governments took considerable time in the formulation, scrutiny and submission of detailed schemes conveying the sanctions of the schemes and the field staff also took appreciable time. The States have also been facing considerable difficulty in selecting and recruiting the additional staff required for running of these schemes. Purchase of equipment and materials for these schemes according to the set procedure was time consuming.

14.08. The present position is that 31 schemes in 12 States have technically and administratively been approved for a total amount of Rs. 41.69 lakhs. Besides, there are other 12 schemes which have been received from the State Governments and are in different stages of scrutiny and processing.

These schemes are expected to be shortly approved for a total amount of Rs. 8.5 lakhs. The actual expenditure under the research programme likely to be incurred by the end of the year 1963-64 is estimated at about Rs. 4 lakhs. A total outlay of Rs. 6 lakhs and Rs. 10 lakhs is forecast for the years 1964-65 and 1965-66 respectively, on all the schemes technically and administratively approved or likely to be approved during the Third Plan period. Thus the total outlay during the Third Five Year Plan on the programme is estimated at Rs. 20 lakhs.

Proposals for the Fourth Five Year Plan.

14.09. The primary objective of the research scheme initiated during the Third Five Year Plan was to develop new implements, methods and practices which may result in deriving greater benefits from the outlay incurred in the implementation of the minor irrigation programme and in more efficient and economic utilisation of the irrigation water made available on the various irrigation projects. The applied research on the items intimately connected with the field problems of implementation would not only improve the technical standards in execution but also bring about economy in initial cost. The need for such applied research has become all the more important now when greater emphasis is being laid on accelerating the minor irrigation programme and new irrigation potential is built up at a fast rate. It is, therefore, proposed not only to continue the research schemes initiated during the Third Five Year Plan, but also to further intensify the programme during the Fourth Five Year Plan by taking up new items of research which may have an important bearing on the practical problems faced in implementation. The minor irrigation proposals for the Fourth Five Year Plan visualise increased accent on groundwater development, and the same trend is likely to continue in the Fifth and the subsequent Plans. Accordingly, it is proposed that research on items connected with groundwater utilisation schemes, such as open wells, tubewells, pumpsets, measures for improving recharge of groundwater, etc., would be intensified during the Fourth Five Year Plan.

14.10. An outlay of Rs. 60 lakhs is proposed for the applied research programme on minor irrigation and water use during the Fourth Five Year Plan.

CHAPTER XV

PROGRAMME FOR TRAINING

15.01. At the time when the Third Five Year Plan proposals were being formulated, providing for substantial increase in the minor irrigation programme over the achievement anticipated in the Second Plan, it was considered essential that increasing attention should be paid to the technical aspects of the programme. It was felt that for this purpose, there was urgent need of having a large number of experienced technical hands who may assist in implementing the programme on sound technical lines and also guide the farmers in construction, maintenance and operation of private and community minor irrigation works. The need was particularly felt in the sphere of lift irrigation for guiding the cultivators in such matters as location of wells, size of wells, water bearing strata which they should tap and the sub-stratum at which the steining walls should be left, boring and deepening operations that may be carried out for improving the discharge of wells and installation and operation of water lifting appliances. Similarly, in order that the cultivators may carry out better and expeditious utilisation of the irrigation works completed, it was considered essential that there should be available in the country a much larger number of trained technical hands who may provide to the cultivators the necessary guidance on matters like (a) maintenance and operation of private or small community works entrusted to the local panchayats for maintenance, (b) alignment and construction of field channels, (c) providing structures and water control equipment over the field channels, (d) levelling and preparation of fields by using improved implements, and (e) depth and frequency of irrigation for optimum use of water and maximum production.

15.02. The matter was discussed in detail with the State Governments who invariably stressed the need for undertaking a programme of training for minor irrigation and water use. The Third Plan provision for Rs. 40 lakhs was agreed to for the programme in the whole country. It was envisaged that 100 per cent grant would be made available by the Central Government for implementation of the individual schemes of the States under this programme.

Details of the Programme

15.03. It was proposed under the programme to provide practical training to agricultural inspectors, engineering overseers and other staff of equivalent status engaged in the C.D. Blocks and other Departments, on works connected with minor irrigation and development of irrigated agriculture. It was also proposed to include among trainees—(a) the instructors incharge of the pre-service training of the village level workers at the Extension Centres, (b) the instructors incharge of in-service training of village level workers. It was visualised that these instructors would then give attention to the important problems of minor irrigation and water use while they impart training to the village level workers. The benefits of this scheme would thus be extended to the village level workers as well.

15.04. It was provided that the scheme would be organised State-wise and in general each State would have one centre in its territory. At each centre it was provided that there may be three individual courses in a year and each course may have a duration of three months and about 30 trainees. The curriculum prescribed included lectures in theory but laid more emphasis on the practical training under field conditions.

15.05. The responsibility for implementing this scheme rested on the State Governments. It was envisaged that at each training centre which might be located at one of the existing agricultural colleges/research institutes, some extra staff including two specialists, one of which might be an engineer with good background of irrigation and the other an agronomist with good background of soil and land management practices would be provided.

Progress anticipated during the Third Five Year Plan.

15.06. As the programme was introduced for the first time, during the Third Five Year Plan, the State Governments took considerable time in the initial formulation, scrutiny and submission of detailed schemes. After these schemes were approved they experienced difficulty in selecting and recruiting the technical staff required for running of these schemes and arranging necessary accommodation required for conducting the training courses and housing trainees. Difficulty was also faced in arranging the necessary number of trainees to be deputed by the various Departments.

15.07. A preliminary orientation training course was conducted in Bellary in May to July 1962, to provide specialised training on minor irrigation and water use to the selected staff drawn from the four States of Andhra Pradesh, Madras, Mysore and Madhya Pradesh. It was envisaged that the instructors to be finally posted for conducting the training courses in these States would be selected from among these trained hands. This has actually been done in three States.

15.08. The present position about the implementation of the training schemes in different States is that with the exception of the States of Maharashtra and West Bengal, the training schemes have been approved in all the States. The schemes have made good head-way in the States of Bihar, Madhya Pradesh, Madras and Uttar Pradesh, where 26, 44, 42 and 14 trainees respectively have been trained by the end of the year 1963-64. In terms of financial outlay while the schemes were sanctioned for a total amount of Rs. 35.49 lakhs, the total expenditure likely to be incurred at the end of the year 1963-64 is estimated at Rs. 4 lakhs. Outlay of Rs. 8 lakhs is forecast for each of the years 1964-65 and 1965-66. Thus the total outlay during the Third Five Year Plan on this programme is estimated at Rs. 20 lakhs.

Proposals for the Fourth Five Year Plan.

15.09. With increased emphasis on minor irrigation and irrigated agriculture, the need for technical hands, especially trained on these subjects has become more urgent. It is proposed to continue during the Fourth Five Year Plan, the operation of all the training centres set up during the Third Five Year Plan and intensify their activities and turn-out to the maximum extent possible. It is estimated that on an average, the recurring expenditure for running of one centre would be of the order of Rs. 40,000

per annum. Hence, the total financial requirements for continuing the training programmes at all the centres during the Fourth Five Year Plan would be Rs. $40,000 \times 5 \times 15 =$ Rs. 30 lakhs.

15.10. In implementation of the minor irrigation programme, there has gradually been increased emphasis on groundwater development. Whereas during the Second Five Year Plan, the groundwater schemes accounted for 33 per cent of the total physical achievement, the percentage is likely to increase to 51.6 during the Third Five Year Plan. This trend would continue in the Fourth and the subsequent Plans. For effective implementation of this expanding groundwater development programme and deriving maximum and sustained benefit therefrom, it is essential to carry out a systematic survey of groundwater potentialities, open out new groundwater worthy areas and also extend a much larger measure of technical guidance to the cultivators in the execution of these schemes. Location, design, size and spacing of open wells and tubewells and the selection of the proper type of water lifting appliances and pumps are factors which have an important bearing on the scientific and optimum utilisation of available groundwater resources.

15.11. The existing set up in the States is not adequate to meet the above-mentioned requirements. There is acute shortage of technical personnel to carry out these jobs satisfactorily. The work of carrying out surveys and investigations for assessing the groundwater potentialities and guiding the construction of open wells and tubewells require specialised training and experience. With this end in view, it is considered imperative to initiate additional training programme for imparting training on the subject of surveys and investigations for groundwater utilisation. The training is proposed to be imparted to the professionals who may be either post-graduate in geology or engineering graduates and sub-professionals who may be either degree holders in geology or engineering diploma holders with aptitude for groundwater hydrology. At each centre, there may be six training courses, three for the professionals and three for the sub-professionals; each course having a duration of three months and about 30 trainees. The training staff would include one irrigation engineer conversant with groundwater use, one geologist and one hydrologist. It is proposed that the centres may be set up during the Third Five Year Plan itself so that they come into functioning as soon as the Fourth Five Year Plan starts. Financial requirements of Rs. 60 lakhs at an average rate of Rs. 5 lakhs per centre is estimated for this programme during the Fourth Five Year Plan.

15.12. The total requirement for the training programmes to be implemented during the Fourth Five Year Plan would thus be Rs. 90 lakhs.

CHAPTER XVI

PROGRAMME FOR GROUNDWATER EXPLORATION

16.01. Systematic groundwater exploratory work was started on a nation-wide scale in 1954-55 with the Dollar aid received from the Technical Cooperation Mission of U.S.A. under the Operational Agreement No. 12. For this purpose the Exploratory Tubewells Organisation was set up in 1954. The Indo-American technical collaboration in the execution of the project was in force until the end of August 1959. During this period the Geological Survey of India were also associated with the project for geo-hydrological and geo-physical work. Thereafter, the subsequent phases of the project were sanctioned first till the end of the Second Plan period and later till the end of the Third Plan period. Since 1958-59, the project is being handled entirely by the Exploratory Tubewells Organisation; the services of a few geological officers have been made available by the Geological Survey of India. A geo-hydrological wing has been established in the Organisation.

16.02. The details of the exploratory bores drilled in different States in the three Plan periods and the results achieved and the expenditure figures are given in the accompanying statements. The exploratory work aims at delineating areas suitable for groundwater development by means of irrigation tubewells, the general yardstick for capacity of each successful tubewell being 20,000 gallons per hour at 20 feet drawdown. The successful exploratory tubewells are transferred to the State Governments for use as agricultural wells. Cost of these wells is treated as long term loan to the State Governments.

16.03. During the first two years of the Third Plan, the Organisation received financial assistance under P.L. 480 funds to the extent of Rs. 80 lakhs.

16.04. The spare capacity available in the Exploratory Tubewells Organisation is being utilised for construction of production tubewells on behalf of the State Governments. In the first three years of the Third Plan, 229 such production wells have been constructed. 450 more are proposed to be (including 250 drinking water wells in Rajasthan and 175 wells in Bihar) constructed in the last two years of the Plan period.

Statement Showing Exploratory Bores Drilled and Results Achieved

Sl. No.	Name of State	1951-56		1956-61		1961-66		Programme for re-remaining two years (1964-66)
		First Plan		Second Plan		Third Plan		
		successful	abandoned	successful	abandoned	(upto Mar. 64) Successful	abandoned	
1	Gujarat	..	..	12	48	10	19	..
2	Madhya Pradesh.	16	14	..	1	15	10	..
				(Narbada Valley)	(Tapti Valley)			
3	Assam	..	..	12	2	5	..	6
4	West Bengal	..	..	45	5	4	3	..
5	Orissa	..	..	12	2	7	9	8
6	Bihar	..	..	7	10	5	1	4
7	Rajasthan	..	..	11	17	10	56	25
8	Punjab	..	..	11	27	1	13	17
9	Kerala	..	..	1	4	..	..	..
10	Uttar Pradesh	..	..	29	8	6	..	11
11	Madras	..	..	27	13	1	9	28
12	Andhra Pradesh	..	..	11	4	..	..	24
13	Maharashtra	..	..	2	29	..	..	..
14	Himachal Pradesh	..	..	..	..	..	..	5
15	Jammu & Kashmir	..	..	..	..	..	..	10
16	Mysore	..	..	..	..	..	4	1
	TOTAL	16	14	180	170	64	124	139

Statement Showing Areas Explored and Proved Groundwater Worthy

Sl. No.	Name of State	Area explored in sq. miles	Extent proved ground worthy in sq. miles.	Average discharge I.G.P.H.	No. of production tube-wells feasible.
1	Uttar Pradesh	8,800	1,320	36,000	900
2	Madhya Pradesh	5,000	1,218	29,000	600
3	Maharashtra				
	(a) Purna valley	1,440	600	6,500	300
	(b) Tapti Valley	4,000	80	33,600	40
4	Gujarat				
	(a) Saurashtra	1,900	135	2,000	30
	(b) Kutch	5,760	500	30,000	250
5	Rajasthan	11,000	600	30,000	100
6	Bihar	7,000	992	38,000	400
7	Kerala	500	104	11,000	40
8	Andhra Pradesh	404	125	31,000	80
9	Orissa	1,800	1,327	22,000	250
10	Madras	2,600	1,396	26,000	400
11	Punjab	6,800	356	34,000	100
12	Assam	1,500	780	35,000	500
13	West Bengal	9,000	5,468	40,000	4,000

Statement showing details of expenditure incurred on Groundwater exploratory work

	O.A. 12 (1954— August 1959)	Second phase Sept. 59 to Mar. 61	Third Mar. 66. (estimated for least 3 years)	Apr. 61-	Rs. in Lakhs
1. Rupee expenditure gross after deducting internal recoveries.	251.13	69.25	1961-62 1962-63 1963-64 1964-65 1965-66	41.08 33.73 48.00 42.20 70.13	<u>235.14</u>
2. Recoverable from State Govt. towards sale of successful exploratory tubewells.	1.38	12.41	1961-62 1962-63 1963-64 1964-65 1965-66	22.98 15.84 33.24 40.00 40.00	<u>152.06</u>
3. Aid under O.A. 12—					
Equipment	140.00				
Foreign experts.	54.47				
				For two years. 1961-62 } 1962-63 }	74.81
4. P.L. 480 aid.					

16.05. The main hurdle in the Third Plan has been the non-acceptance of Exploratory Tubewells Organisation's application to the U.N. Special Fund for technical assistance to the extent of \$ 1.2 millions. This was especially meant for the purchase of drilling rigs for work in the Bhabar areas under the Himalayas.

Programme of Work in the Fourth Plan Period

16.06. The exploratory programme in the Fourth Plan will be directed towards assessing the groundwater resources in the semi-consolidated and consolidated formations and also in the left over alluvial tracts including bouldery terrain (intermontane valleys). For this purpose, the fleet of drilling equipment in hand is proposed to be replaced and reinforced as found necessary. A Geophysical Wing is proposed to be set up in the Organisation. The Exploratory Tubewells Organisation will also take up field investigations with regard to rehabilitation of State owned sick tubewells and on the job training of drillers and groundwater technicians. The estimated expenditure on the Exploratory Tubewells Organisation in the Fourth Plan is expected to be of the order of Rs. 400 lakhs gross, out of which a sum of Rs. 140 lakhs may be recovered from the State Governments, by sale of successful exploratory wells. The net expenditure may thus be of the order of Rs. 260 lakhs.

16.07. The Organisation also proposed to undertake construction of 1,500 production tubewells in the Fourth Plan on behalf of the State Governments. This involves an initial outlay of Rs. 140 lakhs on establishment, for purchase of equipment, etc. The operational charges are recoverable from the State Governments concerned.

16.08. Negotiations are being made with the U.N. Special Fund for the establishment of a Water Resources Basin Management Training Institute. It is likely that a provision of Rs. 100 lakhs would be needed on this account.

16.09. Thus the total requirement of the Exploratory Tubewells Organisation for Fourth Five Year Plan would be Rs. 500 lakhs.

CHAPTER XVII

REQUIREMENTS OF KEY MATERIALS

17.01. It is needless to state that the achievement of targets set for the Fourth Five Year Plan on various minor irrigation schemes would be essentially dependent, besides other factors, on the required availability of key materials, such as cement, coal, steel and diesel oil. To avoid shortfalls or bottlenecks later during the execution stage on account of short supply of these materials, it is essential that a precise assessment, as far as practicable, may be made of the requirements of these materials and these requirements intimated to the other Ministries concerned. This would enable these Ministries to take steps in advance for meeting the aggregate requirement of the Fourth Five Year Plan.

17.02. According to the classification suggested in Chapter II, there are 22 different types of minor irrigation schemes which are being implemented under the minor irrigation programme. The proposed Fourth Plan targets for these schemes, on all India basis, are given in Statement 'B' of Chapter XII. In order to work out the requirements of cement, coal and steel for realising these targets, it is essential that the proposed outlay of the schemes may be divided item-wise for main basic categories of works, such as earth-work, brick masonry, cement concrete, etc. In fact, this break-up would vary from work to work and at best only a very rough approximation can be made on the basis of some assumed averages. This approximate estimation on scheme-wise basis has been attempted in the Annexure. According to this study, the break-up of the aggregate outlay of minor irrigation proposed for the Fourth Five Year Plan under major items of work comes as:—

	Rs. in crores.
1. Earth work	142.26
2. Brick masonry	89.82
3. Stone masonry	54.49
4. Cement concrete	14.60
5. Reinforced cement concrete	11.11
6. Structural steel	5.56
7. Other items—equipment, power line, labour, well drilling, etc.	267.50

17.04. The requirements of cement, coal and steel is worked out from the above as under:—

Cement

17.05. Cement will be needed for items 2 to 5 above, namely, brick masonry, stone masonry, cement concrete and reinforced cement concrete. The average cost per 100 cft. of brick and stone masonry with 1 :4 cement

mortar is around Rs. 150. In some cases, the brick work 1 : 3 and the brick work 1 : 5 may also be used but on an average mortar mix of 1 : 4 has been assumed. The cost of cement concrete with an average mix of 1 : 3 : 6 is estimated to be about Rs. 180. The cost of reinforced cement concrete which would normally be in a mix of 1 : 2 : 4 is estimated to be Rs. 500. On this basis, the aggregate quantities of these items of works would work out, as under:—

Brick masonry	Rs. 8928 lakhs	$\times \frac{100}{150} = 5988$ lakh cft
Stone masonry	Rs. 5449 lakhs	$\times \frac{100}{150} = 3633$ lakh cft
Cement concrete	Rs. 1460 lakhs	$\times \frac{100}{180} = 811$ lakh cft
Reinforced cement concrete	Rs. 111 lakhs	$\times \frac{100}{500} = 222$ lakh cft

One bag of cement contains 110.5 lbs of cement.

17.06. Reckoning that the content of cement in 100 cft, of these items, is 5.5 bags in brick or stone masonry, 12.5 bags in cement concrete 1 : 3 : 6 and 18 in 1 : 2 : 4 reinforced cement concrete, the requirement of cement for these items would be as under:—

Brick masonry	59.88 lakh units $\times 5.5$ bags = 329.34 lakh bags.
Stone masonry	36.33 lakh units $\times 5.5$ bags = 199.81 lakh bags.
Cement concrete	8.11 lakh units $\times 12.5$ bags = 101.37 lakh bags.
Reinforced cement concrete	2.22 lakh units $\times 18$ bags = 39.96 lakh bags.

TOTAL 670.48 lakh bags.
or
33.52 lakh tonnes

Coal

17.07. Coal would be required for burning bricks in kilns at the rate of about one wagon of 20 to 22 tons per lakh of bricks. The use of bricks would be made only in brick masonry. The aggregate quantity of brick masonry, as worked out in para 17.05, comes to 5988 lakh cft. Reckoning that about 1500 bricks would be required per 100 cft. of brick masonry inclusive of wastage at about 10 per cent, the total number of bricks required would be $5988 \times 1500 = 89820$ lakhs. The coal requirement would work out as 89,820 wagons of 20 to 22 tons capacity each totally to about 19.76 lakh tons of coal, i.e., 20.07 lakh tonnes of coal.

Steel

17.08. Structural steel would be used in fabrication of persian wheels and sluice gates used on diversion and storage schemes and pulley blocks, angle iron, etc., used on surface wells. The total outlay of structural

steel on this account has been estimated as Rs. 5.56 crores. Reckoning the cost of about Rs. 1,000 per ton for the finished product including the cost of steel and fabrication the total quantity of steel required will work out as 55,600 tons.

17.09. Apart from the requirement of structural steel as worked out above, the use of steel would also be involved in the item of reinforced cement concrete. The total quantity of R.C.C. as worked out in para 17.05 above comes to 222 lakh cft. Reckoning that on an average about 5.00 cwt of steel would be used for 100 cft. of R.C.C. the aggregate quantity of steel required on this account would be 55,500 tons.

17.10. Thus the total requirement of steel works out as 1,11,100 tons *i.e.*, 1,12,878.0 tonnes.

Allowance for additional programme to be executed under the C.D. Sector and by private cultivators.

17.11. Against the proposed outlay of Rs. 585 crores under the GMF Sector including the anticipated contribution of Rs. 125 crores from the Land Mortgage Banks, the outlay envisaged under the C.D. Sector is about Rs. 50 crores. This works out roughly to 10 per cent of the combined outlay under the G.M.F. Sector. An outlay of the order of about Rs. 100 crores is also envisaged to be incurred by the cultivators from their own financial resources. It is, therefore, necessary that the requirements of key materials worked out above, may be increased by 30 per cent to cover the entire minor irrigation programme. The total requirement of these materials will, therefore, be as under:—

Total estimated requirements of cement, coal and steel

17.12. On the basis of the above study, the total requirements of key materials for achievements of the aggregate targets proposed for minor irrigation schemes during the Fourth Five Year Plan work out as under:—

Cement 33.52 lakh tonnes	$\times \frac{130}{100} = 43.57$ or say 44 lakh tonnes.
Coal 20.07 lakh tonnes	$\times \frac{130}{100} = 26.09$ or say 26 lakh tonnes.
Steel 1,12,878 tonnes	$\times \frac{130}{100} = 1.46$ or say 1.5 lakh tonnes.

Requirement of Diesel Oil

17.13. Diesel oil would be required for operation of diesel engine pumpsets, drilling rigs, compressor units and earth moving equipment. Item-wise requirement is worked out as under:—

Diesel Engine Pumpsets

17.14. There were about 2,30,000 diesel engine pumpsets working in the country in the year 1960-61. The number is likely to increase to

about 5,75,000 by the year 1965-66. Their phased progressive development during the Fourth Five Year Plan is likely to be as below:—

Year	Number of diesel oil pumpsets likely to be in operation.	Requirement of diesel oil (in million gallons)
1966-67	4,05,000	81.00
1967-68	4,40,000	88.00
1968-69	4,80,000	96.00
1969-70	5,25,000	105.00
1970-71	5,75,000	115.00
TOTAL		485.00

17.15. The H.P. of the diesel engine pumpsets normally used is between 5 and 10. On an average, the pumpsets run for about 800 hours in a year. Reckoning a diesel oil consumption of about $\frac{1}{4}$ gallon per hour, the annual consumption of diesel oil per diesel pumpset would be of the order of 200 gallons. The annual phased requirement of diesel oil for the diesel run pumpsets, has been worked out on this basis in the table above.

Drilling Rigs.

17.16. The average consumption of diesel oil per drilling rig is estimated as 2 gallons per hour. Reckoning 2,500 working hours per annum for the rigs, the annual diesel oil consumption per rig would work out to 5,000 gallons. The total annual requirement of diesel oil for the rigs on the basis of the number of drilling rigs likely to be in operation during various years of the Fourth Five Year Plan, as indicated in Chapter XVIII, would work out as under:—

Year	Number of drilling rigs likely to be in operation.	Diesel oil consumption. (million gallons)
1966-67	272	1.36
1967-68	345	1.73
1968-69	417	2.08
1969-70	489	2.45
1970-71	560	2.80
TOTAL		10.42

Compressor Units

17.17. Reckoning diesel oil consumption for running compressor units as 2 gallons per hour and 2,500 working hours in a year, the annual

consumption of diesel oil per compressor unit would work out to 5,000 gallons. The requirement of diesel oil per year on the basis of number of compressor units likely to be in operation, as indicated in Chapter XVIII, would work out as under:—

Year	Number of compressor units likely to be in operation	Diesel oil consumption (million gallons)
1966-67	470	2.35
1967-68	538	2.69
1968-69	606	3.03
1969-70	674	3.37
1970-71	742	2.71
TOTAL		15.15

Earth Moving Equipment

Scraper-Dozer Units.

17.18. One scraper-dozer unit would include simultaneous operation of 4 scrapers and 2 tractors. Reckoning diesel oil consumption of 2½ gallons per hour, per scraper and 3 gallons per hour tractor, the total diesel oil consumption for a unit would work out as 16 gallons. Assuming that there would be 2,500 working hours in a year, the total diesel oil consumption per annum per unit would be 40,000 gallons. According to the number of scraper-dozer units likely to be in operation during various years, as indicated in Chapter XVIII, the total diesel oil consumption per year works out as:—

Year	Scraper-dozer units likely to be in operation.	Diesel oil consumption (million gallons)
1966-67	29	1.16
1967-68	34	1.36
1968-69	39	1.56
1969-70	44	1.76
1970-71	48	1.92
TOTAL		7.76

Shovel-Dumper Units

17.19. One shovel-dumper unit would include simultaneous operation of one shovel and 8 dumpers. Estimating the diesel oil consumption of 4 gallons per hour for 1½ c. yds. shovel and 1½ gallons per hour for 4 to 5 c.yds. dumper, the total diesel oil consumption for the unit would work out as 1½ gallons per hour. Assuming 2,500 working hours in a year,

the yearly consumption of diesel oil per unit would be 40,000 gallons. The year-wise requirement of diesel oil, on the basis of the number of shovel-dumper units in operation every year, as indicated in Chapter XVIII, works out as under:—

Year	Number of shovel-dumper units likely to be in operation	Diesel oil consumption (million gallons)
1966-67	9	0·36
1967-68	10	0·40
1968-69	11	0·44
1969-70	13	0·52
1970-71	14	0·56
TOTAL		2·28

Total Requirement of Diesel Oil

17.20. The aggregate requirement of diesel oil per year comes as.—

Year	Diesel oil consumption (million gallons)
1966-67	86·23
1967-68	94·18
1968-69	103·11
1969-70	113·10
1970-71	123·99
TOTAL	520·61
	say 520 million gallons
	or 2·35 million tonnes.

ANNEXURE

Statement showing Item-wise (Earth Work, Brick Masonry, Cement Concrete, etc.,) Break-up of Proposed outlay on Different Schemes During the Fourth Five Year Plan.

(Rs. in crores)

Sl. No.	Name of the scheme]	OUTLAY ON							
		Total outlay	Earth work	Brick masonry	Stone masonry	Cement concrete	R.C. concrete	Structural Steel	Other items e.g. mechanical equipment steel piles, power lines, land acquisition, labour, etc.
1	2	3	4	5	6	7	8	9	10
1.	Construction of new wells	150.73	7.50	60.00	15.00	1.70	7.50	1.70	57.33
2.	Restoration of old wells	12.06	..	3.60	0.60	0.10	..	0.10	7.66
3.	Boring of wells . . .	14.58	..	..	..	..	..	..	14.58
4.	Deepening of wells .	6.05	..	..	..	..	..	..	6.05
5.	State tubewells .	30.97	1.50	5.00	..	0.40	0.25	..	23.82
6.	Cooperative tubewells .	2.10	0.15	0.40	..	0.04	0.04	..	1.47
7.	Private tubewells .	37.81	3.00	7.50	..	0.35	0.35	..	26.61
8.	Filter-point tubewells .	0.80	..	..	..	..	..	..	0.80
9.	Artesian tubewells .	0.20	0.02	0.04	..	..	..	..	0.14
10.	Electric motor pump-sets . . .	49.06	..	0.50	..	0.50	..	..	48.06

	1	2	3	4	5	6	7	8	9	10
11. Diesel engine pump-sets . . .			45.68	..	0.45	..	0.45	..	..	44.78
12. Persian wheels . . .		2.66	..	0.05	0.02	0.03	..	2.31	0.25	
13. Construction of new tanks and reservoirs . . .		76.26	45.80	2.25	17.00	3.10	0.40	0.40	7.31	
14. Restoration of old tanks and reservoirs . . .		49.33	29.60	1.50	10.73	2.00	0.25	0.25	5.00	
15. Hilly channels—Kuhls, Dongas and lowkongs . . .		7.60	3.00	0.25	2.00	0.80	0.08	..	1.47	
16. Non-hilly channels—anicuts, weirs, channels, pynes, etc. . .		48.40	24.50	3.20	6.50	4.00	1.80	0.55	7.85	
17. State Lift Irrgn. . .		11.84	1.80	1.00	0.80	0.05	0.05	..	8.14	
18. Coop. Lift. Irrgn. . .		2.10	0.32	0.17	0.13	0.01	0.01	..	1.46	
19. Water conservation-cum-ground-water recharging schemes . . .		16.75	12.50	0.80	0.80	0.15	0.08	..	2.42	
20. Drainage works . . .		13.11	8.35	1.90	0.40	0.50	0.13	0.13	1.70	
21. Embankment and flood protection works . . .		2.97	2.12	0.36	0.06	0.12	0.03	0.03	0.25	
22. Anti-sea water intrusion works . . .		4.28	2.10	0.85	0.45	0.30	0.14	0.09	0.35	
TOTAL OF ALL SCHEMES . . .		585.34	142.26	89.82	54.49	14.60	11.11	5.56	267.50	

CHAPTER XVIII

REQUIREMENT OF EQUIPMENT & MACHINERY

18.01. Bulk of minor irrigation is executed by manual labour mostly un-skilled and some skilled. There are, however, some schemes which require the use of mechanical equipment for faster and more economical execution and also for obtaining better quality of work. Boring of wells and particularly drilling of tubewells becomes much faster when power rigs are employed for this purpose. Drilling large sized holes or drilling through great depths and in difficult strata becomes possible only through use of such rigs. Similarly, deepening of wells in hard rocky sub-stratum by blasting is made possible only through pneumatic drilling by compressor units and jack hammers.

18.02. On schemes like tanks, although most of earth work is carried out by manual labour, in some cases it becomes imperative to use earth moving equipment for the sake of speed, economy and operation and obtaining better grade of work, particularly in regard to compaction of earth in embanked reaches. In many types of soils, earth moving equipment enables better compaction of earth at much lesser cost. In cases, where earth-work involves haulage of excavated earth over a long distance, say about a furlong or so, the transport of earth by manual labour remains neither simple nor economic. Use of earth moving equipment becomes a 'MUST' on economic grounds in such cases. Long leads are involved, particularly in the scheme of desilting-cum-reclamation of tanks where the excavated soil from the bed of tanks is utilised to reclaim land, otherwise remaining submerged, in the fore-shore area. Use of earth moving equipment becomes also essential for quick completion of works in areas which are thinly populated.

18.03. Further there are schemes under the minor irrigation programme where equipment forms part of the work themselves. Schemes as tubewells, boring of wells, installation of pumpsets and lift irrigation from rivers and streams come under this category. Equipment, such as pipes, diesel engines, electric motors and pumps, is required for functioning of these schemes.

18.04. Minor irrigation programme requires also equipment, such as: (a) trucks for haulage of materials and also for transport of air compressors, used for blasting of wells; (b) jeeps to be used for transport of survey parties and equipment in difficult, out of the way areas; and (c) scientific instruments and investigation equipment required for use on schemes of surveys, investigation, research and training, etc.

18.05. Requirement of equipment indicated above in relation to the targets set for the Fourth Five Year Plan is worked out as under:—

Drilling Rigs

18.06. Drilling rigs are required for boring in existing wells particularly where rocky or otherwise difficult sub-stratum is involved and for drilling of all deep or difficult tubewells, whether State, Cooperative,

private or artesian. The anticipated achievement for these items during the Third Five Year Plan and the targets for the Fourth Five Year Plan are given as under:—

Items	Anticipated achievement during Third Five Year Plan	Targets for Fourth Five Year Plan
1. Boring of existing wells (Number)	1,25,000 (approx.)	2,08,000 (approx.)
2. Tubewells—State, Cooperative, Private and artesian (Number)	15,500 (approx.)	43,000 (approx.)

18.07. The boring work in existing wells as well as in tubewells would be carried out by hand boring sets as well as power rigs. It may be assumed that about 75 per cent work would be carried out by the hand boring sets and the remaining 25 per cent by the power rigs. On an average, a rig may be expected to complete borings in about 35 wells per annum. The corresponding rate for drilling of tubewells may be taken about 18 per rig on an average. On this basis, the requirements of power rigs during the five years of the Fourth Five Year Plan according to the following proposed year-wise phasing of the targets works out as:—

Year	Boring in existing wells		Drilling of tubewells	
	Phased target	Requirement of power rigs	Phased target	Requirement of power rigs
	(units)	(number)	(units)	(number)
1966-67	30,000	214	4,200	58
1967-68	35,800	256	6,400	89
1968-69	41,600	298	8,600	119
1969-70	47,400	339	10,800	150
1970-71	53,200	380	13,000	180
	2,08,000		43,000	

18.08. Reckoning that there would be about 200 rigs already functioning in the country at the end of the Third Five Year Plan, the year-wise and the total additional requirement of rigs for the Fourth Five Year Plan works out as under:—

Year	Total requirement of rigs	Rigs already available in the previous year	Additional rigs required at the beginning of the year
1966-67	272	200	72
1967-68	345	272	73
1968-69	417	345	72
1969-70	489	417	72
1970-71	560	489	71
TOTAL			360

18.09. Thus the total number of additional power rigs required for realising the target set for the Fourth Five Year Plan would be 360. Allowing about 20 per cent for replacement of the existing 200 rigs in the country, the additional requirement on this account would be 40. Hence the total number of rigs required including those for replacement would be 400. These rigs may be of the following types:—

1. Core (diamond) drilling rigs	30
2. Direct Rotary	90
3. Reverse circulation rotary	90
4. Percussion	130
5. Rotary-cum-percussion	60
TOTAL	400

18.10. As per present indications, it is not likely that the indigenous manufacture of rigs would be able to make much headway upto the end of the Fourth Five Year Plan. It is anticipated that out of the above 360 rigs may have to be imported from abroad. Assuming an average cost of Rs. 1.50 lakhs per rig, the foreign exchange involved on this account would be Rs. 5.4 crores.

Air Compressor Units

18.11. As deepening of wells by blasting is a very useful scheme for augmenting the discharge of wells, great emphasis is proposed to be given to this scheme during the Fourth Five Year Plan. Against the anticipated achievement of deepening of about 1 lakhs wells during the Third Five Year Plan, the target pitched for the Fourth Plan is about 2 lakh wells. Compressors are used for drilling the holes in the wells for the purpose of blasting. On an average, one air compressor unit is able to achieve a progress in deepening of wells, of about 4 to 5 ft. per day. The depth for each well required to be deepened varies from region to region. Assuming that on an average, the wells would be required to be deepened by about 12 to 15 ft. and reckoning 200 days in a year, one air compressor unit would be able to tackle about 66 wells in a year. The year-wise requirement of compressors on this basis and according to the year-wise phasing of the target envisaged would work out as under:—

Year	Phased target (Units)	Requirement of air compressor (units)
1966-67	31,000	470
1967-68	35,500	538
1968-69	40,000	606
1969-70	44,500	674
1970-71	49,000	742
TOTAL	2,00,000	

18.12. Reckoning that there would be about 400 air compressor units already functioning in the country at the end of the Third Five Year Plan, the year-wise and the total requirement of additional air compressor units during the Fourth Five Year Plan would be as under:—

Year	Total requirement of air compressor units	Number already available in the previous year	Additional compressor units required at the beginning of the year
1966-67	470	400	70
1967-68	538	470	68
1968-69	606	538	68
1969-70	674	606	68
1970-71	742	674	68
TOTAL			342

18.13. Thus the total additional capacity of the air compressor units required for coping with the additional work would be 342. Another 80 air compressor units are expected to be required for replacement of the existing ones. Thus a total of 422, say 425 air compressor units, each comprising an air compressor of 100 to 200 c.f.m. capacity at 100 lbs. per sq. inch, 6 Jack hammers (rock drills) of 30 to 50 lbs. weight, about 180 drilling rigs of 1" to 2" size, 6 shank rods of 5 ft. length with other ancillary attachment, would be needed, during the Fourth Five Year Plan. Air compressors are being manufactured in the country in sufficient numbers; hence no foreign exchange component would be involved.

Earth Moving Equipment

18.14. According to the study carried out in Chapter XVII, the aggregate outlay on earth work for minor irrigation schemes proposed for the Fourth Five Year Plan works out to Rs. 142.26 crores. Although the rate of earth work would vary from region to region and from scheme to scheme, it is estimated that on an average the rate would be Rs. 6 per c.f.c. (100 ft. cube). Thus the total quantity of earth work involved would be about 240 million c.f.c. As mentioned earlier, the bulk of this earth work would be carried out by manual labour. However, in some cases, the use of earth moving equipment would be necessary for speed, economy and better quality of work. On the whole it may be assumed that about 10 per cent of total earth work may have to be carried out by the earth moving equipment. This would mean that earth moving equipment would be required for tackling 24 million c.f.c. of earth work. The year-wise phasing of this plan target may be as under:—

Year	Phased target (in lakhs c.f.c.)
1966-67	36
1967-68	42
1968-69	48
1969-70	54
1970-71	60
TOTAL	240

18.15. Most of the earth work on minor irrigation works would be carried out by such machines as the scraper-dozer units. In some cases of long haulage, however, the use of power shovels and dumpers will be found more feasible. On the whole, it is reckoned that about 80 per cent of the total earth work, *i.e.* 19.2 million c.f.c. would be carried out by scraper-dozer units and the rest 20 per cent, *i.e.*, 4.8 million c.f.c. by shovel-dumper units. The performance per unit of these two types of earth moving equipment would be as below:—

Scraper-dozer units

18.16. A scraper-dozer unit on an average would consist of:—

1. Scrapers	4 Nos.
2. Crawlers tractors	3 Nos. —one for pushing, one for dozing and compaction and one spare.
3. Sheep foot roller	1 No.

18.17. Normal experience is that if the average capacity of the scraper is 8 to 10 c. yd., the average outturn of this unit, in good common earth would be about 40 c.f.c. per hour. Reckoning 2,500 working hours per year the total progress of each unit during a year would be $2500 \times 40 = 1$ lakh c.f.c.

Shovel-dumper units

18.18. $1\frac{1}{2}$ c. yd. power shovels are normally able to excavate about 35 c.f.c. per hour in good common earth. Dumpers are available in various capacities upto even 15 c. yds. or more. However, smaller, 4 to 5 c. yds. capacity dumpers, would, by and large, be quite adequate for the purpose of minor irrigation works. If the average lead is assumed to be half a mile, the average output of a dumper of this capacity would be about 4.3 c.f.c. per hour with an average efficiency of about 65 per cent. Thus 8 dumpers would be required to be used in conjunction with one power shovel and the average output of the combined unit would be about 35 c.f.c. per hour. Reckoning 2,500 working hours in a year, the outturn per unit in a period of one year would be 87,500 c.f.c.

Requirement of Scraper-dozer and Shovel-dumper units :

18.19. According to the phasing of the target for earth work and the performance per unit indicated above, the year-wise total requirement of the earth moving units work out as under:—

Year	Scraper-dozer units		Shovel-dumper unit	
	Phased target in lakhs C.F.C.	Units required	Phased target in lakhs C.F.C.	Units required
1966-67	28.8	29	7.2	9
1967-68	33.6	34	8.4	10
1968-69	38.4	39	9.6	11
1969-70	43.2	44	10.8	13
1970-71	48.0	48	12.0	14
TOTAL	192.0		48.0	

18.20. Reckoning that there would be about 24 Scraper-dozer units and 7 Shovel-dumper units already functioning in the country at the end of the Third Five Year Plan, the year-wise and the total additional requirement of these units during the Fourth Five Year Plan would be as under:—

Year	Scraper-dozer units	Shovel-dumper units.
1966-67	5	2
1967-68	5	1
1968-69	5	1
1969-70	5	2
1970-71	4	1
TOTAL	24	7

18.21. Adding for replacement of the existing units, the total additional requirement of equipment may be reckoned as 30 Scraper-dozer units and 10 Shovel-dumper units.

Other Earth Moving Equipment required

18.22. In addition to the units mentioned above, motor graders would also be required where roads for long haulage are to be maintained. Further, big sized tractors and trailers would be required for haulage of earth moving equipment to long distances. Lump sum requirement of this equipment has been indicated, on the basis of experience gained during the Third Five Year Plan, in the abstract given below:—

18.23. Abstracts of requirements for Earth Moving Equipment.

Items	No.	Estimated cost (Rs. in lakhs)
1. Motorised Scrapers 8-10 c. yds. capacity	120	120
2. Power Shovels 1-1/2 c. yds capacity	10	30
3. Dumpers, 4 to 5 c. yds capacity	80	48
4. Crawler tractors with pushers	30	30
5. Crawler tractors for dozing and compaction	30	30
6. Crawler tractors as spares	30	25
7. Sheep Foot Rollers	30	15
8. Motor graders	20	20
9. Tractors for haulage and transport	10	8
10. Trailors	10	4
TOTAL	370	330

Component of foreign exchange involved in Earth Moving Equipment

18.24. Although manufacture of power shovels and scrapers has started in the country, it is yet on a very modest scale and self-sufficiency in this equipment is yet likely to take a very long time. It is visualised that for meeting the requirements of the Fourth Five Year Plan, about 75 per cent of the required equipment would have to be imported. The component of foreign exchange involved would be about Rs. 2.50 crores.

Pipes

18.25. Pipes are required for casing the holes in borings of existing wells as well as tubewells including artesian and filter points. For boring in existing wells and for filter-point tubewells, the size of the pipes required would range from 3 to 6 inches. For private tubewells including artesian ones, it would range from 6 to 12 inches. For State tubewells, it will vary from 6 to 16 inches. On an average about 60 ft. of pipes would be required per boring of existing wells. The length required for filter-point tubewells is usually about 40 ft. For large sized State tubewells, the length of pipes required may be reckoned as about 350 ft. and on an average for cooperative and private tubewells as about 150 ft. per well. Thus the requirements of pipes on the basis of targets set for the Fourth Five Year Plan would be as under:—

	R. ft.
(a) 3" to 6" Dia pipes.	
2,07,920 borings in existing wells at 60' per bore	1,24,75,200
2,678 filter points at 40' per unit	1,07,480
TOTAL	1,25,82,680
(v) 6" to 16" Diaies	
39,630 private, cooperative and artesian tubewells at 150' per unit	59,44,500
3,320 State tubewells at 350' per unit	11,62,000
TOTAL	71,06,500
GRAND TOTAL	1,96,89,180
	say 200 lakh R. ft.

18.26. The pipes in the range of 3" to 6" Dia are being manufactured in the country by Messrs. Kalinga Tubes and the Indian Tubes. Manufacture of pipes of 8 inches and above in diameter has recently been started by the Hindustan Steel Limited, Rourkela. If adequate steps are taken up for expanding the manufacturing capacity of these pipes in the country, it should be possible to meet about 75 per cent of the requirement from the indigenous manufacture. The balance 25 per cent may have to be imported from abroad mostly from the East European countries. The average cost of imported pipes may be taken as Rs. 16 per ft; the foreign exchange involved would thus work out as Rs. 8.00 crores.

Electric Motors

18.27. The number of electric motors in use for irrigational pumping in the country is reported to have been 25,047 in 1951, 54,777 in 1956 and 1,60,164 in 1961. These figures show that a considerable number of additional electric motors was installed during the three Plan periods, by the cultivators from their own financial resources. It is anticipated that under the G.M.F. Sector alone during the Third Five Year Plan, the

additional number of about 73,000 would be installed. Against this expected performance, the target set for the Fourth Five Year plan under the G.M.F. Sector is 2.40 lakhs. Great acceleration is proposed under this programme as there are indications that there will be great emphasis on power generation and rural electrification during the remaining years of the Third Five Year Plan and the Fourth Five Year Plan. In addition to the electric motor installations under the G.M.F. Sector, it is expected that about 35,000 motors would be brought under commission under the C.D. Sector and from private resources. Thus it is expected that on account of increased availability of cheap electric power, a total of about 2.75 lakh motors would be commissioned during the Fourth Five Year Plan. The capacity of these motors will vary, by and large, from 3 to 5 H.P.

18.28. In addition to the above requirements, electric motors would also be needed for running of tubewells, State, Cooperative and private, as well as artesian wells and filter-points. The requirement on this account is expected to be about 30,000. The capacity of these electric motors would vary from 5 to 15 H.P.

18.29. Electric motors would also be required for running of pumping installations for lifting water from rivers and streams. The number of such electric motors is estimated to be about 5,000. Their capacity would normally vary from 10 to 50 H.P.

18.30. Thus the total number of electric motors required would be of the order of 3.5 lakhs. These electric motors are being manufactured in the country; hence no foreign exchange would be involved. Some foreign exchange amounting to about Rs. 10 lakhs may be required for replacement of some of the existing electric motor installations of exceptionally high H.P. on lift irrigation schemes. Manufacture of these electric motors may not be possible in the country.

Diesel Engines

18.31. The number of diesel engines in use for irrigational pumping is reported to have been 65,794 in 1951, 1,22,230 in 1956 and 2,29,944 in 1961. These figures show that as in the case of electric motors, a substantial number of diesel engines had been installed by the cultivators themselves from their own financial resources, against the expected achievement of installing about 76,000 of diesel engines under the G.M.F. Sector during the Third Five Year Plan, the target pitched for the Fourth Five Year Plan is for installing of about 1,28,000 diesel engines. Taking into account the additional installations of diesel engines on tubewells, lift irrigation schemes and also those to be carried out under the C.D. Sector and the cultivators from their own resources, it is estimated that a total of 2 lakhs diesel engines would be installed for irrigational pumping during the Fourth Five Year Plan. Most of these diesel engines would be below 10 H.P. Some higher H.P. engines upto 60 H.P. or so would be required for lift irrigation from rivers and streams.

18.32. It is anticipated that a few diesel engines of a high H.P. capacity may have to be imported at a cost of about Rs. 10 lakhs or so for lift irrigation schemes from rivers and streams.

Pumping Sets

18.33 About 5.6 lakh pumping sets to work in conjunction with the above estimated number of electric motors and diesel engines would also be needed.

Transport Equipment

18.34. Trucks would be required for haulage of air compressor equipment and also for transport of materials, such as cement, bricks, coal, etc., and also mechanical equipment. The requirement of trucks for compressor units would be 425 on the basis of one for each additional compressor unit. It is necessary that these trucks should have four-wheel drive so that they can ply with ease on rough countryside roads.

18.35. Transport of materials is mostly done by the private contractors who own their own vehicles. However, it is usually expedient to supplement it to some extent by departmental vehicles maintained in the various working Divisions for the purpose. It is expected that about 200 trucks would be required for departmental carriage of materials. This figure does not take into account the additional capacity that may be required for the carriage of materials by the private contractors.

18.36. For handling the accelerated minor irrigation programme as proposed for the Fourth Five Year Plan, it is very necessary that surveys and investigations should be intensified and organised systematically for the purpose. To bring in efficiency and speed in the survey and investigation work, it will be essential to provide Investigation Divisions and the Sub-divisions with jeeps. Assuming that two new Divisions with 8 sub-divisions would be opened for surveys and investigations of minor irrigation schemes in each State, about 150 jeeps will be required to enable the survey work to be carried out with speed and efficiency. Adding 50 more jeeps required for improving the efficiency of the existing staff, the total number needed would be 200.

Scientific & Investigation Equipment

18.37. The scientific and investigation equipment required would include about 600 level instruments needed for the new Investigation Divisions to be set up in each State and their equipment such as electric loggers, moisture meters, tensiometers, soil moisture measuring units, pressure membrane plates, hygro-thermographs, insolyregraph, etc., required for exploration of groundwater and Research & Training Schemes. An appreciable part of this equipment may have to be imported for which the foreign exchange involved may be of the order of Rs. 15 lakhs.

Spares

18.38. It is envisaged that, about Rs. 25 lakhs of foreign exchange would be required for meeting urgent needs of the State Governments in respect of spares, tools, accessories, sundries and replacement of parts of their existing equipment and machinery of the types enumerated above. Even during the Third Five Year Plan, the foreign exchange released for these items is likely to average to about Rs. 5 lakhs per year with a total of Rs. 25 lakhs during the Plan period. However, as part of the increased demand for these items during the Fourth Five Year Plan is likely to be met by increased production in the country, the quantum of foreign exchange required for these items has been kept the same as in the Third Five Year Plan.

Abstract of the Requirement

18.39. On the basis of the above study, the requirement of the various items of equipment and machinery for realising the Fourth Plan targets works out as under:—

Items	Nos.	Component of foreign exchange involved (Rs. in crores)
1. Drilling rigs	400	5.40
2. Air compressor units	425	..
3. Earth moving equipment	370	2.50
4. Pipes	200 lakh R. ft.	8.00
5. Electric motors	3.1 lakh	0.10
6. Diesel engines	2 lakhs	0.10
7. Pumpsets	5.6 lakhs	..
8. Trucks	625	..
9. Jeeps	200	..
10. Scientific and investigation equipment	600	0.15
	level and other instru- ments.	-
11. Spares	Lumpsum	0.25
TOTAL .		Rs. 16.50 crores

CHAPTER XIX

IMPORTANT MEASURES FOR URGENT, ADVANCE ACTION

19.01. The existing problems in the technical and organisational field of minor irrigation have already been dealt with in detail in Chapters VI to XI. Many of these problems have been aggravated by recent acceleration of minor irrigation programme during the Third Five Year Plan. Notwithstanding these problems, it has been necessary to pitch a high Fourth Plan target for minor irrigation which is key programme for quick agricultural development. The Fourth Five Year Plan proposals visualise about two to four times acceleration on the following schemes which would contribute nearly 50 per cent of the total target:—

Name of Scheme	Third Plan estimated achievement	Fourth Plan Target
1. Boring of wells (Nos.)	1,25,687	2,07,920
2. Deepening of wells (Nos.)	99,549	1,99,000
3. Electric motor pumpsets (Nos.)	72,960	2,40,580
4. Diesel engine pumpsets (Nos.)	76,306	1,27,960
5. Private tubewells (Nos.)	11,925	38,880
6. Lift irrigation from rivers and streams (acres.)	2,75,990	4,46,500

19.02. In order to ensure that the proposed target is fully realised and adequate technical and administrative control is exercised to obtain effective implementation of the minor irrigation, urgent advance action is necessary in implementation of the following important measures:—

- 1: Fast acceleration of tempo of surveys and investigations, particularly on groundwater schemes with a view to (a) delineating new groundwater worthy areas, (b) establishing full potentialities of the already proven areas so that over-draft of groundwater and the consequent lowering of the water table and failure of wells is avoided, (c) preparing basin-wise/district-wise integrated master plans which would enable to take up the programme on a priority basis and in coordination with different categories of schemes so that there is integrated development of irrigation resources without any duplication of efforts, and (d) collecting hydrological and geological data and preparing contour maps for enabling projection and preparation of designs and construction details of the individual schemes-preparation of specific survey schemes for the purpose by the States and making available 100 per cent grant-in-aid for these schemes by the Centre during the remaining period of the Third Five Year Plan.

19.03. The need for intensive surveys and investigations and for integrated approach in the work has already been emphasised in Chapter VI. While, by and large, the State Governments have strengthened their existing organisations for surveys and investigations in the Public Works/Irrigation Departments, these survey organisations take care of only surface water schemes. Adequate organisation for carrying out surveys of groundwater potentialities so that the schemes of wells, boring and deepening of wells, tubewells, pumpsets, etc., making use of groundwater can be implemented on a scale commensurate with the potentialities, is lacking in almost all the States. For this reason, it has also not been possible to prepare integrated basin-wise/district-wise master plans incorporating possibilities of surface water as well as groundwater schemes, for guiding minor irrigation constructions on sound technical basis in coordination with major-medium irrigation schemes. It is utmost importance that the State Governments should take urgent steps to intensify surveys and investigations and to re-orientate their existing survey and investigation organisation so that the groundwater potentialities are also included in their purview. It is necessary for this purpose that the State Governments should prepare specific schemes for undertaking surveys and investigations on an intensive scale and that in order to provide an impetus for expeditious undertaking of these schemes, 100 per cent subsidy should be made eligible for these schemes during the remaining period of the Third Five Year Plan.

19.04. To start with, it would be desirable that the surveys and investigations may be specially concentrated in the districts which are selected under the intensified agricultural development programme.

2. Expeditious strengthening of the technical organisation in the States for undertaking accelerated programme of boring and deepening of wells, installation of pumpsets and advising the cultivators on location, size and design of open wells and choice of water lifting appliances including pumpsets.

19.05. The need for such an adequate technical organisation in the States for deriving maximum and sustained benefits from groundwater schemes, such as open wells, pumpsets, tubewells, etc., has already been brought out in paras 8.07 to 8.09 of Chapter VIII. As against the estimated achievement of 2.3 and 3.0 million acres of additional area irrigated from groundwater schemes during the First and the Second Five Year Plans respectively, the anticipated achievement during the Third Five Year Plan is likely to be of the order of 6.7 million acres. The target pitched for the Fourth Five Year Plan is 8.5 million acres. It is evident that as the minor irrigation programme has been progressing, increasing emphasis is being laid on groundwater schemes. It is, therefore, of basic importance that alongside arranging scientific surveys for groundwater potentialities, the technical organisations responsible for exploiting these potentials on scientific lines should also be adequately strengthened. This step is highly desirable to make optimum use of groundwater supplies available and to prevent infructuous expenditure in the form of failed wells, existing wells getting into dis-use due to over-draft or otherwise, or over-sized or under-sized installation of pumping equipment/water lifting appliances for lifting water from the wells. The States should start taking steps forthwith to have adequate technical and trained staff for this purpose on regional basis.

3. Stepping up the tempo of the training programmes.

19.06. With the recent acceleration of minor irrigation programme during the Third Five Year Plan, the need for trained technical hands to tackle the larger programme efficiently and effectively on sound technical lines has become very acute. To fulfil this need, it is important that the State Governments should take adequate advance steps for obtaining maximum turn out from the training programme on minor irrigation and water use already in hand.

19.07. With increased accent on groundwater development, it is essential to carry out systematic surveys of groundwater potentialities, open out new groundwater worthy areas and also to extend larger measure of technical guidance to the cultivators in the execution of these schemes. Location, design, size and spacing of open wells and tubewells and the selection of the proper type of water lifting appliances and pumps are factors which have an important bearing on the efficient and optimum utilisation of available groundwater resources. To meet the increasing demand of technical hands for carrying out these jobs, it is proposed to initiate during the Fourth Five Year Plan, an additional training programme for imparting training on the subjects of surveys and investigations for groundwater utilisation. The urgency of the situation demands that advance action should be initiated for setting up the requisite number of training centres for conducting the proposed training courses during the Third Five Year Plan itself, so that these Centres come into functioning before the Fourth Five Year Plan starts.

4. Providing incentive to the cultivators for taking to lift irrigation works, by (a) liberalising terms and conditions for sanction of electric power to the irrigators and charging concessional or subsidised rates for the electricity consumed as recommended in Chapter VIII, (b) extending benefit of subsidy to schemes of pumpsets, tubewells and lift irrigation from rivers and streams as recommended in Chapter XIII, and (c) increasing the quantum of subsidy in the backward areas to help the poorer cultivators in taking up the work as suggested in Chapter XIII.

19.08. As already mentioned earlier, the Fourth Five Year Plan proposals envisage many times expansion in the programme of installation of electrical pumpsets, tubewells and lift irrigation from rivers and streams. To ensure fulfillment of this ambitious target, it is highly essential that strong impetus in the form of the above measures should be provided for undertaking of these schemes on a much wider scale.

5. Undertaking of adequate steps with the industrial sector to ensure that the increased requirements of key materials, equipment and machinery, diesel engine electric motors, pumps, pipes, etc., for achieving the Fourth Five Year Plan targets as detailed in Chapter XVII and XVIII would be fully met with.

19.09. The requirements of key materials, equipments and machinery and other items for achieving the target set for the Fourth Five Year Plan have been worked out in detail in Chapters XVII and XVIII. It is necessary that these requirements should be taken into account by the Ministry of Heavy Industry in formulating their plans for adequate expansion of the indigenous manufacture during the rest of the Third Five Year Plan and the Fourth Five Year Plan.

6. Ensuring timely release of foreign exchange for meeting phased requirements of equipment to be imported from abroad for achieving the targets, as indicated in Chapter XVIII.

19.10. The equipment required to be imported includes items, such as drilling rigs and earth moving equipment, indigenous manufacture of which is not likely to make sufficient headway to meet the entire requirements of the Fourth Five Year Plan. It is necessary that the requirements of equipment to be imported may be properly phased according to the acceleration proposed from year to year and advance steps taken to clear all formalities for obtaining foreign exchange and arranging their import in time. For all additional equipment which is proposed to be pressed into action during the year 1966-67, that is the first year of the Fourth Plan, it is essential that advance action to get the formalities for import cleared, should be taken in the last year or even earlier in the Third Five Year Plan itself, so that the equipment is available in position right in the beginning of the year 1966-67. Similar advance action would be required to be taken for procurement of equipment in all the subsequent years of the Fourth Plan.

7. Integrated planning of lift irrigation, small scale industries and rural electrification programme with a view to ensuring maximum coverage of agricultural area under lift irrigation for taking up lift irrigation schemes. (Chapter VIII).

19.11. There are indications that during the Fourth Five Year Plan, great emphasis would be laid on development of power and rural electrification programme: Expansion of lift irrigation through electrical installations, therefore, finds a prominent place in the targets of minor irrigation for the Fourth Five Year Plan. In order to achieve the target set fully, it is necessary that lift irrigation, small scale industries and rural electrification programmes should be properly integrated and synchronised so that it is possible to extend power lines at minimum cost thus covering more agricultural areas under the rural electrification programme. This approach would further help to improve the load factor and the economics of rural electrification thus overcoming the usual hesitation on the part of the State Electricity Boards to take to agricultural load.

8. Improving technical standards in planning, designing and execution of works by much more increased emphasis than hitherto given on: (a) research and training programmes, (b) production of technical manuals and literature on various minor irrigation schemes and increased dissemination of knowledge on the subject, and (c) follow-up action on all important technical recommendations on various schemes that have been made from time to time, and are summarised in Chapter VII.

19.12. As already emphasised earlier, adequate research and training programmes in the field of minor irrigation are very essential for stimulating technical thinking, bringing better technical standards in planning, designing and execution of minor irrigation works and for exercising economy in construction. In order to introduce greater technical bias and merit in planning and implementation of the schemes, it is essential that the State Governments should get technical handbooks prepared on important minor irrigation schemes giving design practices and constructional features which are most suitable for their respective regions. This

would not only provide much needed technical orientation but also greatly help in inter-State exchange and pooling of knowledge on important technical matters concerning the development of minor irrigation schemes. The States should initiate action in this direction without delay. They may consider the desirability of deputing competent and experienced officers exclusively for this purpose for a short period. Following are some of the important subjects tentatively suggested for preparation of these manuals:—

- (i) Location, size, design and spacing of open surface wells;
- (ii) boring and deepening of wells;
- (iii) tubewells;
- (iv) water lifting appliances including pumpsets;
- (v) tanks—construction and renovation;
- (vi) design and construction of diversion schemes;
- (vii) design and construction of headwater tanks, percolation tanks, check dams, etc.;
- (viii) design and construction of small drainage, flood protection and anti-sea water intrusion works.

19.13. A number of technical recommendations have been made from time to time for improving the execution of minor irrigation schemes on sound technical lines. These technical recommendations have been summarised in Chapter VII. It is highly essential for sound technical implementation of the programme that the State Governments should pay adequate attention to these recommendations.

9. Undertaking measures suggested in Chapters IX to XI for proper maintenance and utilisation of completed works and improving assessment of irrigation benefits.

19.14. The problems of maintenance and utilisation of minor irrigation benefits have been dealt with in detail in Chapter IX and X respectively. In order to ensure quick and sustained deriving of benefits from works completed under the minor irrigation programme, it is imperative that various measures suggested in these Chapters should be implemented by the State Governments at the earliest.

19.15. In the interest of realistic planning and forecast of benefits, it is pressingly essential that the State Governments should organise and carry out sample check and sample surveys of the irrigation benefits that have been accruing from different minor irrigation schemes. The yardsticks adopted appears to be high in many cases and need to be properly evaluated in the light of the results of sample checks and surveys. Other recommendations made in Chapter XI also require urgent action at the earliest.

APPENDIX I

NAME OF STATE—ANDHRA PRADESH

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan.

Serial No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. asstt/Unit (in Rs.)	Yardstick Irrn/Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1.	Construction of new wells	70,000	140.00	1400.00	2,000	2.0	1,000
2.	Restoration of old wells	10,000	10.00	50.00	500	1.0	500
3.	Boring of wells	1,000	5.00	30.00	3,000	5.0	600
4.	Deepening of wells	20,000	30.00	100.00	500	1.5	333
TOTAL GROUP A			185.00	1580.00			
B. TUBEWELL SCHEMES							
5.	State tubewells	50	5.00	35.00	70,000	100	700
6.	Cooperative tubewells						
7.	Private tubewells	2,000	60.00	300.00	15,000	30	500
8.	Filterpoint tubewells						
9.	Artesian tubewells	400	8.00	20.00	5,000	20	250
TOTAL GROUP B			73.00	355.00			
C. WATER LIFTING APPLIANCES							
10.	Electric motor pumpsets	30,000	150.00	600.00	2,000	5	400
11.	Diesel Engine pumpsets	10,000	60.00	300.00	3,000	6	500
12.	Persian wheels						
TOTAL GROUP C			210.00	900.00			

D. STORAGE SCHEMES

13. Construction of new tanks and reservoirs	333.33	2000.00	600
14. Restoration of old tanks and reservoirs	150.00	600.00	400
TOTAL GROUP D	483.33	2600.00	

E. DIVERSION SCHEMES

15. Hilly channels—Kuhls/Dongs and Lowkhongs, etc.	10.00	50.00	500
16. Non-hilly, channels, anicuts, weirs, channels, pynes bandharas, etc.	162.50	650.00	400
TOTAL GROUP E	172.50	700.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17. State Lift Irrigation	20.00	50.00	250
18. Cooperative Lift Irrigation			
TOTAL GROUP F	20.00	50.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19. Rapats, submerging dams, ahars, bundhies, percolation tanks	32.50	65.00	200
TOTAL GROUP G	32.50	65.00	

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20. Drainage works	100.00	200.00	200
21. Embankment and flood protection works	12.50	25.00	200
22. Anti-sea water intrusion works	8.33	25.00	300
TOTAL GROUP H	120.83	250.00	
GRAND TOTAL	1297.16	6500.00*	501

*Out of total provision of Rs. 65 crores it is expected that Rs. 10 crores will be available from the Cooperative Sector i.e., Land Mortgage Banks for schemes 1, 2, 7, 10 and 11. The net provision under G.M.F. Sector would thus be Rs. 55 crores.

APPENDIX 2

NAME OF STATE—ASSAM

Minor Irrigation Programmes under G.M.P. Sector during Fourth Five Year Plan.

Serial No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/Unit (in Rs.)	Yardstick Irrn/Unit (In acres.)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1.	Construction of new wells	.	.	.	.	.	.
2.	Restoration of old wells	.	.	.	.	.	.
3.	Boring of wells	.	.	.	.	.	.
4.	Deepening of wells	.	.	.	.	.	.
TOTAL GROUP A			.	.	.	.	.
B. TUBEWELL SCHEMES							
5.	State tubewells	.	30	3.00	25.00	83,330	100
6.	Cooperative tubewells	.	.	.	.	.	83
7.	Private tubewells	.	.	.	.	.	.
8.	Filterpoint tubewells	.	.	.	.	.	.
9.	Artesian tubewells	.	.	.	.	.	.
TOTAL GROUP B			.	3.00	25.00	.	.
C. WATER LIFTING APPLIANCES							
10.	Electric motor pumpsets	.	.	.	.	.	.
11.	Diesel engine pumpsets	.	3,000	60.00	150.00	5,000	20
12.	Persian wheels	.	.	.	.	.	250
TOTAL GROUP C			.	60.00	150.00	.	.

D. STORAGE SCHEMES

13.	Construction of new tanks and reservoirs	.	.	.
14.	Restoration of old tanks and reservoirs	.	.	.
TOTAL GROUP D		.	.	.

E. DIVERSION SCHEMES

15.	Hilly channels — Kuhls/Dongs and Lowkhongs, etc.	28.57	100.00	350
16.	Non-hilly channels, anicuts, weirs, channels, pynes band-haras, etc.	230.00	575.00	250
TOTAL GROUP E		258.57	675.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17.	State Lift Irrigation	.	.	.
18.	Coop. Lift Irrigation	.	.	.
TOTAL GROUP F		.	.	.

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19.	Raparts, submerging dams, ahars bundhies, percolation tanks	.	.	.
TOTAL GROUP G		.	.	.

H. DRAINAGE, EMBANKMENT. & FLOOD PROTECTION WORKS

20.	Drainage works	50.00	75.00	150
21.	Embankment and flood protection works	50.00	75.00	150
22.	Anti-sea water intrusion works	.	.	.
TOTAL GROUP H		100.00	150.00	
GRAND TOTAL		421.57	1000.00	337

APPENDIX 3

NAME OF STATE—BIHAR

Minor Irrigation Programmes under G.M.P. Sector during Fourth Five Year Plan

Serial No.	Name of Scheme	Unit	Acreege ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/ Unit (in Rs.)	Yardstick Irrn./ Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	40,000	160.00	640.00	1,600	4	400
2	Restoration of old wells	5,000	5.00	20.00	400	1	400
3	Boring of wells with strainer without strainer	3,000	36.00	150.00	5,000	12	417
4	Deepening of wells	26,000	52.00	195.00	750	2	375
TOTAL GROUP A.				253.00	1005.00		
B. TUBEWELL SCHEMES							
5	State tubewells	100	30.00	90.00	90,000	300	300
6	Cooperative tubewells	350	35.00	210.00	60,000	100	600
7	Private tubewells	3,000	150.00	450.00	15,000	50	300
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B				215.00	750.00		
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	20,000	160.00	440.00	2,200	8	27
11	Diesel engine pumpsets	10,000	80.00	360.00	3,600	8	450
12	Persian wheels	2,000	4.00	10.00	500	2	250
TOTAL GROUP C.				244.00	810.00		

D. STORAGE SCHEMES:

13	Construction of new tanks and reservoirs	10.00	50.00	300
14	Restoration of old tanks and reservoirs	50.00	150.00	300
TOTAL GROUP D.		60.00	200.00	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs, etc.	12.00	60.00	500
16	Non-hilly channels, anituts, weirs, channels, pynes bandhas, etc.	230.00	575.00	250
TOTAL GROUP E.		242.00	635.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation			
18	Coop. Lift Irrigation			
TOTAL GROUP F.				

G. WATER CONSERVATION-CUM-GROUND WATER RECHARGING SCHEMES

19	Rapats, submerging dams, ahars, bundhies, percolation tanks	300.00	450.00	150
TOTAL GROUP G.		300.00	450.00	

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works	100.00	150.00	150
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			
TOTAL GROUP H.		100.00	150.00	

GRAND TOTAL

1414.00	4000.00*	283
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*Out of total provision of Rs. 40 crores it is expected that Rs. 5 crores will be available from the Cooperative Sector i.e., land Mortgage Banks for schemes 1, 2, 7, 10, 11 and 12. The net provision under G.M.F. Sector would thus be Rs. 35 crores.

ANNEXURE 4

NAME OF STATE—GUJARAT

Minor Irrigation Programmes under G.M.F. Sector during Fourth Five Year Plan

Serial No.	Name of Scheme	Unit	Acreage ('000)	Financial (in lakh Rs.)	Quantum of fin. assistance/ Unit (in Rs.)	Yardstick Irrn./ Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	60,000	180.00	1620.00	2,700	3	900
2	Restoration of old wells	20,000	30.00	210.00	1,050	1.5	700
3	Boring of wells	10,000	50.00	150.00	1,500	5	300
4	Deepening of wells]	30,000	60.00	60.00	200	2	100
TOTAL GROUP A			320.00	2040.00			
B. TUBEWELL SCHEMES							
5	State tubewells	200	50.00	200.00	100,000	250	400
6	Cooperative tubewells						
7	Private tubewells	2,000	80.00	300.00	15,000	40	375
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B			130.00	500.00			
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	15,000	150.00	315.00	2,100	10	210
11	Diesel engine pumpsets	15,000	180.00	630.00	4,200	12	350
12	Persian wheels	5,000	15.00	30.00	600	3	200
TOTAL GROUP C			345.00	975.00			

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	120.00	900.00	750
14	Restoration of old tanks and reservoirs	60.00	180.00	300
TOTAL GROUP D		180.00	1080.00]	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs, etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas, etc.	15.00	45.00	300
TOTAL GROUP E		15.00	45.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation			
18	Coop Lift Irrigation	20.00	60.00	300
TOTAL GROUP F		20.00	60.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, sugmerging dams, ahars bundhies, percolation tanks	75.00	150.00	200
TOTAL GROUP G		75.00	150.00	

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works	40.00	100.00	250
21	Embankment and flood protection works			
22	Anti-sea water intrusion works	12.50	50.00	400
TOTAL GROUP H		52.50	50.00	

GRAND TOTAL

	1137.50	5000.00*	440
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* Out of total provision of Rs. 50 crores it is expected that Rs. 21.5 crores will be available from the Cooperative Sector i.e., Land Mortgage Bank for schemes 1, 2, 7, 10, 11 and 12. The net provision under G.M.F. Sector would thus be Rs. 28.5 crores.

APPENDIX 5

NAME OF STATE--JAMMU & KASHMIR

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Serial No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of finance assistance/unit (in Rs.)	Yardstick Irrn/Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	.	.	.	.	.	.
2	Restoration of old wells	.	.	.	.	.	.
3	Boring of wells	.	.	.	.	.	.
4	Deepening of wells	.	.	.	.	.	.
TOTAL GROUP A							
B. TUBEWELL SCHEMES							
5	State tubewells	.	.	.	.	.	.
6	Cooperative tubewells	.	.	.	.	.	.
7	Private tubewells	.	.	.	.	.	.
8	Filterpoint tubewells	.	.	.	.	.	.
9	Artesian tubewells	.	.	.	.	.	.
TOTAL GROUP B							
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	.	.	.	.	.	.
11	Diesel engine pumpsets	.	.	.	.	.	.
12	Persian wheels	.	.	.	.	.	.
TOTAL GROUP C							

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs			
14	Restoration of old tanks and reservoirs			

TOTAL GROUP D .

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs, etc.	45.83	275.00	600
16	Non-hilly channels, anicuts, weirs, channels, pynes, ban- dharas, etc.			

TOTAL GROUPE .

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation	6.25	25.00	400
18	Coop. Lift Irrigation			

TOTAL GROUP F .

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, shars, bundhies, percolation tanks			
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TOTAL GROUP G .

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works			
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			

TOTAL GROUP H .

GRAND TOTAL

		52.80	300.00	576
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APPENDIX 6

NAME OF STATE—KERALA]

Minor Irrigation Programme under G.M.P. Sector during Fourth Five Year Plan

Serial No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of finan. assistance/ Unit (in Rs.)	Yard. stick Irrn. Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells						
2	Restoration of old wells						
3	Boring of wells						
4	Deepening of wells						
TOTAL GROUP A							
B. TUBEWELL SCHEMES							
5	State tubewells						
6	Cooperative Tubewells						
7	Private tubewells						
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B							
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	2,000	20.00	60.00	3,000	10	300
11	Diesel engine pumpsets	3,500	42.00	140.00	4,000	12	333
12	Persian wheels						
TOTAL GROUP C			5,500	62.00	200.00		

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs			
14	Restoration of old tanks and reservoirs			
TOTAL GROUP D				

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs, etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, ban-dharas, etc.	125.00	500.00	400
TOTAL GROUP E		125.00	500.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation			
18	Coop Lift Irrigation]	100.00	300.00	300
TOTAL GROUP F		100.00	300.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Repats, submerging dams, ahars, bundhles, percolation tanks			
TOTAL GROUP G				

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works			
21	Embankment and flood protection works	25.00	100.00	400
22	Anti-sea water intrusion works	12.50	50.00	400
TOTAL GROUP H		50.00	250.00	500
TOTAL GROUP H		87.50	400.00	
GRAND TOTAL		374.50	1400.00	374

APPENDIX 7

NAME OF STATE—MADHYA PRADESH

Minor Irrigation Programmes under G.M.F. Sector during Fourth Five Year Plan

Serial No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/ Unit (in Rs.)	Yardstick irrn./unit (in acrea)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	50,000	150.00	1125.00	2,250	3	750
2	Restoration of old wells	20,000	20.00	100.00	500	1	500
3	Boring of wells	170	0.85	5.00	3,000	5	600
4	Deepening of wells	24,000	36.00	120.00	500	1½	333
TOTAL GROUP A			206.85	1350.00			
B. TUBEWELL SCHEMES							
5	State tubewells	50	12.50	45.00	90,000	250	360
6	Cooperative tubewells						
7	Private tubewells						
8	Filterpoint tubewells						
9	Artesian tubewells || . . . . .						
TOTAL GROUP B			12.50	45.00			
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	20,000	80.00	450.00	2,250	4	563
11	Diesel engine pumpsets	10,000	50.00	350.00	3,500	5	700
12	Persian wheels	3,335	7.50	25.00	750	2.5	300
TOTAL GROUP C			137.50	825.00			

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	66.67	300.00	750
14	Restoration of old tanks and reservoirs	300.00	900.00	300
TOTAL GROUP D.		366.67	1400.00	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs, etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas etc.	125.00	500.00	400
TOTAL GROUP E		125.00	500.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State lift irrigation			
18	Coop. lift irrigation	16.67	50.00	300
TOTAL GROUP F		16.67	50.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, ahars, bundhies, percolation tanks	40.00	80.00	200
TOTAL GROUP G		40.00	80.00	

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works			
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			
TOTAL GROUP H				

GRAND TOTAL		905.19	4250.00*	470
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*Out of total provision of Rs. 42.50 crores it is expected that Rs. 5 crores will be available from the Cooperative Sector *i.e.*, Land Mortgage Banks for schemes 1, 2, 10, 11 and 12. The net provision under G.M.F. Sector would thus be Rs. 37.50 crores.

APPENDIX 8

NAME OF STATE—MADRAS

Minor Irrigation Programmes under G.M.F. Sector during Fourth Five Year Plan

Serial No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/ Unit (in Rs.)	Yardstick Irrn/unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	30,000	30.00	540.00	1,800	1.0	1,800
2	Restoration of old wells	10,000	5.00	50.00	500	0.5	1,000
3	Boring of wells	5,000	10.00	50.00	1,000	2.0	500
4	Deepening of wells						
TOTAL GROUP A			45.00	640.00			
B. TUBEWELL SCHEMES							
5	State tubewells	100	10.00	70.00	70,000	100.0	700
6	Cooperative tubewells						
7	Private tubewells	5,000	100.00	300.00	6,000	20.0	300
8	Filterpoint tubewells	1,667	16.67	50.00	3,000	10.0	300
9	Artesian Tubewells						
TOTAL GROUP B			126.67	420.00			
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	20,000	100.00	300.00	1,500	5	300
11	Diesel engine pumpsets	5,000	30.00	150.00	3,000	6	500
12	Persian wheels						
TOTAL GROUP C			130.00	450.00			

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	15.00	120.00	800
14	Restoration of old tanks and reservoirs	240.00	900.00	375
TOTAL GROUP D .		255.00	1020.00	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs, etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas etc.	50.00	200.00	400
TOTAL GROUP E .		50.00	200.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State lift irrigation	25.00	50.00	200
18	Coop. lift irrigation			
TOTAL GROUP F .		25.00	50.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Repats, submerging dams, ahars bundhies, percolation tanks	100.00	200.00	200
TOTAL GROUP G .		100.00	200.00	

H. DRAINAGE, EMBANKMENTS & FLOOD PROTECTION WORKS

20	Drainage works	10.00	20.00	200
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			
TOTAL GROUP H .		10.00	20.00	

GRAND TOTAL

	741.67	3000.00*	404
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*Out of total provision of Rs. 30 crores it is expected that Rs. 2.50 crores will be available from the Cooperative Sector i.e., Land Mortgage banks for schemes 1, 2, 7, 8, 10 and 11. The net provision under G.M.F. Sector would thus be Rs. 27.50 crores.

APPENDIX 9

NAME OF STATE—MAHARASHTRA

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/unit (in Rs.)	Yardstick Irrn/unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	150,000	450.00	4050.00	2,700	3	900
2	Restoration of old wells	50,000	75.00	530.00	1,060	1.5	707
3	Boring of wells	1,250	6.25	25.00	2,000	5	400
4	Deepening of wells	75,000	150.00	150.00	200	2	100
TOTAL GROUP A			681.25	4755.00			
B. TUBEWELL SCHEMES							
5	State tubewells						
6	Cooperative tubewells						
7	Private tubewells	500	15.00	75.00	15,000	30	500
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B			15.00	75.00			
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	40,000	400.00	840.00	2,100	10	210
11	Diesel engine pumpsets	25,000	250.00	1050.00	4,200	10	420
	Persian Wheels						
TOTAL GROUP C			650.00	1890.00			

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	100.00	900.00	900
14	Restoration of old tanks and reservoirs	100.00	500.00	500
TOTAL GROUP D.		200.00	1400.00	

E. DIVERSION SCHEMES

15	Hills channels—Kuhls/Dongs and Lowkhongs, etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas	83.33	500.00	600
TOTAL GROUPE		83.33	500.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift irrigation			
18	Coop. Lift irrigation	33.33	100.00	300
TOTAL GROUP F		33.33	100.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, ahars, bundhies, percolation tanks	90.00	180.00	200
TOTAL GROUP G		90.00	180.00	

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works	50.00	100.00	200
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			
TOTAL GROUP H		50.00	100.00	
GRAND TOTAL		1802.91	9000.00*	499

*Out of total provision of Rs. 90 crores it is expected that Rs. 50 crores will be available from the Cooperative Sector i.e. Land Mortgage Banks for schemes 1, 2, 7, 10 & 11. The net provision under G.M.F. Sector would thus be Rs. 40 crores.

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/unit (in Rs.)	Yardstick Irrn/unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	50,000	75.00	1625.00	3,250	1.5	2167
2	Restoration of old wells	5,000	2.50	50.00	1,000	0.5	2000
3	Boring of wells	1,250	2.50	50.00	4,000	2.0	2000
4	Deepening of wells	10,000	10.00	75.00	750	1.0	750
TOTAL GROUP A			90.00	1800.00			
B. TUBEWELL SCHEMES							
5	State tubewells						
6	Cooperative tubewells						
7	Private tubewells						
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B							
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	20,000	50.00	500.00	2,500	2.5	1000
11	Diesel engine pumpsets	20,000	60.00	600.00	3,000	3.0	1000
12	Persian wheels						
TOTAL GROUP C			110.00	1100.00			

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	125.00	1500.00	1200
14	Restoration of old tanks and reservoirs	133.33	1000.00	750
TOTAL GROUP D		258.33.	2500.00	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and lowkhongs etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas etc.	150.00	750.00	500
TOTAL GROUP E		150.00	750.00	

F SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation			
18	Coop. Lift irrigation			
TOTAL GROUP F				

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, ahars, bundhies, percolation tanks	50.00	150.00	300
TOTAL GROUP G		50.00	150.00	

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works	20.00	50.00	250
21	Embankment and flood protection works	12.50	50.00	400
22	Anti-seawater intrusion works	25.00	100.00	400
TOTAL GROUP H		57.50	200.00	
GRAND TOTAL		715.83	6500.00*	908

*Out of total provision of Rs . 65 crores it is expected that Rs.10 crores will be available from the Cooperative Sector i.e. Land Mortgage Banks for schemes 1, 2, 10 & 11. The net provision under G.M.F. Sector would thus be Rs. 55 crores.

APPENDIX II

NAME OF STATE—NAGALAND

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/unit (in Rs.)	Yardstick Irrn/unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells						
2	Restoration of old wells						
3	Boring of wells						
4	Deepening of wells						
TOTAL GROUP A							
B. TUBEWELL SCHEMES							
5	State tubewells						
6	Cooperative tubewells						
7	Private tubewells						
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B							
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets						
11	Diesel engine pumpsets						
12	Persian wheels						
TOTAL GROUP C							

D. STORAGE SCHEMES

- 13 Construction of new tanks and reservoirs . . .
 14 Restoration of old tanks and reservoirs . . .

TOTAL GROUP D . . .

E. DIVERSION SCHEMES

- 15 Hilly channels—Kuhls/Dongs and Lowkhongs, etc. . .
 16 Non-hilly channels, anicuts, weirs, channels, pynes, band-
 liaras etc.

6.25 25.00 400

TOTAL GROUP E . . .

6.25 25.00

F. SURFACE WATER LIFT IRRIGATION SCHEMES

- 17 State Lift Irrigation
 18 Coop. lift irrigation

TOTAL GROUP F . . .

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

- 19 Rapats, submerging dams, others, bundhies, percolation
 tanks

TOTAL GROUP G . . .

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

- 20 Drainage works
 21 Embankment and flood protection works
 22 Anti-sea water intrusion works

TOTAL GROUP H . . .

GRAND TOTAL . . .

6.25 25.00 400

APPENDIX 12

NAME OF STATE—ORISSA

Minor Irrigation Programms under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/ unit (in Rs.)	Yardsticks Irrn./Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	.	.	.	.	.	.
2	Restoration of old wells	.	.	.	.	.	.
3	Boring of wells	.	.	.	.	.	.
4	Deepening of wells	.	.	.	.	.	.
TOTAL GROUP A			.	.	.	.	.
B. TUBEWELL SCHEMES							
5	State tubewells	.	50	10.00	40.00	80,000	200
6	Cooperative tubewells	.	.	.	.	.	400
7	Private tubewells	.	1,000	40.00	100.00	10,000	40
8	Filterpoint tubewells	.	1,000	10.00	30.00	3,000	10
9	Artesian tubewells	.	.	.	.	.	300
TOTAL GROUP B			.	60.00	170.00	.	.
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	.	5,000	50.00	110.000	2,200	10
11	Diesel engine pumpsets	.	.	.	.	.	220
12	Persian wheels	.	.	.	.	.	.
TOTAL GROUP C			.	50.00	110.00	.	.

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	25.00	150.00	600
14	Restoration of old tanks and reservoirs	80.00	240.00	300
TOTAL GROUP D		105.00	390.00	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs etc.			
16	Non-hilly channels, anicuts weirs, channels, pynes, band-haras etc.	100.00	350.00	350
TOTAL GROUP E		100.00	350.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation	60.00	180.00	300
18	Coop. Lift Irrigation			
TOTAL GROUP F		60.00	180.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, ahars, bundhics, percolation tanks			
TOTAL GROUP G				

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works			
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			
TOTAL GROUP H				
GRAND TOTAL		375.00	1200.00*	320

*Out of total provision of Rs. 12 crores it is expected that Rs. 1 crore will be available from the Cooperative Sector, i.e., Land Mortgage Banks for schemes 7 & 17. The net provision under G.M.F. Sector would thus be Rs. 11 crores.

APPENDIX 13

NAME OF STATE—PUNJAB

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/unit (in Rs.)	Yardstick Irrn/Unit (In acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	25,000	225.00	400.00	1,600	9	180
2	Restoration of old wells	6,000	24.00	30.00	500	4	125
3	Boring of wells	10,000	40.00	50.00	500	4	125
4	Deepening of wells						
TOTAL GROUP A			289.00	480.00			
B. TUBEWELL SCHEMES							
5	State tubewells	100	30.00	90.00	90,000	300	300
6	Cooperative tubewells						
7	Private tubewells	15,000	600.00	1200.00	8,000	40]	200
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B			630.00	1290.00			
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	20,000	200.00	400.00	2,000	10	200
11	Diesel engine pumpsets	10,000	100.00	300.00	3,000	10	300
12	Persian wheels						
TOTAL GROUP C			300.00	700.00			

D. STORAGE SCHEMES

- 13 Construction of new tanks and reservoirs
 14 Restoration of old tanks and reservoirs

TOTAL GROUP D

E. DIVERSION SCHEMES

- | | | | | |
|----|---|------|-------|-----|
| 15 | Hilly channels—Kuhls/Dongs and Lowkhongs, etc. | 8.00 | 40.00 | 500 |
| 16 | Non-hilly channels, anicuts, weirs, channels, pynes, handharas etc. | | | |

TOTAL GROUP E 8.00 40.00

F. SURFACE WATER LIFT IRRIGATION SCHEMES

- | | | | | |
|----|---------------------------------|-------|-------|-----|
| 17 | State Lift Irrigation | 20.00 | 60.00 | 300 |
| 18 | Coop. Lift Irrigation | | | |

TOTAL GROUP F 20.00 60.00

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

- 19 Rspats, submerging dams, ahars, bundhies, percolation tanks

TOTALGROUP G

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

- | | | | | |
|----|---|-------|--------|-----|
| 20 | Drainage works | 50.00 | 100.00 | 200 |
| 21 | Embankment & flood protection works | 10.00 | 30.00 | 300 |
| 22 | Anti-sea water intrusion works | | | |

TOTAL GROUP H. 60.00 130.00

GRAND TOTAL 1307.00 2700.00* 207

*Out of total provision of Rs. 27 crores it is expected that Rs. 4 crores will be available from the Cooperative Sector, i.e., Land Mortgage Banks for schemes I, 2, 7, 10 and 11. The net provision under G.M.F. Sector would thus be Rs. 23 crores.

APPENDIX 14

NAME OF STATE—RAJASTHAN

Minor Irrigation Programme under G.M.P. Sector during Fourth Five Year Plan

Sl. No.	Name of scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/unit (in Rs.)	Yardstick Irrm/unit (In acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	12,500	37.50	250.00	2,000	3	667
2	Restoration of old wells	2,000	3.00	15.00	750	1.5	500
3	Boring of wells						
4	Deepening of wells	30,000	30.00	50.00	167	1	167
TOTAL GROUP A			70.50	315.00			
B. TUBEWELL SCHEMES							
5	State tubewells	100	25.00	75.00	75,000	250	300
6	Cooperative tubewells						
7	Private tubewells	200	20.00	40.00	20,000	100	200
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B			45.00	115.00			
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	7,500	22.50	150.00	2,000	3	667
11	Diesel engine pumpsets	5,000	15.00	150.00	3,000	3	1000
12	Persian wheels						
TOTAL GROUP C			37.50	300.00			

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	100.00	600.00	600
14	Restoration of old tanks and reservoirs	14.30	50.00	350
TOTAL GROUP D		114.30	650.00	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhis/Dongs and Lowkhongs, etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas etc.	40.00	120.00	30
TOTAL GROUP E		40.00	120.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation			
18	Coop. Lift Irrigation			
TOTAL GROUP F				

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Repairs, submerging dams, ahars, bundhies, percolation tanks	50.00	100.00	200
TOTAL GROUP G		50.00	100.00	

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works			
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			
TOTAL GROUP H				
GRAND TOTAL		357.30	1600.00*	448

*Out of total provision of Rs. 16 crores, it is expected that Rs. 1 crore will be available from the Cooperative Sector i. e. Land Mortgage Banks for schemes 1, 2, 10 & 11. The net provision under G.M.F. Sector would thus be Rs. 15 crores.

APPENDIX 15

NAME OF STATE—UTTAR PRADESH

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Sr. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/unit (in Rs.)	Yardstick Irrn/Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	200,000	800.00	3400.00	1,700	4	425
2	Restoration of old wells	30,000	60.00	150.00	500	2	250
3	Boring of wells	150,000	300.00	750.00	500	2	250
4	Deepening of wells	10,000	10.00	50.00	500	1	500
TOTAL GROUP A.			1170.00	4350.00			
B. TUBEWELL SCHEMES							
5	State tubewells	1,000	350.00	900.00	90,000	350	257
6	Cooperative tubewells						
7	Private tubewells	10,000	500.00	1000.00	10,000	50	200
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B.			850.00	1900.00			
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	40,000	400.00	720.00	1,800	10	180
11	Diesel engine pumpsets	10,000	150.00	330.00	3,300	15	220
12	Persian wheels	40,000	80.00	200.00	500	2	250
TOTAL GROUP C.			630.00	1250.00			

D. STORAGE SCHEMES				
13	Construction of new tanks and reservoirs	150.00	900.00	600
14	Restoration of old tanks and reservoirs			
TOTAL GROUP D.		150.00	900.00	
E. DIVERSION SCHEMES				
15	Hilly channels—Kuhls/Dongs and Lowkhongs etc.	20.00	100.00	500
16	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas etc.			
TOTAL GROUP E.		20.00	100.00	
F. SURFACE WATER LIFT IRRIGATION SCHEMES				
17	State Lift irrigation	40.00	100.00	250
18	Coop. Lift irrigation			
TOTAL GROUP F.		40.00	100.00	
G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES				
19	Rapats, submerging dams, ahars, bundhies, percolation tanks	150.00	300.00	200
TOTAL GROUP G.		150.00	300.00	
H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS				
20	Drainage works	150.00	300.00	200
21	Embankment and flood protection works	20.00	50.00	250
22	Anti-sea water intrusion works			
TOTAL GROUP H.		170.00	350.00	
GRAND TOTAL		3180.00	9250.00*	291

*Out of total provision of Rs. 92.50 crores it is expected that Rs. 15.00 crores will be available from the Cooperative Sector i. e. Land Mortgage Banks for schemes 1, 2, 8, 10, 11 and 12. The net provision under G.M.F. Sector would thus be Rs. 77.50 crores.

APPENDIX 16

Name of State—WEST BENGAL

Minor Irrigation Programmes under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of fin. assistance/unit (in Rs.)	Yardstick Irrn/Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells						
2	Restoration of old wells						
3	Boring of wells						
4	Deepening of wells						
Total Group A.							
B. TUBEWELL SCHEMES							
5	State tubewells		1,500	300.00	1,500.00	100.000	300
6	Cooperative tubewells						
7	Private tubewells		100	4.00	10.00	10,000	40
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B				304.00	1,510.00		
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets		750	3.75	15.00	2,000	5
11	Diesel engine pumpsets		1,250	12.50	50.00	4,000	10
12	Persian wheels						
TOTAL GROUP C.				16.25	65.00		

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs			
14	Restoration of old tanks and reservoirs	133.00	400.00	300
	TOTAL GROUP D.	133.00	400.00	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, band-haras etc.	7.00	25.00	360
	TOTAL GROUP E.	7.00	25.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift irrigation	100.00	400.00	400
18	Coop. Lift irrigation			
	TOTAL GROUP F.	100.00	400.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, ahars, bundhies, percolation tanks			
	TOTAL GROUP G.			

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works	66.00	100.00	150
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			
	TOTAL GROUP H.	66.00	100.00	
	GRAND TOTAL	626.25	2500.00	399

APPENDIX 17

Name of the Union Territory—DELHI

Minor Irrigation Programmes under G.M.F. Sector During Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (in Rs.)	Quantum of fin. assistance unit (in Rs.)	Yard stick Irrn/ Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1.	Construction of new wells	900	2.70	18.00	2,000	3	666
2.	Restoration of old wells						
3.	Boring of wells	200	0.40	2.00	1,000	2	500
4.	Deepening of wells						
TOTAL GROUP A			3.10	20.00			
B. TUBEWELL SCHEMES							
5.	State tubewells	30	7.50	21.00	70,000	250	280
6.	Cooperative tubewells						
7.	Private tubewells	50	2.00	5.00	10,000	40	250
8.	Filterpoint tubewells						
9.	Artesian tubewells						
TOTAL GROUP B			9.50	26.00			
C. WATER LIFTING APPLIANCES							
10.	Electric motor pumpsets	100	0.50	2.00	2,000	5	400
11.	Diesel Engine pumpsets	50	0.40	2.00	4,000	8	500
12.	Persian wheels	200	0.20	1.00	500	1	500
TOTAL GROUP C			1.10	5.00			

D. STORAGE SCHEMES

13. Construction of new tanks and reservoirs
 14. Restoration of old tanks and reservoirs

TOTAL GROUP D

E. DIVERSION SCHEMES

15. Hilly channels--Kuhls/Dongs and Lowkhongs, etc.
 16. Non-hilly channels, anicuts, weirs, channels, pynes, band-
 haras etc.

TOTAL GROUP E

F. SURFACE WATER LIFT IRRIGATION SCHEMES

- | | | | |
|-------------------------------------|------|-------|-----|
| 17. State Lift Irrigation | 2.50 | 10.00 | 400 |
| 18. Coop. Lift Irrigation | | | |

TOTAL GROUP F

C. WATER CONSERVATION CUM-GROUNDWATER RECHARGING SCHEMES

19. Rapats, submerging dams, ahars, bundhies, percolation tanks

TOTAL GROUP G

H. DRAINAGE, EMBANKMENT AND FLOOD PROTECTION WORKS

- | | | | |
|---|------|------|-----|
| 20. Drainage works | | | |
| 21. Embankment and flood protection works | 2.50 | 5.00 | 200 |
| 22. Anti-Sea water intrusion works | | | |

TOTAL GROUP H

GRAND TOTAL

18.70 66.00 353

APPENDIX 18

Name of the Union Territory—GOA

Minor Irrigation Programms under G.M.F.P Sector during Fourth Five Year Plan

Sl. No.	Name of the Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of financial assistance/unit (in Rs.)	Yardstick Irrn/Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEME							
1.	Construction of new wells	200	0.60	5.00	2,500	3	833
2.	Restoration of old wells	200	0.10	1.00	500	1/2	1,000
3.	Boring of wells	50	0.25	1.00	2,000	5	400
4.	Deepening of wells						
TOTAL GROUP A			0.95	7.00			
B. TUBEWELL SCHEMES							
5.	State tubewells						
6.	Cooperative tubewells						
7.	Private tubewells						
8.	Filterpoint tubewells						
9.	Artesian tubewells						
TOTAL GROUP B							
C. WATER LIFTING APPLIANCES							
10.	Electric Motor pumpsets	200	1.00	4.00	2,000	5	400
11.	Diesel Engine pumpsets	125	1.00	5.00	4,000	8	500
12.	Persian wheels						
TOTAL GROUP C			2.00	9.00			

D. STORAGE SCHEMES

13. Construction of new tanks and reservoirs			
14. Restoration of old tanks and reservoirs	2.00	8.00	400
TOTAL GROUP D	2.00	8.00	400

E. DIVERSION SCHEMES

15. Hilly channels-Kuhls/Dongs and Lowkhongs, etc.			
16. Non-Hilly channels, anicuts, weirs, channels, pynes, band-haras etc.	5.00	15.00	300
TOTAL GROUP E	5.00	15.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17. State Lift Irrigation			
18. Coop. Lift Irrigation			
TOTAL GROUP F			

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19. Rapats, submerging dams, ahars, bundhies, percolation tanks etc.			
TOTAL GROUP G			

H. DRAINAGE, EMBANKMENT AND FLOOD PROTECTION WORKS

20. Drainage works			
21. Embankment and flood protection works			
22. Anti-sea water intrusion works	1.00	3.00	300
TOTAL GROUP H	1.00	3.00	
GRAND TOTAL	10.95	43.00	384

APPENDIX 19

Name of Union Territory—HIMACHAL PRADESH.

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of financial assistance/unit (in Rs.)	Yardstick Irrn/Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	.	.	.	.	.	.
2	Restoration of old wells	.	.	.	.	.	.
3	Boring of wells	.	.	.	.	.	.
4	Deepening of wells	.	.	.	.	.	.
TOTAL GROUP A							
B. TUBEWELL SCHEMES							
5	State Tubewells	.	.	.	.	.	.
6	Cooperative tubewells	.	.	.	.	.	.
7	Private tubewells	.	.	.	.	.	.
8	Filterpoint tubewells	.	.	.	.	.	.
9	Artesian tubewells	.	.	.	.	.	.
TOTAL GROUP B							
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	.	.	.	.	.	.
11	Diesel Engine pumpsets	.	.	.	.	.	.
12	Persian wheels	.	.	.	.	.	.
TOTAL GROUP C							

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs			
14	Restoration of old tanks and reservoirs			
	TOTAL GROUP D			

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls/Dongs and Lowkhongs, etc.	25.00	100.00	400
16	Non-hilly channels, anicuts, weirs, channels pynes bandharas etc.			
	TOTAL GROUP E	25.00	100.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation			
18	Cooperative Lift Irrigation			
	TOTAL GROUP F			

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, shars, bundhies, percolation tanks			
	TOTAL GROUP G			

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works			
21	Embankment and flood protection works			
22	Anti-sea water intrusion works			
	TOTAL GROUP H			

GRAND TOTAL	25.00	100.00	400
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APPENDIX 20

Name of Union Territory—MANIPUR

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of financial assistance/unit (in Rs.)	Yardstick irr/unit (in acres)	Cost Per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells						
2	Restoration of old wells						
3	Boring of wells						
4	Deepening of wells						
TOTAL GROUP A							
B. TUBEWELL SCHEMES							
5	State tubewells						
6	Cooperative tubewells						
7	Private tubewells						
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B							
C. WATER LIFTING APPLIANCES							
10	Electric Motor pumpsets						
11	Diesel engine pumpsets						
12	Persian wheels						
TOTAL GROUP C							

D. STORAGE SCHEMES

- 13 Construction of new tanks and reservoirs
 14 Restoration of old tanks and reservoirs]

TOTAL GROUP D

E. DIVERSION SCHEMES

- 15 Hilly channels—Kuhls/Dongs and Lowkhongs, etc.
 16 Non-Hilly channels, anicuts, weirs, channels, pynes, bandharas
 etc.

5.00 15.00

300

TOTAL GROUP E

5.00 15.00

F. SURFACE WATER LIFT IRRIGATION SCHEMES

- 17 State Lift irrigation
 18 Cooperative Lift irrigation

TOTAL GROUP F

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

- 19 Rapats, submerging dams, ahars, bundhies, percolation tanks

TOTAL GROUP G

H. DRAINAGE, EMBANKMENT AND FLOOD PROTECTION WORKS

- 20 Drainage works
 21 Embankment and flood protection works
 22 Anti-sea water intrusion works

2.50 5.00

200

TOTAL GROUP H

2.50 5.00

GRAND TOTAL

7.50 20.00

267

APPENDIX 21

Name of Union Territory—N.E.F.A.

Miscellaneous Irrigation Programmes under G.M.F. Sector during Fourth Five Year Plan

S. No	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of Financial assistance/unit (in Rs.)	Yardstick Irr/Unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells						
2	Restoration of old wells						
3	Boring of wells						
4	Deepening of wells						
TOTAL GROUP A.							
B. TUBEWELL SCHEMES							
5	State tubewells						
6	Cooperative tubewells						
7	Private tube wells						
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B.							
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets						
11	Diesel engine pumpsets						
12	Persian wheels						
TOTAL GROUP C.							

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs			
14	Restoration of old tanks and reservoirs			
	TOTAL GROUP D.			

E. DIVERSION SCHEMES

15	Hilly channels-Kuhls/Dongs and Lowkhongs, etc.	2.50	10.00	400
16	Non-Hilly channels, anicuts, weirs, channels, pynes, bandharas etc.			
	TOTAL GROUP E.	2.50	10.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift Irrigation			
18	Cooperative Lift Irrigation			
	TOTAL GROUP F.			

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, ahars, bundhies, percolation tanks			
	TOTAL GROUP G.			

H. DRAINAGE, EMBANKMENT AND FLOOD PROTECTION WORKS

20	Drainage works			
21	Embankment and flood protection works			
22	Anti-sea water intrusion works.			
	TOTAL GROUP H.			
	GRAND TOTAL	2.50	10.00	400

APPENDIX 22

Name of Union Territory—PONDICHERY

Minor Irrigation Programme under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of financial assistance / unit (in Rs.)	Yardstick irr/unit (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells	.	.	.	.	.	.
2	Restoration of old wells	.	.	.	.	.	.
3	Boring of wells	.	.	.	.	.	.
4	Deepening of wells	.	.	.	.	.	.
TOTAL GROUP A.			.	.	.	.	.
B. TUBEWELL SCHEMES							
5	State tubewells	.	.	.	.	.	.
6	Cooperative tubewells	.	.	.	.	.	.
7	Private tubewells	.	.	.	.	.	.
8	Filterpoint tubewells	.	.	.	.	.	.
9	Artesian tubewells	.	.	.	.	.	.
TOTAL GROUP B.			0.40	2.00			
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets	.	.	.	.	.	.
11	Diesel engine pumpsets	.	.	.	.	.	.
12	Persian Wheels	.	.	.	.	.	.
TOTAL GROUP C.			0.43	2.00			

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	0.50	3.00	600
14	Restoration of old tanks and reservoirs	1.25	5.00	400
TOTAL GROUP D.		1.75	8.00	

E. DIVERSION SCHEMES

15	Hilly channels-Kuhls/Dongs, and Lowkhongs, etc.			
16	Non-hilly channels, anicuts, weirs, channels, pynes, bandharas etc.	1.66	5.00	300
TOTAL GROUP E.		1.66	5.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift irrigation			
18	Cooperative lift irrigation			
TOTAL GROUP F.				

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging, dams, ahars, bundhies, percolation tanks			
TOTAL GROUP G				

H. DRAINAGE, EMBANKMENT AND FOOD PROTECTION WORKS

20	Drainage works	2.50	5.00	200
21	Embankment and flood protection works			
22	Anti-sea water intrusion works.			
TOTAL GROUP H.		2.50	5.00	
GRAND TOTAL		6.74	22.00	326

APPENDIX 23

Name of Union Territory—TRIPURA

Minor Irrigation Programmes under G.M.F. Sector during Fourth Five Year Plan

Sl. No.	Name of Scheme	Unit	Acreage ('000)	Financial (Rs. in lakhs)	Quantum of financial assistance/unit (in Rs.)	Yard stick Irrn/Units (in acres)	Cost per acre of benefit (in Rs.)
A. WELL SCHEMES							
1	Construction of new wells						
2	Restoration of old wells						
3	Boring of wells						
4	Deepening of wells						
TOTAL GROUP A							
B. TUBEWELL SCHEMES							
5	State tubewells		10	1.50	6.00	60,000	150
6	Cooperative tubewells						400
7	Private tubewells						
8	Filterpoint tubewells						
9	Artesian tubewells						
TOTAL GROUP B				1.50	6.00		
C. WATER LIFTING APPLIANCES							
10	Electric motor pumpsets						
11	Diesel engine pumpsets						
12	Persian wheels						
TOTAL GROUP C							

D. STORAGE SCHEMES

13	Construction of new tanks and reservoirs	0.50	3.00	600
14	Restoration of old tanks and reservoirs			
TOTAL GROUP D		0.50	3.00	

E. DIVERSION SCHEMES

15	Hilly channels—Kuhls, Dongs and Lowkhongs, etc.			
16	Non-Hilly channels, anicuts, weirs, channels, pynes, bandhar as etc.	3.00	15.00	500
TOTAL GROUP E		3.00	15.00	

F. SURFACE WATER LIFT IRRIGATION SCHEMES

17	State Lift irrigation	3.00	9.00	300
18	Cooperative lift irrigation			
TOTAL GROUP F		3.00	9.00	

G. WATER CONSERVATION-CUM-GROUNDWATER RECHARGING SCHEMES

19	Rapats, submerging dams, ahars, bundhies, percolation tanks			
TOTAL GROUP G				

H. DRAINAGE, EMBANKMENT & FLOOD PROTECTION WORKS

20	Drainage works	3.00	6.00	200
21	Embankment and flood protection works	4.00	12.00	300
22	Anti-sea water intrusion works			
TOTAL GROUP H		7.00	18.00	
GRAND TOTAL		15.00	51.00	340

APPENDIX—24

RESOLUTION OF THE ALL INDIA MINOR IRRIGATION CONFERENCE AFTER CONSIDERATION OF THE REPORT

The report of the Working Group for formulation of Fourth Five Year Plan proposal on Minor Irrigation was discussed with the State Governments & the U.Ts. on 16th to 18th July, 1964.

The State Government & the U.Ts. were represented both by their technical & administrative officers.

The main points discussed were as follows:—

1. Measures for intensification of Surveys & investigations so as to cover all types of minor irrigation Works including ground water Schemes & for preparation of integrated basin-wise master plans.
2. Assessment of the potentialities for the development of minor irrigation in each region of the State.
3. Steps to be taken for strengthening the organisations in the States for undertaking accelerated programme for boring & deepening of wells, advising cultivators on location size of open wells, installation of water lifting appliances including pumpsets..
4. Steps for intensifying training programme on minor irrigation and water use in the States in order to fulfil the needs for trained technical hands required for tackling the larger programmes efficiently on sound technical lines.
5. Needs & steps for initiating a Training programme on ground water investigations.
6. Preparation of technical manuals on important subjects connected with minor irrigation for guidance of the field staff.
7. Progress on measures for proper maintenance of completed irrigation works—need for providing adequate technical & financial support to the panchayats for carrying out the maintenance of the works entrusted to them.
8. Measures for proper assessment of irrigation benefits—Organisation of sample checks & surveys for realistic evaluation of yardsticks adopted for estimating the irrigation benefits.

After detailed discussion at this conference, following resolutions were passed.

(1) Measures for intensification of surveys and investigations so as to cover all types of minor irrigation works including groundwater schemes and for preparation of integrated basin-wise master plans.

The Conference recognises that for implementation of minor irrigation schemes on sound techno-economic basis and for deriving full benefits from the fast accelerating minor irrigation programme an intensified comprehensive programme of surveys and investigations should include:—

- (a) Preparation of regional master plans which would enable to take up the programme on a phased priority basis with a fairly long-term perspective in view, and in co-ordination with different categories of schemes including groundwater schemes so that there is integrated development of irrigation resources without any duplication of efforts.
- (b) Preparation of detailed projects for execution.
- (c) Combing out the entire State for ascertaining the surface water availability in the various streams and formulating proposals for optimum utilisation of the water thus available.
- (d) Establishing groundwater potentialities in old proven and new areas with a view to planning and regulating construction of open wells and tubewells and specifying minimum safe spacing for wells so that there is no over-draft or mutual interference of supplies.
- (e) Investigating the scope for and preparing detailed schemes for construction of percolation tanks, check dams, etc., with a view to augmenting groundwater supplies wherever feasible and necessary, particularly where the groundwater table having a tendency to go down.
- (f) Co-ordinating and integrating lift irrigation schemes with the power development and extension programme to ensure maximum coverage of area under lift irrigation and improve the load factor as well as the economics of rural electrification.
- (g) Co-ordination of groundwater development and surface water storage schemes with soil conservation programmes with a view to assuring adequate groundwater availability in the wells and preventing/retarding silting rate of tanks.

The Conference realises the usefulness of groundwater schemes for bringing about integrated development of water resources and quick increase in food production, but observes that in most of the States the existing organisations are not adequately geared for carrying out groundwater investigations.

The Conference recommends that urgent action should be taken in the following directions:—

- (i) Strengthening and re-orienting the existing organisations at the field level to cover groundwater investigations and achieve the objectives indicated above. The arrangements for strengthening and re-orienting may be on the lines that are considered most suitable under the present set up, over-all prospects for long-term development and other local conditions existing in each State.

- (ii) Preparation of detailed co-ordinated plans of minor irrigation schemes based on the results of surveys and investigations at the field levels. The work may be entrusted either to one technical department or a co-ordinated agency at the District and the State levels.
 - (iii) Preparation of detailed schemes incorporating these proposals by the State Governments and submitting the same to the Government of India, Ministry of Food & Agriculture, within a fortnight, so that these schemes can be taken up for implementation during the current year.
 - (iv) Expeditions scrutiny and sanction of the above schemes by the Government of India and providing 100 per cent grant for these schemes during the remaining period of the Third Five Year Plan over and above the Central assistance already agreed to.
- (2) Assessment of the potentialities for the development of minor irrigation in each region of the States.

The Conference recognises that the size of the minor irrigation programme taken up for implementation during the Fourth Five Year Plan in each State should not only be related to the physical capacity of the States for execution of the schemes, but also should be based on the prospects for further development of minor irrigation resources. With this objective in view, the Conference recommends that the State Governments should carry out and complete, in a period of two months, a tentative broad assessment of the long-term potentialities for development of various minor irrigation schemes in different regions of the States, on the lines indicated in the Ministry's letter No. 27-1/64-GMF(Co.), dated the 16th April, 1964, addressed to all the State Governments, and review the proposed Fourth Five Year Plan targets on the basis of this assessment.

- (3) Steps to be taken for strengthening the organisations in the States for undertaking accelerated programme for boring and deepening of wells, advising cultivators on location, size of open wells, installation of water lifting appliances including pumpsets.

The Conference recognises that in view of the increasing emphasis on groundwater development and to prevent infructuous expenditure in the form of failed wells or existing wells getting into dis-use or over-sized installations of pumping equipment, the execution of these works should not be left to the individual cultivators but should be systematically regulated by a competent technical organisation. There is also need, in view of much higher targets set for boring and deepening, for providing increasing departmental help to the cultivators for carrying out boring and deepening operations to augment the discharges of wells.

The Conference recommends that the State Governments should appoint adequate number of trained technical hands at the district and field levels for looking after this work and priority for such appointments should be given in the region where intensive groundwater development is being or proposed to be taken up. The State Governments should also take adequate steps for strengthening their existing organisations for boring and deepening by appointing additional technical staff, such as, supervisors, borers, etc., in sufficient numbers and providing the boring and deepening units with requisite equipment.

- (4) Steps for intensifying training programme on minor irrigation and water use in the States in order to fulfill the needs for trained technical hands required for tackling the larger programmes efficiently on sound technical lines.

The Conference realises that with the increased emphasis on minor irrigation and irrigated agriculture, the need for technical hands specially trained on these subjects has become extremely urgent. With a view to fulfilling this need, the Conference recommends that the State Governments should arrange maximum turn-out from the training programme of minor irrigation and water use already in hand by undertaking urgent steps in the following directions:—

- (1) Adequate number of trainees from the Irrigation, Agriculture and Community Development Departments, should be deputed for each Training Session. Adequate advance arrangements should be made for the purpose, so that shortage of staff does not stand in the way of such deputation;
 - (2) If considered necessary, the scope of the scheme may be enlarged so as to cover the training of the Assistant/Executive Engineers as well as District Agricultural Officers;
 - (3) After imparting training, the trained hands should be properly utilised exclusively for minor irrigation or area development programmes.
- (5) Needs and steps for initiating a training programme on groundwater investigations.

The Conference recognises that in order to meet the increasing demand of technical hands for carrying out groundwater surveys and extending larger measure of technical guidance to the cultivators in the execution of groundwater schemes, there is need to initiate a programme for imparting training on the subject of surveys and investigations for groundwater utilisation.

The Conference recommends that in view of the shortage of requisite staff for providing this type of training in the country, this training programme may be arranged by the Centre at a few suitable places and that the State Governments may depute their in-service departmental officers, such as, irrigation engineers, hydrologists and geologists for obtaining the specialised training, thus arranged.

- (6) Preparation of technical manuals on important subjects connected with minor irrigation for guidance of the field staff.

The Conference recommends that with a view to introducing greater technical bias and merit in planning and implementation of minor irrigation schemes and obtaining requisite benefit from inter-State exchange and pooling of knowledge on important technical matters concerning minor irrigation, the State Governments should take steps to get technical hand-books prepared on all important minor irrigation schemes giving design practices and construction features which are most suitable for their respective regions. To enable preparation of these manuals, competent and experienced officers should be deputed exclusively for this work for a short period.

- (7) Progress on measures for proper maintenance of completed irrigation works—need for providing adequate technical and financial support to the panchayats for carrying out the maintenance of work entrusted to them.

The Conference is of the view that the existing arrangements for maintenance of completed works are still not adequate or commensurate with the fast accelerating tempo of the minor irrigation programme and there is considerable scope for improvement.

The Conference recommends that the State Governments should take urgent action on the various steps that have been detailed in paragraph 9.05 of the Report of the Minor Irrigation Working Group and pay a particular attention to the following points:—

- (1) In all such cases where the community works have been transferred to the panchayats or panchayat samitis for maintenance, these institutions should be provided with requisite finances. They may either be empowered to levy a suitable cess on the beneficiaries for defraying the maintenance charges or the State Governments should provide the requisite finances from their own budget;
 - (2) The technical organisations like the Rural Engineering Department should actively assist the panchayats in carrying out the maintenance work;
 - (3) While entrusting the work to the panchayats, proper technical standards of the work so transferred should invariably be prepared by the concerned departments for strict adherence by the panchayats for maintenance of the works;
 - (4) Till such time that the responsibility for maintenance of smaller community works is transferred to the panchayats, the responsibility for maintenance of such works completed under the minor irrigation programme should rest with the technical departments executing them;
 - (5) For arranging proper repairing facilities for the pumpsets inside a region, the suppliers of the pumpsets should invariably be insisted upon to arrange spare part depots and workshops in the region.
 - (6) Short-term training courses should be organised for training the cultivators on proper operation and maintenance of pumpsets and other water lifting appliances where such appliances are installed in large numbers.
- (8) Measures for proper assessment of irrigation benefits—organisation of sample checks and surveys for realistic evaluation of yardsticks adopted for estimating the irrigation benefits.

The Conference recognises that in the interest of realistic planning and forecast of benefits, a precise assessment and evaluation, on a continuing basis, of physical benefits accruing from different schemes is highly essential.

The Conference recommends that the State Governments should take urgent action to implement the various suggestions of the Working Group

detailed in paragraphs 11.13 to 11.25 of the Report of the Working Group on Minor Irrigation. The State Governments should pay particular attention to adopting a functional classification of minor irrigation schemes as referred to in paragraph 11.13 of the Report for planning of minor irrigation programme and reporting irrigation benefits and to constant evaluation and verification of yard-sticks through random sample surveys and checks organised on scientific lines and on a regular basis, for the purpose.

- (9) Measures for increasing the intensity of irrigation in the existing irrigation commands by construction of supplementary minor irrigation works.

The Conference is to the view that except in small pockets in most of the States, good scope for construction of supplementary minor irrigation works in the commands of the major-medium irrigation projects, exists only in the Northern States, such as Uttar Pradesh, Punjab, Bihar, etc. In these States, by and large,, such minor irrigation constructions are already being covered under the minor irrigation programme.