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**Symposium**  
**on**  
**Management of Irrigation Waters**

**NOTE :**

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## FOREWORD

✓ Wise use of water is vital to modern civilisation. Population growth puts the emphasis in food production on the development of water resources and their better management. Irrigation is not a single self-contained activity, but brings in soil physics, soil chemistry, agricultural meteorology, plant physiology, soil biology, engineering economics and crop husbandry. The management of irrigation water is amenable to progress provided there is greater collaboration and co-ordination among the various agencies and the scientific disciplines that make up the field. A skilful management of water supplies for successful irrigated agriculture requires development of information through research dissemination of this information and creation of an enlightened public attitude.

To explore ways and means to develop irrigated agriculture in the context of present and future water resources, a symposium on Management of Irrigation Waters was held at Simla in July 1964 along with 34th Annual Research Session of the Board. Nineteen papers were presented on the different aspects of the subject: (1) Organisational set-up for water management; (2) Agency for the construction of watercourses and field channels; (3) Supply of irrigation water and (4) Assessment of water charges. The symposium was largely attended by State Irrigation Chief Engineers, Directors, Research Engineers and Scientists of various Irrigation Research Stations and officers of State Agriculture Departments.

The views expressed by the participants on various aspects of the symposium subject were examined by a committee consisting of Sarvashri M. R. Chopra, G. A. Narasimha Rao, Baleshwar Nath, Arjan Singh, G. S. Sidhu, K. K. Uppal, S. M. Sikka and Satwant Singh and it brought out recommendations for implementation by Irrigation and Agriculture Departments.

This compilation contains symposium papers, discussions, General Report by Shri Joginder Nath, Superintending Engineer, Irrigation Department, Punjab and recommendations of the Sub-Committee. The Board expresses its grateful thanks to the authors of the papers, discussors and participants who largely contributed to the success of the symposium and also to Sub-Committee members in finalising the recommendations.

S. N. GUPTA

*Secretary*

*Central Board of Irrigation and Power*

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## RECOMMENDATIONS OF THE SUB-COMMITTEE ON MANAGEMENT OF IRRIGATION WATERS

A sound and efficient management of the distribution of irrigation waters is of vital importance so as to use precious resource to the best advantage without wastage, over-use or mis-use and to derive optimum benefits.

The question of framing suitable recommendations for effective utilisation of water in the project areas has been receiving the attention of the Central Board of Irrigation and Power for quite some time. The subject was discussed in detail at the 36th Annual Session of the Board held in November 1963 and a Symposium on the subject was also held in July, 1964. Following detailed discussions and study of the existing practices in the various states, the Board has drawn up the following recommendations for consideration by the State Governments and the Ministry of Irrigation and Power.

In framing the recommendations, the question of land formation, drainage, etc., has been considered as a prerequisite to be looked into by appropriate authorities so that land would physically be in a position to receive water. Similarly it is considered that suitable steps will be taken by the department concerned with regard to crop rotation and other allied aspects. It is hoped that implementation of these recommendations will bring about efficient working of the irrigation systems.

### 1. Agency for the Construction of Watercourses and Field Channels

The Board is in general agreement with the suggestions of Planning Commission appended in Annexures 1 and 2. They have been slightly modified to suit the prevalent conditions which are reproduced below for acceptance.

(i) Project authorities should be responsible for the construction of watercourses at Government cost for blocks up to 100 acres (since revised to a discharge of 1 to 3 cusecs or 0.03 to 0.09 cu. meter per sec.). This limit may be varied in different states according to local conditions relating to topography, crop pattern, etc.

(ii) The survey and alignment of field channels beyond the point to which watercourses are constructed at Government cost, should be the responsibility of project authorities. Responsibility for excavation of these channels should be entrusted to the beneficiaries and they should be helped and organised for this purpose, e.g., by the Community Development Authorities, through *Panchayats* (i.e., village communities) and cooperatives. If the beneficiaries are unable to discharge this responsibility, the State Government should, through legislation, arrange to have the field channels constructed through other agencies, the cost being recovered from the beneficiaries.

(iii) The maintenance of watercourses constructed at Government cost as well as of field channels excavated by the beneficiaries should be the responsibility of the beneficiaries singly or jointly. The State Government should have power, through legislation, to undertake maintenance at the cost of beneficiaries.

The Board feels that field to field irrigation as practised in several states, especially in paddy growing regions, should in due course be changed to a system of watercourses and field channels.

### 2. Organisational Set-up for Water Management beyond the Outlet

The Board recognises the important and complementary roles played by different departments in efficient utilisation of the water resources in irrigated agriculture. With a view, however, to ensuring a planned agricultural development,

A field channel is a channel built by cultivators beyond the watercourse to serve the various fields within the block.”

(NOTE : Where the block is small, watercourse may not be necessary and field channels take water directly from the outlet.)

2. In certain States, the size of some of the outlets is kept too large that the water flowing from the outlet into the watercourse becomes unmanageable for the cultivators. This matter had been receiving consideration of the Ministry of Irrigation and Power and Planning Commission, and it is considered that there should be an upper limit for the discharge from an outlet into a watercourse. This upper limit may be fixed at 2 to 3 cusecs, depending upon the type of soil and crop. Paragraph 1(i) of the letter of May 19, 1959, referred to earlier, may therefore, be modified to read as under :

“Project authorities should be responsible for the construction of watercourses at Govt. cost for “chaks” or blocks up to 100 acres in area. This limit may, however, be varied in different States according to local conditions relating to topography, crop pattern, etc. The upper limit for the discharge from an outlet into a watercourse may be fixed at 2 to 3 cusecs, depending upon the type of soil and crop. The authorities concerned should consult local opinion in fixing the alignment of these watercourses.”

3. Cases have come to notice where outlets have been designed for much higher discharges. In such cases, the command may be split up and served by two or more outlets from the parent channel or outlet converted into or replaced by a minor/sub-minor with suitable number of outlets, constructed at Government expenses to facilitate serving the command by easily manageable discharges. It is considered that this arrangement would improve the distribution of water among the cultivators and would also avoid wastage of water. It is suggested that in the case of projects under construction, where outlets of larger size have been provided in the original project estimates, these estimates may be revised to incorporate the improvements suggested above.

This letter may kindly be acknowledged.

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## GENERAL REPORT\*

In a country like India where a major part of the population is engaged in agriculture, irrigation needs to be undertaken on a more scientific basis. Costly irrigation projects have been constructed during the last few years and they can be considered to be successful enterprises only if the irrigation potential is fully utilized and the harnessed waters are economically and scientifically used.

At the 36th Annual Session of the Central Board of Irrigation and Power held on 19th November 1963 the subject of framing suitable recommendations for effective operation and control of water management in the project areas was discussed at length. Various view points were presented and there was unanimous agreement that the role of engineers should be defined very clearly and the responsibilities of other departments and organisations connected with water management should also be laid down. It was with this object in view that it was decided to hold this Symposium.

The following papers have been received apart from suggestions from certain authors :

- (1) Problems of Indian Agriculture—by Shri N. D. Gulhati.
- (2) Field Management of Canal Supplies—A Tremendous Challenge—by Shri Baleshwar Nath, Member, Irrigation Team, Committee on Plan Projects, Planning Commission, New Delhi.
- (3) Management of Irrigation Waters in Maharashtra—by Shri N. V. Khursale, Chief Engineer and Joint Secretary to Govt. of Maharashtra, Irrigation and Power Department, Bombay and Shri P. R. Gandhi, Deputy Secretary, Irrigation and Power Department, Government of Maharashtra, Bombay.
- (4) Management of Irrigation Waters in Gujarat State—by Sarvashri J. P. Nacgamvala, Chief Engineer, Irrigation and Joint Secretary, Government of Gujarat, D. R. Shankara Iyer, Under Secretary and A. V. Gururaja Rau, Junior Engineer, P.W.D., Gujarat.
- (5) Irrigation Management in Punjab—by Shri Madan Lal Wahi, Chief Engineer, Irrigation Works, Punjab.
- (6) Management of Irrigation Waters—by Chief Engineer, Irrigation, Madhya Pradesh.
- (7) Land and Water Management in Andhra Pradesh Outlining Recommendations for Efficient Water Use—by Shri P. T. Malla Reddy, Chief Engineer, Major Irrigation and General, P.W.D., Andhra Pradesh, Hyderabad.
- (8) Management of Irrigation Waters—by Shri V. Rama Rao, Chief Engineer, Irrigation, Orissa.
- (9) Management of Irrigation Waters—by Shri C. S. Parthasarathy, As.istant Chief (Irrigation), Planning Commission, New Delhi.
- (10) An Appraisal of the System of Distribution of Canal Irrigation Waters in Punjab—by Shri P.S. Bhatnagar, Chief Designs Engineer and Shri G. P. Malhotra, Deputy Director, Bhakra and Beas Designs Organisation, New Delhi.
- (11) Economic Utilisation of Water for Irrigation—by Shri B. S. Sivan, Deputy Director, Central Water and Power Commission, New Delhi.
- (12) Management of Irrigation Waters and Land—by Shri Barkat Ram, Director, Hydel Designs Directorate, Chandigarh and Shri B. D. Bali, Officer Incharge (Mech.), Hydel Designs Directorate, Chandigarh.
- (13) Field Distribution of Irrigation Water in the D.V.C. Area—by Shri N. C. Mukerjee, Superintending Engineer, Designs and Investigation Circle, Barrage and Irrigation, D.V.C.
- (14) Management of Irrigation Waters—Role of Engineers *vis-a-vis* their counterparts in other Departments—by Shri S. M. Ramgarhia, Superintending Engineer, Irrigation Branch, Punjab.
- (15) An Administrative Aspect in Management of Irrigation Water—by Shri J. D. Sahi, Director, Plant Designs, Beas Project, Talwara (Punjab).
- (16) Some Problems in the Management of Irrigation Water—Role of Agriculture Department—by Dr. D. G. Dakshindas, Sugar-cane Specialist, Pedegaon (Maharashtra).

\*By Shri Joginder Nath, Superintending Engineer, Irrigation Department, Punjab.

## (17) A combined paper on :

- (i) The Role of Agriculture Department regarding Land Levelling, Supply of Manures, *etc.*, and how far and in what manner the Responsibility for Field Utilisation can be laid on them and
- (ii) The Relative Responsibility of the various Units Responsible for these Activities and how they can be interrelated and co-ordinated — by Dr. V. G. Vaidya, Additional Director of Agriculture, Maharashtra State, Poona.

## (18) A Note on the Role of Agriculture and Irrigation Departments in the Management of Irrigation Water for Crops—by Shri R. R. Panje, Director, Indian Institute of Sugar-cane Research, Lucknow.

## (19) Suggestions on efficient Management of Irrigation Waters by the following authors have been condensed into one paper :

- (i) Shri J. P. Mittal, Additional Chief Engineer, Irrigation Department, U.P.
- (ii) Shri J. Walter, Superintending Engineer, Designs, Madras.
- (iii) Dr. R. V. Tamhane, Adviser on Soil Conservation, Ministry of Food and Agriculture, New Delhi and Dr. N. P. Rege, Deputy Adviser on Soil Conservation, Ministry of Food and Agriculture, New Delhi.
- (iv) Shri Ardaman Singh, Superintending Engineer, Plant Design, Beas-Sutlej Link Project, Punjab.
- (v) Shri L. Sreenivas, Agronomist, Department of Agriculture, Maharashtra State, Poona.
- (vi) Dr. Amrik Singh Cheema, Director of Agriculture, Punjab.
- (vii) Shri K. K. Pramanik, Superintending Engineer, Mayurakshi Canal Circle, Suri, Birbhum (West Bengal).
- (viii) Sarvashri S. N. Gupta, Director, U. P. Irrigation Research Institute, Roorkee and A. P. Bhattacharya, Research Officer, Irrigation Research Institute, U.P., Roorkee.

Various aspects of the problem under consideration which have been described and discussed in detail in these papers mainly fall under the following sub-heads :

- (a) The responsibility of the engineers in the field distribution of water and how it can be implemented and in what manner should this be further enhanced or reduced to ensure optimum utilisation.

- (b) The responsibility of *Panchayats* in digging up watercourses, fixing *warabandi* and settling disputes regarding distribution of water. Their present performance and future set-up.
- (c) The role of the Agriculture Department regarding soil survey, land levelling, setting up of demonstration and experimental farms, supply of seeds and manures, pest control, *etc.*, and how far and in what manner the responsibility for field utilisation can be laid on them.
- (d) The relative responsibility of the various units responsible for these activities and how they can be inter-related and co-ordinated.
- (e) The present mode of assessment, the authority responsible for assessment and the effect of such assessment on the total water management.
- (f) The types of outlets mainly used in the area and how they effect the utilisation.
- (g) Other factors which effect the development of irrigated agriculture.

Regarding the management of water supply up to the outlet head there are no two opinions. This is admitted to be the duty of the irrigation engineer. It is only beyond the outlet head that the duties of various agencies need to be clearly defined.

**Responsibility of the engineers in the field distribution of water and how it can be implemented and in what manner should this be further enhanced or reduced to ensure optimum utilisation**

One of the most important factors on which efficient distribution of water depends is the correct alignment of the watercourse system and proper maintenance of the watercourses.

It is agreed by all the authors that alignment of water courses must be determined by the engineer as it is entirely a technical matter. This procedure is already being followed in most of the States.

Regarding the cost of excavation of watercourses and their maintenance the procedure is different in different States. As described by Shri M. L. Wahj, in the Punjab, the beneficiaries are entirely responsible for the construction and maintenance of their watercourses. In case of failure on their part, the engineer is empowered to get the needful done at the cost of the beneficiaries.

Chief Engineer of Madhya Pradesh has indicated that the main watercourses are generally constructed by the State and they are maintained by the beneficiaries. The subsidiary watercourses or field channels are constructed and

maintained entirely by the beneficiaries. Where the beneficiaries do not carry out their obligations there is a legislation under which the State can get the watercourses constructed at the cost of the beneficiaries.

As described by Shri N. C. Mukerji, in the D.V.C. area mainly field to field irrigation is practiced, and therefore, there is no need to construct watercourses. Attempts have been made to convert the field to field system of irrigation into the field channel system but this change-over is presenting difficulties. But it is recognised that this would be the most suitable system to ensure equitable distribution of supplies and optimum utilisation.

As pointed out by Shri N. V. Khursale and Shri P. R. Gandhi, watercourses up to  $1\frac{1}{2}$  cusec (0.042 cumec) discharge are constructed at Government expense in Maharashtra State and for less than  $1\frac{1}{2}$  cusec (0.042 cumec) discharge, they are constructed by the beneficiaries themselves.

It has not been mentioned by them as to who is responsible for the maintenance of watercourses after construction. It is presumed that this is the responsibility of the beneficiaries.

In regard to the matter of maintenance of watercourses after their construction, the following suggestions have been made :—

Shri N. D. Gulhati suggests that the construction and maintenance of watercourses must be done by the engineering staff and not left to the cultivators.

Shri M. L. Wahi has proposed that the maintenance should be done by the cultivators failing which the work should be got done on their behalf by the "Management", a set-up he has outlined in detail in his paper.

Chief Engineer, Madhya Pradesh, Shri Baleshwar Nath and Shri P. S. Bhatnagar are of the view that the upkeep of watercourses should be the responsibility of the Village Panchayats.

Shri P. S. Bhatnagar has in addition pointed out that the specifications regarding the standard of maintenance should be laid down by the engineers and if necessary the Panchayats may employ a junior engineer for the purpose.

Sarvashri J. P. Naegamvala, D. R. Shankara Iyer and A. V. Gururaja Rau propose that the maintenance of watercourses should be left to the cultivators who should be able to maintain them properly through the Block Development Staff.

Sarvashri P. T. Malla Reddy, J. P. Mittal, R. R. Panje, S. N. Ramgarhia, B. S. Sivan and K. K. Pramanik are of the view that watercourses should be maintained by the beneficiaries

themselves failing which the engineer incharge should be authorised to get the maintenance done at the cost of the beneficiaries.

**(b) The responsibility of Panchayats in digging up watercourses, fixing warabandis and settling disputes regarding distribution of water. Their present performance and future set-up.**

The views of authors in regard to the responsibility of various agencies in digging up watercourses have been outlined above.

In regard to the distribution of supply and fixing warabandis, the procedure is not uniform in all the States. As explained by Shri M. L. Wahi and Shri S. M. Ramgarhia, in the Punjab, the cultivators are entitled to supplies on the basis of C.C.A. lying within the *chak* boundary of the outlet. The discharge from an outlet is either distributed by the cultivators themselves in proportion to the area of their holdings in the outlet *chak* or in case the cultivators desire, a *warabandi* can be framed under the rules by the engineer.

Shri S. M. Ramgarhia is not in favour of passing on the work of preparation of *warabandis* and distribution of water to the Panchayats but proposes that the engineering staff should continue to prepare *warabandi* cases and implement them at site.

Shri M. L. Wahi proposes that in order to ensure optimum use of irrigation supply and to get maximum agricultural production from the land, the present irrigation management should be re-orientated in its important aspects. He suggests that intensive irrigation should be practiced and only that land should be given water which has been declared good as a result of soil survey, etc., and the distribution of supply should be left to the users.

Shri N. D. Gulhati is of the view that distribution of water and construction of watercourses must be the responsibility of the engineers. They must extend service beyond the outlet. It is possible to achieve good results only if there is unified control of one department.

Shri J. P. Mittal has mentioned that a procedure similar to that prevailing in the Punjab is being followed in U.P. regarding maintenance of watercourses and distribution of supplies. He adds that efforts are afoot to transfer these functions gradually to *Gaon Sabhas*.

Sarvashri Baleshwar Nath, R. R. Panje, Ardaman Singh, Barkat Ram and B. D. Bali are of the opinion that the responsibility of distribution of supply should be shouldered by the Panchayats.

Shri N. C. Mukerji is of the view that distribution of supplies and construction of watercourses should be undertaken by the Agriculture Department with the help of village Panchayats.

- (c) **The role of Agriculture Department regarding soil survey, land levelling, setting up of experimental and demonstration farms, supply of seeds and manures, pest control, etc., and how far and in what manner the responsibility for field utilisation can be laid on them**

**(I) SOIL SURVEY**

Shri Baleshwar Nath, Shri M. L. Wahi, Shri C. S. Parthasarathy, Shri J. Walter and Dr. D. G. Dakshindas have strongly stressed the importance of soil surveys. Shri Baleshwar Nath has pointed out that soil classification needs to be done on a detailed and systematic basis so that proper crop planning suitable for the nature and type of soil could be adopted. He also states that there are large areas in the country where scientific soil classification has not been done which fact stands in the way of properly planned scientific field management of canal supplies apart from defective crop planning.

It is agreed by all that this is an item of work which should be dealt with by the Agriculture Department.

**(II) LAND LEVELLING, SETTING UP OF EXPERIMENTAL AND DEMONSTRATION FARMS, SUPPLY OF SEEDS AND MANURES AND PEST CONTROL**

It is agreed by all the authors who have expressed views on this item that land levelling, setting up of demonstration farms, supply of seeds and manures and pest control should be the responsibility of the Agriculture Department.

Shri N. D. Gulhati has laid great stress on "Land farming", and he has stated that if this is done it will lead to larger area being provided with irrigation facilities and it shall also reduce the cost of drainage operations. He also advocates setting up of demonstration farms and application of fertilisers to increase the yield of crops.

Shri N. V. Khursale and Shri P. R. Gandhi have stated that before actual application of water to the new lands to be brought under irrigation, it becomes necessary to level the land and do "bundling" of the land to be irrigated. Quite often the financial position of the irrigators is not sound enough to take up this work on their own and, therefore, it becomes necessary to make available financial assistance for them from the cooperative societies and if that is not possible, levelling and bundling should be done departmentally by the Agriculture Department with the help of machinery. They further add that it is also the duty of the Agriculture Department to supply pure seeds and manure well in time. The Agriculture Department is also responsible for taking measures in regard to pest control. The trial-cum-demonstration farms are also under the control of the Agriculture Department.

Sarvashri J. P. Naegamvala, D. R. Shankara Iyer and A. V. Gururaja Rau have pointed out that the timing of the establishment of the trial-cum-demonstration farms is a very significant feature. Usually it has been found that the farms are set up only when the canals are ready and by the time farms come out with any positive recommendations quite a few years pass by without giving any suitable advice to the cultivators regarding crop planning. Demonstration farms should, therefore, be set up a few years in advance of the provision of irrigation facilities. Farms can carry out experiments by getting water from nearby wells or by installing tube-wells. They also agree that it is for the Agriculture Department to supply seeds and manures.

Shri M. L. Wahi proposes that after detailed soil surveys have been carried out, a master plan of crop pattern for irrigated areas selected for intensive irrigation should be prepared by the Agriculture Department.

Dr. V. G. Vaidya, Additional Director of Agriculture, Maharashtra has described in detail the necessary steps that should be taken to prepare a comprehensive plan of land levelling, crop pattern, estimate of requirement of seeds and fertilizers, implements, short-term loans, setting up of demonstration farms and other facilities that should be extended to the cultivators. He has further stated that a complete plan should be prepared within one year of the approval of the project estimate to undertake an irrigation project.

Dr. A. S. Cheema, Director of Agriculture Department, Punjab agrees that responsibility for land levelling, supply of manures and fertilisers and changing of the crop pattern are operations for which the Agriculture Department is primarily responsible.

Dr. D. G. Dakshindas remarks that the Agriculture Department should be mainly responsible for chalking out a crop pattern in the particular area but this should be done in consultation with the representatives of the Engineering Department and local irrigators. He recommends that it would be advisable to have small "Irrigation Committees" for each distributary for helping in drawing up a crop pattern.

**(d) The relative responsibility of the various units responsible for these activities and how they can be inter-related and co-ordinated**

It is the function of the Irrigation Branch to create the irrigation potential. The manner of distribution of supplies through watercourses as advocated by various authors has already been indicated above. In regard to the soil surveys, land levelling, setting up of demonstration farms and supply of seeds and manures it is the unanimous opinion of all that it is the responsibility

of the Agriculture Department. Now arises the vital question of co-ordination between various agencies connected with these activities.

Shri N. D. Gulhati is of the view that Irrigation Departments in the States should be re-organised and turned into the Departments of Irrigated Agriculture. These departments should be responsible for development of watercourses and the conveyance of irrigation water to the outlets and their ultimate utilisation. These departments should provide services relating to land farming, construction and upkeep of watercourses, field drainage, periodical soil surveys, determination of crop varieties to be grown and also lay down an appropriate crop rotation to maintain the fertility of the soil. For this purpose the Agriculture and Soil Survey services must be built into the Departments of Irrigation Agriculture.

Shri M. L. Wahi proposes that an organisation of the pattern as it exists in the U.S.A. should be set up. According to this, the project area is sub-divided into different irrigation districts, each district being responsible for a block of area ranging from about 50,000 to 70,000 acres. The Irrigation District is proposed to be under the control of a Board of five Directors selected from amongst the farmers of the district and it should have 3 official members nominated by the Irrigation Department, Agriculture Department and the Revenue Department. The Irrigation representative should function as a manager and the Revenue representative as *ex-officio* Secretary of the Board, with powers of an Assistant Collector. The Board could have some staff for ensuring distribution of supply and for collection of water charges. The Board would also look after the construction and maintenance of watercourses, render technical advice to farmers on matters relating to irrigation and agriculture and also undertake assessment of water charges. It has been proposed by Shri M. L. Wahi that as a trial measure three to four Irrigation Districts may be set up in the Bhakra areas of the Punjab.

Shri N. V. Khursale and Shri P. R. Gandhi suggest that as the subject of agriculture is basically dealt with by the Agriculture Department, it is proper for that department to play the most prominent role. The Irrigation Department and C. R. D. are complementary departments who should play a secondary role to help the Agriculture Department in the utilisation of the created irrigation potential at the outlet head. According to them, the Agriculture Department should be the right department for co-ordinating the activities of all departments for increasing food production and for utilising the irrigation potential.

They further add that the Irrigation Department has appointed Regional Committees for making suggestions to the department for the speedy utilisation of the irrigation potential.

These Regional Committees consist of the representatives of the various departments at the district level as well as the non-official members either from the leading persons from the irrigation command or members of the Legislative Assembly and Legislative Council.

After the declaration of the emergency, Agriculture Department has appointed one Agricultural Production Committee at the State level, members of which are Secretaries of various departments and Chairman is the Chief Secretary. This Committee makes necessary recommendations for the utilisation of the irrigation potential. The recommendations made by the Agricultural Production Committee are considered by the High Level Committee headed by the Chief Minister, members of which are Ministers of various departments. After the approval of the recommendations of the Agricultural Production Committee by the High Level Committee, action on the various recommendations is speedily taken by all the departments of the State.

Sarvashri J. P. Naegamvala, D. R. Shankara Iyer and A. V. Gururaja Rau have stated that in Gujarat District, the Development Commissioner has been made the Focal Officer to co-ordinate the activities of the concerned departments.

Chief Engineer, Madhya Pradesh is of the view that after the potential has been created, the responsibility for utilisation of water should rest with the Agriculture Department through a "Project Development Committee". This Committee should consist of representatives of the Revenue, Agriculture and Irrigation Departments with representatives of other connected departments. The Collector of the District should be made responsible for proper development of the area under the project. Responsibility of the engineers beyond the outlet should cease.

Shri P. T. Malla Reddy has explained that in Andhra Pradesh, in each district there is a District Irrigation Development Board which has the District Collector as its Chairman. The Superintending Engineer concerned and the District Agriculture Officers are its members. Progress in development of irrigation under the project is watched by this Board. At the State level, is constituted an Irrigation Development Board which has the Member, Board of Revenue incharge of Irrigation as Chairman and heads of departments of P.W.D., Agriculture, Cooperative and Additional Development Commissioner as members. The State Irrigation Development Board fixes targets of development for each project every year and reviews their achievements periodically.

Shri C. S. Parthasarathy suggests that in order to facilitate close co-ordination between the agriculture and engineering aspects of irrigation projects in the interest of optimum utilisation

tion of water and land resources the State Irrigation Department should have agriculture specialists on its staff.

Shri Baleshwar Nath proposes that an Irrigation Extension Cadre in the Irrigation Departments of the State is urgently needed. These cadres should be staffed by qualified persons agriculturally trained and with sound knowledge of agriculture and field engineering. These extension services should also develop field research and provide guidance to the irrigators to make the best use of irrigation water available. This means that he also advocates unified control by the Department of Irrigated Agriculture.

Shri J. P. Mittal has indicated that in U.P., co-ordination at district, divisional and State levels is being achieved through various committees set up for this purpose at these levels.

Dr. A. S. Cheema, Director of Agriculture, Punjab has recommended the formation of Advisory Committees to solve the difficulties and bottlenecks. The Advisory Committees are proposed to consist of officers of various departments dealing with the irrigation activities and members of the farmers community.

Shri J. D. Sahi is of the opinion that the Irrigation Branch should have unified control over the distribution of supplies. He has suggested that the irrigation personnel should be classified into the category of construction engineers and canal engineers. Canal engineers of the Irrigation Branch should be imparted special departmental training in the science of soil and agriculture.

**(e) Present mode of assessment, the authority responsible for assessment and the effect of such assessment on the total water management**

As explained by Shri N. V. Khursale and Shri P. R. Gandhi in Maharashtra, assessment of water rates is done by the Irrigation Branch and the demand statements are sent to the Collector of the District for realisation.

It has been explained by Shri J. P. Naegamvala, Shri D. R. Shankara Iyer and Shri A. V. Gururaja Rau that in Gujarat State water rates are assessed on the basis of area actually irrigated. Demand statements are prepared by the staff attached to the engineers and the realisation is done by the Revenue Department.

Shri M. L. Wahi and Shri S. M. Ramgarhia have stated that according to the system of assessment in the Punjab water rates are charged on the crop actually matured. The demand statements are prepared by the Irrigation Branch and realisation is made by the Revenue Department.

Shri J. P. Mittal has explained that in U.P. in the case of canals, the procedure of assessment is the same as in the Punjab.

The system of assessment of irrigation revenue in Madhya Pradesh has been explained by the Chief Engineer, Madhya Pradesh. The system is different in different regions. In the Mahakoshal region irrigation is done only for the paddy crop. Irrigation revenue is levied on the area under an agreement irrespective of whether it is irrigated or not. Demand statements are prepared by the staff attached to the engineers and the collection is done by the *Panchayats*.

In other regions of Madhya Pradesh, assessment is done on the area actually irrigated. Demand statements are prepared in the Irrigation Department and are sent to the Revenue Department for realisation.

Shri Baleshwar Nath has proposed that Irrigation Cooperative Societies should be formed in the villages who could take up the responsibility of paying water charges on cooperative basis either quantitatively or on matured areas. They should collect the dues on honorary basis so that establishment charges as a whole can be kept low. He is of the view that with the coming in of *Panchayats* in the villages, this proposition may not be difficult in practice.

Shri Ardaman Singh has also proposed that the *Panchayats* should be made responsible for the assessment of revenue.

Shri M. L. Wahi, Shri P. S. Bhatnagar and Shri G. P. Malhotra have stressed that on account of the fact that the cultivators are at present entitled to supplies of water based on their CCA, there is a tendency on their part to over-irrigate their fields. Since the charges for water are generally levied only on the area irrigated and matured and not on quantity of water used, the utilisation of water by the farmers has tended to become unscientific. If water could be supplied to the cultivators on volumetric basis the cultivators would use only that amount of water which is absolutely necessary and this would also induce them to maintain their watercourses in a better condition. In the present system, even if the cultivator has been educated to make use of the results obtained from various agricultural experiments, the temptation of using the available water and thus irrigating the field very much in excess of what is necessary is always there. It has, therefore, been suggested that automatic mechanical gauges to meter the supplies passing through the outlet should be installed. Since such installations would take time to develop certain measures such as fixing of V-Notches or Cippolotti Weirs are recommended to be taken as an interim measure.

Shri Barkat Ram and Shri B. D. Bali have also very strongly advocated changeover to the volumetric system of assessment. They have

given statistics to show the superiority of volumetric assessment compared to the acreage basis of assessment. On tube-wells in the Punjab, during the period when assessment was being made on the basis of electric consumption, the average consumption per acre was about 50 units. In 1962-63 when charges began to be levied on acreage basis the consumption per acre went up to 68 units. This clearly proves that if assessment is not made on volumetric basis the cultivator has a positive tendency to become careless in the use of water and over-irrigates his fields which ultimately also leads to water-logging and more expenditure on farm drainage.

**(f) The Types of outlets mainly used in the area and how they effect the utilisation**

As described by Shri B. S. Sivan it is essential to select the right type of outlet for supplying irrigation water to the cultivators. The type of outlet and its controlling arrangement contribute to effectively check wastage of water.

As described by Shri N. V. Khursale and Shri P. R. Gandhi, open flume type of outlets are generally used in Maharashtra.

As stated by Sarvashri S. M. Ramgarhia, Barkat Ram and B. D. Bali the type of outlets commonly used in Punjab are the open flume and adjustable proportionate module type, in addition to the ordinary pipe outlets. From the point of view of volumetric assessment an adjustable proportionate module is considered to be the most appropriate.

As remarked by the Chief Engineer, Madhya Pradesh, uncontrolled type of outlets such as pipes are used in that State. These outlets are easily capable of being tampered with and can result in improper distribution of supply on the main irrigation channels as a whole.

Shri N. C. Mukerji has pointed out that in the D.V.C. flume pipe outlets are generally used. The outlets used by them are not of an advanced type but he remarks that hasty conversion is not desirable.

As pointed out by Shri J. P. Mittal, in U.P. generally flume pipe outlets are used.

**(g) Other factors which effect the development of irrigated agriculture**

Shri N. V. Khursale and Shri P. R. Gandhi have mentioned that the following are a few other factors on which the success of irrigated agriculture depends :

- (i) Providing credit facilities to the cultivators.
- (ii) Providing storage facilities.
- (iii) Providing marketing and communication facilities.

**(i) PROVIDING CREDIT FACILITIES TO THE CULTIVATORS**

The cultivators are generally unable to meet the cost of getting land levelling done and often they are unable to pay the price of seeds and manures. As such, it is necessary to provide them with credit facilities. This is an arrangement which should be made by the Cooperative Department.

**(ii) PROVIDING STORAGE FACILITIES**

It is necessary to provide storage facilities to the cultivators till such time that they can take their produce to the market for sale.

Shri N. V. Khursale and Shri P. R. Gandhi have mentioned that the Maharashtra State Irrigation Commission has recommended that marketing facilities and construction of warehouses should be undertaken by the Government.

**(iii) PROVIDING MARKETING AND COMMUNICATION FACILITIES**

It is necessary to provide marketing and communication facilities in the project area so that the cultivators can conveniently carry their produce to the nearby markets and towns for sale. This is an item which needs to be looked into by the B. & R. Branch of the P. W.D. in consultation with the revenue authorities.

The above mentioned three issues are important from the point of view of development of the project area and therefore due attention deserves to be paid in this regard in all the States.

**(h) Suggestions regarding Lines of discussion at the Symposium**

From the large number of useful and practical suggestions made in these papers the following two major issues emerge

- (i) What should be the organisational set-up in order to bring about complete co-ordination amongst various departments and agencies engaged in the utilisation of water so that water could be scientifically and economically used to increase crop production.
- (ii) How far is the changeover to the volumetric system of assessment considered to be practicable and feasible and what would be the difficulties in the way of introduction and implementation of this system.

After a solution to these two issues is found other inter-related issues regarding distribution of supply will automatically be resolved.

**(I) ORGANISATIONAL SET-UP**

The existing organisational set-up in different States has already been described earlier. It transpires that the existing set-up is not satisfactory on account of absence of unified control and complete co-ordination amongst the various agencies due to which the desired results are not being obtained in the field. It, therefore, appears to be necessary to examine and discuss if it is possible to bring about an improvement in the existing set-up or whether a radical change is required. In this regard several proposals have been made.

Shri N. D. Gulhati has proposed that the Irrigation Departments in the States should be re-organised and turned into the Departments of Irrigated Agriculture. These Departments should have unified control and should be fully responsible for the development of watercourses and the conveyance of irrigation water to the outlets and their ultimate utilisation. For this purpose the Agricultural and Soil Survey Wings of the Agricultural Department are recommended to be built into the Departments of Irrigated Agriculture.

The second suggestion is from Shri M. L. Wahi who proposes a radical change in the existing set-up, to be tried as experimental measure in the first instance in the Bhakra Nangal Project area. The proposal is to set up Irrigation Districts controlled by a Board of Directors elected from amongst the farmers and having nominees of the Government who should be entrusted with the responsibility of constructing and maintaining field channels, distributing irrigation supplies, ensuring farm drainage and collecting water charges for water delivered to the cultivators.

The third suggestion is from Shri N. V. Khursale, Shri P. R. Gandhi and Chief Engineer, Madhya Pradesh. They propose that since the

Agriculture Departments basically deal with the subject of agriculture they should be made entirely responsible for the utilisation of the irrigation potential created at the head of the outlet. The duties of the engineers should end at the outlet head.

The other suggestion is to make the *Panchayats* responsible for the distribution of water and they should be guided in other matters by Advisory Committees consisting of experts from the concerned departments.

The suggestions made by other officers in this regard are more or less covered by the main proposals mentioned above.

**(II) DISTRIBUTION OF SUPPLY ON VOLUMETRIC SYSTEM**

In regard to the issue of delivery of supply to cultivators on volumetric basis and the type of outlets considered suitable for distribution of supplies, the views expressed by various authors have been presented earlier. The proposal for delivering supply to the cultivators on volumetric basis has generally found favour. It remains to be discussed and examined how quickly the changeover can be brought about from the present system of assessment and what would be the practical difficulties involved in the implementation of this proposal. The type of outlets to be adopted needs to be examined in case it is considered desirable that the volumetric system should be enforced.

If the members agree, emphasis during discussion may generally be laid on the two major issues already detailed above, *i.e.*, firstly the organisational set-up, and secondly the proposal for changing over to the volumetric system of assessment.



# PROBLEMS OF INDIAN AGRICULTURE

by

N. D. Gulhati\*

## Unirrigated Farming

Unirrigated farming is conditioned almost entirely by natural phenomena—rainfall, prevailing temperatures, *etc.*, and the nature of the soil. The kind of crop that can be raised is determined by these factors, so also the yield obtained. In large parts of India, with little rainfall during eight or nine months in the year, such agriculture provides a bare subsistence for the cultivators; the annual return to him is small and unreliable, it varies from year to year, depending on the amount of rainfall during the crop period and its distribution during this period.

Land treatment required as a pre-requisite to agriculture is either nil or of a relatively simple type like maintaining field dowsels, to hold rain-water, or contour bunding, to prevent erosion of the soil. Except for rice, no land levelling is necessary.

Unirrigated agriculture does not disturb the natural drainage of the area and, by and large, sub-soil drainage poses no problem. If an area is likely to be inundated by flood waters, such inundation, from the point of view of agriculture, is always welcome, except in high rainfall areas. Even if the flood waters sometimes damage a standing crop, this is almost always compensated by a bumper crop in the following harvest.

Because of the undependable rainfall in large parts of the country, both in total amount and in its timeliness, the out-turn from unirrigated agriculture is small and not assured. For this reason, the cultivator is shy of increasing his working expenses, whether such increase be for improved seeds or for fertilisers or other improvements in agricultural methods. Such agriculture has, accordingly, been stagnant for long and the recent efforts towards improvement have yielded but a relatively slow response in most parts of the country.

## Irrigated Agriculture

On the other hand, with the introduction of an artificial supply of water, irrigated agriculture is relatively secure from the vagaries of nature and the cultivator can reasonably look forward to an assured return for his labour and investment in seeds, fertilisers, insecticides, *etc.*

He can grow high valued crops and two crops a year, if sufficient water is available. Under irrigated conditions, not only is the yield per acre relatively high but one should also expect a rapid increase in production with every improvement, whether of water supply or of seeds or of fertilisers or of any other element of production. But the results so far obtained from some of the large irrigation developments and many medium and minor projects, undertaken in India during the last 15 years, far from showing any such rapid increase in production, reveal a rather sorry state of affairs. Millions of acres of land, which have been provided with irrigation facilities, are not being irrigated. The cultivators, who have been furnished with new means of irrigation, do not apparently grasp the opportunity offered to them to increase production and thus to make large profits from the land. This is in strange contrast to the enthusiasm with which new irrigation projects are in demand all over the country. How can one explain the apparent inconsistency?

## Why Slow Development on New Projects

It is not generally appreciated that the change-over from unirrigated to irrigated agriculture is of a fundamental nature. It calls for expert technical supervision. In many parts of the country, it also requires large investment in land preparation, as a pre-requisite to irrigated farming. In all parts, it requires increased working expenses. A subsistence economy is to be changed to a surplus market economy. The habits of the people and their ways of living are to undergo a radical change. It is not that the cultivator does not want to improve his lot. He lacks the technical skill necessary for the change-over. Having grown the same crop, year after year, and having lived for centuries past, in an atmosphere of uncertain returns from his efforts on the land, the cultivator has to learn to grow new crops and get confidence in his new situation. Another major difficulty lies in the fact that the cultivator does not have the technical know-how for preparing his land for irrigation nor the financial means to meet the relatively large investment in land preparation, necessary on most new projects. He has also no ready means to find the increased working expenses necessary for intensive agriculture.

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Prior to independence, canal irrigation had been developed mostly in the Indo-Gangetic plains and the large deltas on the east coast. This development was a relatively slow process. Irrigation in some form or the other had been practised in these areas for centuries past. Lands are flat and do not require much work or expense to render them irrigable; the farmer can do the necessary work with light implements or animal power. The soils are relatively deep and do not show much variation from place to place. One canal system followed another after an interval of years. Field watercourses were either built as part of the canal project or irrigation waters were led from field to field. Even under these favourable conditions it took 10 to 15 years, after the completion of a canal system, to realise its full potential but only in terms of area irrigated. Crop yield though a good deal more than under unirrigated conditions, remained relatively low. Besides, several mistakes were made. Because of neglected drainage, large areas became waterlogged or saline.

Many of the new canals are designed to serve tracts different in many ways from the Indo-Gangetic plains or the deltas on the east coast. The cultivators in these tracts have been used, for centuries past, to unirrigated agriculture, generally of maize, *jawar* or other light crops. Irrigation, as known in the neighbourhood, is from small tanks and the irrigated areas comprise small patches in the stream beds below the tank. The crop grown is rice, there are no watercourses with little attempt towards water economy.

The general terrain of the lands to be irrigated is uneven or rolling country. Considerable effort and skill is required to construct field, watercourses and prepare the lands for irrigation a task made more difficult by the relatively small depth of soil—a few inches to a few feet—in the uplands. The soil types vary widely, depending on their location in the valley. Near the bed of the valleys, where deep soils predominate, drainage operations are necessary and main drains and field drains would have to be constructed.

#### Land 'Forming'

Thus, apart from the construction of field watercourses and field drains, where required, land 'forming' is an important pre-requisite for a change-over from unirrigated to irrigated agriculture. The technique of land forming would vary from place to place depending on the configuration of the land and the thickness and nature of the soil—the broad purpose being the creation of optimum environments for equalising moisture distribution first in the seed bed and then in the root zone for uniform plant growth. This may be accomplished by land levelling, by forming terraces, or by making furrows in, or against, the direction of the land slope, or by a combination of all the three.

Where available irrigation supplies are relatively scarce, as in most arid and semi-arid areas, one of the important objectives of land

'forming' is also the resulting economy in water use, enabling larger areas to be provided with irrigation facilities and reducing the cost of drainage operations.

#### Crop Pattern Under Irrigated Agriculture

✓ The introduction of an artificial supply of water in any area changes the *status quo ante* between the rainfall, the soil and the crops or vegetation that the soil supports. The nature of the crops to be grown under irrigated conditions and the crop rotation, therefore, become important considerations from many points of view. I will now describe some of these.

✓ The principal aim of an irrigation project is to increase agricultural production. This may be in the form of an increased yield from the crops already grown under unirrigated conditions. More often, high valued crops are introduced and, on some irrigation systems, two crops are grown in a year instead of one generally possible under unirrigated conditions. The actual cropping pattern is determined largely by the nature of the soil, the amount of irrigation supplies and the time of the year during which these supplies are made available, the prevailing temperatures, the habits of the people and general economic considerations.

When large-scale canal irrigation was first introduced in the Indo-Gangetic plains, the cultivator was left free to choose his crops and the rotation in which they should be grown. Some demonstration farms were established and, in course of time, some general advice was available to the cultivators through the agricultural departments but, by and large, the cultivators developed their own crop patterns and determined the extent of areas to be irrigated.

In the deltas, paddy was the prevailing crop before the introduction of irrigation. With the change-over to irrigated agriculture, conditions remained particularly favourable for the growing of paddy; there was not much scope for developing a diversified crop pattern. In course of time, however, plantains, vegetables and orchards increasingly came to be grown in addition to paddy.

✓ In the scarcity areas, east of the Western Ghats, irrigation of the traditional type was, to begin with, a failure. This led to the development of sugar-cane blocks and the exercise of control by Government on the growing of irrigated crops. Thus, in old Bombay part of Maharashtra, the area to be irrigated and the crops to be grown are regulated by the Irrigation Department from year to year. This gives a relatively secure water supply for the cropped area but there is little incentive towards an economic use of water and increase in irrigation.

On some of the new projects like Tungabhadra, a system of localisation has been introduced. In this system, Government determines, once for all when irrigation is first introduced in an

area, the exact parcels of land, within the irrigated area of a canal, that will receive the benefit of irrigation as well as the nature of the crops that may be grown in each field. For this purpose, irrigated crops are divided into three classes: (i) paddy, (ii) sugar-cane, plantains or garden crops, and (iii) crops like *jawar*, *bajra*, cotton, groundnuts, etc. The localisation is determined mainly by the Revenue Department with some assistance from the Agriculture Department.

Certain types of soils, when put under irrigated agriculture, undergo structural changes and, in the absence of efficient drainage and leaching, develop salinity. Even otherwise, where such structural changes do not take place and even if the soil does not inherently have any salt content, the evaporation and transpiration of irrigation waters, in the absence of efficient drainage, leave some salts in the soil. Take for example, the relatively salt-free waters of the Indus system of rivers which have an average salt concentration of about 200 parts per million. Assuming an average application of 4 ft. (1.2 m.) of water, for two crops in a year, and ignoring the small quantity of salts used up in the plant stem and foliage, etc., the salt content of the top 18 in. (0.46 m.) of the soil, after 20 years of irrigated agriculture, would be about one per cent, if no part of the salts present in the irrigation waters would be washed down into the deep sub-soil. Again, if the sub-soil water has a salinity of no more than 400 parts per million (generally regarded as safe), surface evaporation at a rate of 2 ft. (0.6 m.) per year [which is about normal with a water-table 5-10 ft. (1.5-3.0 m.)] below ground will raise the salt content of the top 18 in. (0.4 m.) of soil to about one per cent in 20 years. Not even the hardiest crop can grow in soils of such high salt content. Obviously, when the soil has an inherent salt content, as in almost all arid regions, or the sub-soil water is blackish, or the salt content of irrigation waters is high, conditions would be difficult for maintaining irrigated agriculture on a permanent basis. Accordingly, it is important that the annual accumulation of salts in the root zone should be washed out by efficient drainage. This would involve the use, for this purpose of some irrigation water over and above that required for evaporation and transpiration from the irrigated cropped land. If the natural drainage is not adequate, field drains must be provided and drainage water must be led into rivers either by gravity drains or by pumping (vertical drainage).

It is important to note in this connection that the salt tolerance of different crops varies widely. Crops like pulses, beans, etc., can only grow successfully if the salt concentration in the soil water in the root zone is less than about 2,500 parts per million. Against this, maize, sorgham, sugar-cane and rice can grow successfully with a salt concentration in the root zone of about 5,000 parts per million. Wheat can grow in salt concentration of 7,500 parts per million

while cotton, sugar-beet and *bajri* can grow even where the salt concentration in the root zone is up to 10,000 parts per million. If a crop with a low salt tolerance is grown in an area where the salt concentration in the root zone is relatively high, for good yield, it would be necessary to give additional doses of irrigation in order to wash away the excess of salts, assuming that efficient drainage is available to make leaching possible. Alternatively, the crop yields will fall, cultivation would become uneconomic and, in course of time, the land will go out of use. The situation can be eased considerably if only crops with a high salt tolerance are grown in soils with a relatively high salt content.

### Irrigated Agriculture Needs Special Attention

It would appear from what I have stated that apart from the construction of watercourses (the lack of which has been blamed for the slow development of irrigation on many new projects), there are other important elements which do not receive sufficient attention at present in the change-over from unirrigated to irrigated agriculture. Attention has been drawn to the importance of land 'forming' and to that of field drainage. Apart from this, the present practice of leaving the cultivators to determine the crop pattern, or of imposing a crop pattern by Government, or the 'localisation' procedure described above do not take due note of the technicalities of the situation. The crop pattern under irrigated agriculture has to be carefully determined under expert supervision, not only when irrigation is first introduced but also periodically thereafter. Soil corrective measures, or land reclamation measures as these are called, have to be introduced as an integral part of the agricultural operations. And when the available irrigation supply varies from year to year, the annual cropping has to take note of, and be conditioned by the quantum available.

According to the latest published statistics, available for the year 1959-60, of the total cultivated area of 326.6 million acres in the Union of India, 268.2 million acres, or 82 per cent are unirrigated and only 58.4 million acres, or 18 per cent are provided with irrigation facilities. Because of the large proportion of unirrigated cultivation, total agricultural production in India is not only relatively low but also shows large variations from year to year, by as much as 10 million tons of foodgrains representing about 12 per cent of the present annual production. Increase in irrigated acreage should bring about a measure of stability and also make for a large increase in the annual production. Because of the intensive nature of irrigated farming, however, and the several special features, I have described, it would be obvious that a given irrigated area needs much more attention than an equal unirrigated tract. It has to be recognised that irrigated agriculture, like a specialised industry, requires expert technical supervision at all stages and that the techniques involved

are different from and much more complex than those of unirrigated agriculture. As a first step towards realising full advantage from the irrigation potential being created, irrigated farming must, therefore, be viewed and dealt with differently from unirrigated agriculture.

It has been shown that land 'forming' and field drainage are important for efficient irrigated agriculture; these need constant attention. Under unirrigated conditions, land 'forming' and field drainage are generally unimportant. Again, watercourses, their construction and up-keep, the methods of applying water, the quantum of water to be applied and the time of application are problems which only exist under irrigated conditions.

Apart from these, in view of the intensive cultivation under irrigated conditions and the consequent large demand on the soil for plant-nutrients, application of fertilisers is a much more important problem under irrigated conditions than under unirrigated conditions. Again, the application of chemical fertilisers under irrigated conditions has to be related to the application of irrigation water in such a manner as to prevent the washing down of the fertilisers from the root zone. The types of seeds required for irrigated crops are generally different from those for unirrigated crops. Similarly, the stake involved in fighting insects and pests is much more under irrigated conditions, than under unirrigated conditions. It is thus clear that while general agricultural methods, research and improvements in technique will always be of considerable assistance in irrigated agriculture, there are several special problems and consequent variations in the application to irrigated conditions of general agricultural methods and techniques.

#### **Irrigation Departments to provide Services Beyond the Outlet**

Since the construction of watercourses, land 'forming', field drainage are all engineering activities and since one of the major considerations in the determination of the crops to be grown is the available irrigation supply, which varies from year to year, it is clear that the Irrigation Department must not stop its activities arbitrarily at the outlet, as is the practice in many States. It may be emphasised here that considerable sums of public money have been and are being spent on the development of river waters by dams and barrages and in the conveyance of these waters up to the outlet. Technical know-how is as important beyond the outlet as up to this point. To obtain best results on a permanent basis it is important that Irrigation Departments must equip themselves for work beyond the outlet and should be provided with the requisite funds, personnel and the authorisation to render the services relating to land 'forming', construction and up-keep of watercourses, field drainage, soil surveys, determination broadly of the nature of crops to be grown

(depending on the amount and nature of water supply, climate and soil characteristics) and the application of soil corrective measures as an integral part of irrigated agriculture. These services to the cultivator have to be provided in conjunction with those relating to the provision of improved varieties of seeds, fertilisers and insecticides and guidance regarding improvement in agricultural methods. It is important that there should either be undivided responsibility for all these services (i.e., the development of water resources, their conveyance to the field and all that is involved in their ultimate utilisation in agricultural production), or, what is more difficult, there should be effective co-ordination of the activities of different departments, responsible for different elements of production. The present system in most States, under which the Irrigation Department, the Agriculture Department, the Co-operative Department and the Revenue Department each disowns responsibility for the ultimate development must, in any case, cease and be replaced by one which is more practical and likely to give efficient results.

#### **Attempts at Co-ordination**

In the mid-term appraisal of the Third Plan, recommending the establishment of an Irrigation Development Committee in each State, it has been urged that its effectiveness would be greatly enhanced if, at the same time, the overall responsibility for ensuring effective co-ordination between the various agencies was placed on an officer to be specified at the State, project and local levels. Pursuing this line, it has been recommended—

“At the State level, the overall responsibility might be placed on the State Development Commissioner. It should be his duty to ensure that the various plans and instructions are implemented effectively and in accordance with agreed schedule. At the district level, this responsibility might be placed on the Collector. . . . Responsibility for securing the observance of obligations on the part of the beneficiaries and for utilisation of the available irrigation facilities have been placed on the *Panchayat Raj* Institutions, especially *Panchayat Samitis* and *Village Panchayats*”.

At another place, referring to agricultural development in general, the mid-term appraisal refers to the concern which has been felt for some time that the efforts of various agencies in relation to agricultural production are not being effectively co-ordinated. In search for remedies, a high level Working Group was set up in August 1963, for making proposals for co-ordination within the entire administrative and organisational structure from the village level to the State level. The proposals formulated by the Group are stated to be under consideration at present.

Meanwhile, an Agricultural Production Committee, presided over by the Chief Minister and an Administrative Coordination Committee, presided over by the Chief Secretary, have been set up by all State Governments. This is expected to lead to speedy decisions and expeditious implementation.

### Inadequacy of Agricultural Production— A Standing Problem

Agricultural production, or the inadequacy of it, is not a new problem in India. Ever since the beginning of the Second World War, almost 25 years ago, the Central Government and the State Governments started what was called a grow-more-food campaign. About 10 years later, when the First Five-Year Plan was formulated, food was the crying need of the day and the bulk of that Plan was devoted to agricultural development. In the Third Five-Year Plan, the largest emphasis was again placed on agriculture which, according to the mid-term appraisal, "obviously holds the key to rapid economic growth". While the efforts of the Central and State Governments over the last 25 years have led to substantial development in agricultural production, in spite of hundreds of *crores* of rupees spent on these efforts, it has to be recognised that agricultural production has not, at any stage, come up to our expectation or been sufficient to meet our needs. Something is amiss and, it would appear that it is the organisational structure. Setting up dis-jointed new agencies, at different levels, with no built-in integrated approach, and then forming co-ordinating committees of officers who, to say the least, have already enough on their hands, is no way of fighting a war against poverty and want.

### A Scientific Approach Called For

The problem must be approached in a scientific manner. Modern agriculture, by which I mean agriculture with a view to getting the maximum return possible under the prevailing conditions of climate, soil, water supply, *etc.*, is a highly technical undertaking and, to be successful, must be recognised as such. As a first step, therefore, agriculture must be separated at all levels from routine civil administration and other welfare activities and the entire responsibility for its development must be placed wholly and squarely on organisations manned largely by those who have the requisite technical knowledge and training. Secondly, as explained earlier, since the elements of production as well as the potential in un-irrigated farming and irrigated agriculture differ widely, it would help considerably if the two are treated differently and separate organisations are established for each. Thirdly, for each type of agriculture, there should be unified administration, covering all elements of production. It is only in this way that one can secure optimum interaction between various factors involved. Agriculture is beset by a wide range of impediments.

Any attempt to deal with one of these in isolation may be frustrated or seriously handicapped by the presence of others. Provision of irrigation or improvement in available irrigation facilities, supply of improved seeds, fertilisers, better agricultural technique, when applied singly, may each increase the yield by, say X per cent. But when all these factors are applied in combination, the yield may increase by as much as 10 X per cent. Lastly, the cultivators must get to know the technical know-how and supplied with sufficient working capital. This can best be assured by organising them in Rural or Agricultural Cooperatives. In pursuance of these considerations, it would appear that, apart from the Rural Co-operatives, agricultural production should be the undivided responsibility of only two organisations, one dealing with unirrigated farming and the second with irrigated agriculture.

### Role of Agriculture Departments

For unirrigated farming, the entire responsibility must be placed on the State Agriculture Departments. These departments will thus have jurisdiction over about four-fifth of the cultivated area of the country. It will be their responsibility to undertake the necessary fundamental and applied research in each district or region of the State and to carry the results of this research to the cultivators through their extension services. These departments will also evolve high yielding, drought and pest resisting varieties of seeds, and undertake their production on a large scale. Officers of these departments should tour extensively in rural areas and help cultivators in solving their problems. They will also deal with all problems of soil conservation within the cultivated areas under their jurisdiction.

These departments will co-operate with Rural Co-operatives, for the distribution to the cultivators of improved varieties of seeds and of fertilisers and for organising common services relating to improved agricultural practices. Any subsidy, direct or indirect, to be given to the cultivators in the interest of introducing improvements in agricultural methods or techniques should be given through the Agriculture Departments and Rural Co-operatives.

The general policy of the Agriculture Departments has to be tuned to the requirements of an extensive area depending on irregular rainfall which, in most parts is also inadequate in amount—the net yield to the cultivators being relatively small. The annual performance of these departments has to be judged and anticipations built with these limitations in view.

While the actual collection of land revenue should remain the responsibility of District Collectors, as at present, the work of assessment of the dues should be transferred to the officers

of the Agriculture Departments who must, in any case, remain in close touch with the cultivators and the use to which the land is put.

### Role of Departments of Irrigated Agriculture

For the development of irrigated agriculture in the country, the present Irrigation Departments in the States should be reorganised and turned into Departments of Irrigated Agriculture. These departments should be responsible not only for the development of water resources and the conveyance of irrigation waters to the outlets but also for their ultimate utilisation in irrigated agriculture. For this purpose, these departments will have to provide, as I have stated earlier, services relating to land 'forming', construction and up-keep of field watercourses and field drains, periodic soil surveys of irrigated areas, determination of the crop varieties to be grown and the appropriate crop rotation to maintain permanent soil fertility. For this purpose, agronomic and soil survey services must be built into these departments. It need hardly be added that these departments must be made responsible for all irrigated agriculture, irrespective of the source of water supply whether from major or medium projects or minor irrigation schemes, tube-wells or percolation wells. This is even otherwise called for in view of the hydrologic unity of the water resources in each river basin or sub-basin.

As a part of their activities, these departments should carry out systematic investigations for the development of water resources in each river basin and sub-basin and undertake schemes for their development, as are being done at present by the State Irrigation Departments. The new departments should also conduct field research and studies on the economic use of irrigation waters consistent with maximisation of agricultural output. Research will also be undertaken to determine for each region the best crop pattern so as to make maximum use of seasonal rainfall and the available irrigation supplies from all sources. Taking due note of the work done at the regional research stations of the agriculture departments, the reorganised departments of Irrigated Agriculture will undertake research to evolve new varieties of crops best suited to the nature of irrigation supplies available and the soil characteristics of each block of irrigated area.

In addition, these departments, should set up demonstration centres and arrange field demonstrations, through their own extension services, to show to the cultivators how they can use the available irrigation supplies to maximum benefit, the proper land treatment required for each field, the right method of irrigation, when to apply irrigation water and how much. The extension services of the departments of irrigated agriculture should advise cultivators

on cropping pattern best suited to their soils and on problems of soil amelioration including application of fertilisers.

These departments will co-operate with Rural Co-operatives for the distribution to the cultivators of improved varieties of seeds and of fertilisers and for organising common services relating to improved agricultural practices. All financial resources for the development of irrigated agriculture must be placed at the disposal of these departments and not, as at present, providing them under different heads and then trying to pool them in some way.

The general policy of the departments of Irrigated Agriculture will have to be tuned to the requirements of intensive cultivation and market economy. Their annual performance will have to be judged and anticipations built on this basis. While the actual collection of land revenue should remain the responsibility of District Collectors, as at present, the work of assessment of the dues, whether now under the charge of Irrigation Departments or Revenue Authorities, should be carried out by officers of the Departments of Irrigated Agriculture who would be in intimate touch with the cultivators and the crops being grown.

### Role of Rural Co-operatives

I have already stated that irrigated agriculture must be regarded as a highly specialised industry. This industry is, however, owned, managed and run by a very large number of cultivators, with inadequate technical know-how and weak finance. Under the scheme I have outlined, the technical know-how will be provided by the extension services of the departments of Irrigated Agriculture. The financial position must also be strengthened adequately and, for this purpose, the best arrangement would appear to be Rural Co-operatives, managed and run by the cultivators themselves, with adequate technical guidance provided by the departments of Irrigated Agriculture and necessary funds provided by the State or an independent semi-government financing body.

The functions of Rural Co-operatives should mainly be : (i) to provide the working capital required by the cultivators on a low rate of interest and on a short-term basis, (ii) to advance long-term loans, particularly in the case of irrigated agriculture, for land 'forming', construction of watercourses and field drains, etc., (iii) to assist cultivators in marketing the produce, and (iv) to organise and run common services for the agriculturists. Short-term loans to cultivators should preferably be in kind, i.e., in supply of seeds and fertilisers and in the provision of services.

Rural Co-operatives must have two wings: (i) to work with the Departments of Agriculture, to cover a wide area but involving relatively small

financial outlay per acre, and (ii) to work with the departments of Irrigated Agriculture in a relatively small area but with larger investment per acre.

### Conclusion

To sum up, a radical change is called for in the organisational set-up for agricultural production. Instead of allocating resources to various ministries and departments of Government, instead of creating more and more new agencies at different levels and thus dividing responsibility

among various officers of Government and rural organisations, we must concentrate all efforts through two government organisations—one for un-irrigated farming and the other for irrigated agriculture. The State Agriculture Departments and the proposed Departments of Irrigated Agriculture must be given the requisite responsibility and authority. These two departments, with the help of associations of cultivators in the form of Rural Co-operatives, should be able to deliver the goods. In any case, this arrangement would be in a far better position to do so than the present unscientific and scattered approach.

# FIELD MANAGEMENT OF CANAL SUPPLIES—A TREMENDOUS CHALLENGE

by

Baleshwar Nath\*

## SUMMARY

*In this paper the author aims at portraying limitations of existing laws and procedures and indicates that improvement in field management of canal supplies is possible, if due attention is given to human factors, as well as field operational measures needed to develop irrigated agriculture on planned scientific lines. In this connection he presses upon the need for close study of field conditions and agronomic requirements of areas under irrigated agriculture, soil classification and soil testing preparation and distribution of Water Management Pamphlets in simple local languages, initiation of a programme for land improvement and implementation thereof, organising indigenous manufacture and distribution of ordinary irrigation equipment and giving due attention to drainage problems as are encountered in irrigated areas. Suggestion has also been made in the paper for establishment of distinct Irrigation Extension Cadres in Irrigation Departments and formation of Irrigation Co-operative Societies, possibly within the framework of Panchayati Raj Institutions.*

*The author advocates an emergent action programme comprising institutional and organisational reforms, as well as operational field measures leading to a composite plan for exploitation of water resources for increasing per acre productivity of our lands both in food and fibre. He has stressed upon the fact that while our canal systems themselves are more or less well-managed up to outlet heads, the conditions beyond the outlets pose a tremendous challenge indeed.*

## Introduction

Canal irrigation has two distinct aspects. The first is to capture water either through surface storage or diversion from a natural catchment and to distribute it through distributaries and minors; and the second is field management of the supplies delivered for use on the farms.

The first aspect is almost wholly an engineering problem of hydrology, topographic study of the area, design and construction works based primarily upon techno-economic considerations including legal, administrative and even political implications.

The second aspect involves application of the sciences and engineering, soil and plant relationship, climatology, agricultural practices, organisational set-up, water rates structure, common land laws and socio-economic trends of the communities served. These latter disciplines cannot easily be co-ordinated, and generally present problems in the operation of many an irrigation scheme. In this narration, it is attempted to deal with the question of field water management of irrigation supplies from open canals with particular reference to the alluvial plains of Northern India.

## Long Standing Problem

The problem of proper field management of canal water had been attracting attention of irrigation engineers in India for a long time. As early as 1882-83 Kennedy conducted experiments on the Bari Doab Canal in the then undivided Punjab, and came to the conclusion that losses after a whole season's experiments and collection of data which occurred in that canal in the winter season of 1882-83, were as follows:—

**“Entering canal head		
for each	2.832 cumec	(100 cusec)
Losses in the main canal	0.566 cumec	(20 cusec)
Losses in distributaries	0.170 „	(6 „ )
Losses in water courses	0.594 „	(21 „ )
Total absorption losses	1.330 cumec	(47 cusec)

Out of remaining 1.501 cumec (53 cusec) which reach the field, it was seen that 0.792 cumec (28 cusec) could actually have done all the work so that  $(53-28)=25$  out of the original 100 were wasted and lost in various ways. The efficiency of canal machine was thus then only 28 per cent.”

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\*\*Extracted from the Report of the Indian Irrigation Commission, 1901—1903, Appendix P. 60.



Improvements in outletting of water from canals have been tried both in the Punjab and Uttar Pradesh during the intervening decades. But, field management of irrigation supplies is, by and large, far from satisfactory. Observations since made on different canal systems, even in recent years, give an assessment of losses of almost the same order. In other words, there has not been any appreciable reduction in the losses, more particularly at the field level.

When pressure on land was not high and when there was no shortage of food, this low efficiency of the so-called canal machine, involving excessive and ill-application of water in the field and wastage thereof, could be suffered without much concern. Besides, commercial sense which overruled other considerations for the implementation of the various irrigation schemes led to an attitude of indifference on the part of the administrators towards this important field aspect of the irrigation practices.

### Tremendous Challenge

Situation can now no longer suffer such indifference towards field management of canal supplies. Emergent steps, therefore, seem to be called for to improve the overall efficiency of the so-called canal machine. Much work has been done on our canals themselves, up to outlet heads. Some of our canal systems are truly master pieces of Irrigation Engineering. But, beyond the outlets lies a tremendous challenge.

In India all major canals are State-owned and State-managed. In Northern States their operation is broadly governed by the rules contained in Northern India Canal and Drainage Act, 1873. This Act does not generally permit any legal control being exercised over the watercourses, when the canal water flows after its exit from the outlets. Only when some wastage of canal water is discernible can punitive action be caused under Section 34 which reads as :—

“34—*Liability when water runs to waste*—

If water supplied through watercourse is suffered to run to waste and if after enquiry by the Divisional Canal Officer, persons through whose act or neglect such water was suffered to run to waste, cannot be discovered, all the persons chargeable in respect of the water supplied through such watercourse, shall be jointly liable for the charges made in respect of water so wasted.”

Lately, however, there has been some consciousness about building, up-keep and maintenance of these watercourses. Enactments have been passed in recent years in different States for expeditious completion of watercourses on the new canal projects empowering action being taken by the State authorities. In case of failure of the cultivators in fulfilling their obligations in this respect, use of good offices of *Panchayati*

*Raj* Institutions has been envisaged. Such steps on the part of the State Authorities were indeed, overdue. A drive has been organised in some of the States to meet the pressing situation, particularly arising out of non-utilisation of irrigation potential created during plan periods. But the overall impact of the different measures envisaged in the country as a whole does not, however, appear to be significant yet.

### Human Factors

Legislative action in these matters has only a limited scope. Rules and regulations can hardly make up for lack of fore-bearance and understanding among the users of irrigation supplies. Such factors make the task of internal field distribution of canal water a difficult question indeed. A sizeable contingent of management staff has, therefore, to be maintained. A system of administration and regulation devised to control human frailties, particularly on lower levels, is to be maintained involving expenditure year after year. This could be obviated, if a scientific and rational system could be evolved, operatable by the beneficiaries themselves. But unfortunately, inequities in distribution arise out of age-old practices and social infirmities, also leading to wastage of precious canal supplies in many areas. These could be generally indicated by some examples quoted below :—

- (i) Areas, which are marginally lift require watercourse to get filled up, so that water-level rises therein and there is less lift involved. This requires longer time and great tolerance on the part of other share-holders, which is generally lacking, particularly when demand for water is keen.
- (ii) There is considerable loss in the water channel, which is apparently felt most in the fields situated at a distance from outlet heads. On area-wise distribution of time, such cultivators are at a distinct disadvantage.
- (iii) Ownership of individual holdings is sometimes spread over the cultivated areas of a village or villages. Once having started irrigation, an irrigator is inclined to get his field, far or near, irrigated before making over the outlet supplies to another irrigator. This leads to many practical difficulties.
- (iv) Even where time is apportioned between different irrigators, such apportionment is only on a superficial measure of area and a rational schedule for distribution to supplies based on water requirement of each crop is not possible.

### Irrigation Co-operative Societies

State interference is possible in mitigating mutual disputes only to a limited extent through legalised system like *Warabandi* in Punjab and

*Osrabandi* in Uttar Pradesh. But, a rational equitable self-help distribution system can be evolved by irrigators themselves. May be with greater enlightenment among the public, irrigation cooperative societies could be formed among the cultivators, who could take the responsibilities of paying water charges on a cooperative basis either quantitatively or on matured areas.

These societies could look after the maintenance of watercourses and could affect equitable distribution of water on mutual understanding between different share-holders keeping in view the crop pattern and the conditions of crops, so that it is utilised to yield the maximum advantage to the community in general as opposed to limited interest of individual cultivator only. They may make arrangements for assessment of charges and for collection of dues on honorary basis, so that their establishment cost may be low. This should not be difficult with the *Panchayati Raj* Institution now being established in the country-side, as they form the nucleus of all village activity. Irrigation being a vital subject could be attended to closely and with details by the *Panchayats*. This development, in its turn, may bring about reduction in State expenditure incurred on maintenance of revenue staff and may lighten load on water charges.

### Study of Field Conditions

Irrigated agriculture is not merely application of water to the fields on any at random basis. The questions when to take water, how much water to apply, the method of water application all have a great bearing on the efficiency of irrigation. Irrigation has to be scheduled on considerations like soil moisture and plant growth relationship, determination of optimum moisture regime in the case of different crops, optimum intervals between successive irrigation in the soil of high, medium and low moisture capacities and fertiliser moisture regime relationship. The quantity is also governed by factors like consumptive use and evaporation relationship for different stages of crop growth and evaluation of soil moisture deficits to fix optimum amount of water to be applied.

In the methods of water application, uniformity of depth of application adds considerably to irrigation efficiency. The case of drainage, check up on erosion and workability of agricultural operations are also factors needing attention. An irrigator has also to take into account many other things like slope of land, texture and intake rate of soil, discharge to be handled, length of strips in the case of border strips, length of furrows and distance between furrows and size of plots in relation to discharge of water.

### Water Management Pamphlets

All these factors require not only specific procedure being laid down for economic utilisation of canal supplies and securing equitable distribution within a service area, but also common-

sense level knowledge being imparted to the irrigators through pamphlets written in local languages in easy style so as to be intelligible to the common cultivator. In fact, irrigation authorities in each State must provide a clearing house for water management publications pertaining to field conditions. It is of utmost importance that these publications are not loaded with technicalities of the subject, but aim at providing a simple field level education to the irrigators on the subject of water use on the land.

As a practical measure it may seem advantageous to organise a short course for village extension workers in the practical phases of irrigation. While considerable attention is paid to development of improved crop varieties and increased fertiliser application, it is often overlooked that maximum return from these programmes cannot be realised, unless proper amount of water is furnished to the plant at proper time.

### Land Improvement

Along with proper field level instructions being imparted to the irrigators on field water management of irrigation supplies, it is also imperative to initiate a programme for land improvement. In fact, land improvement must necessarily precede improved water management. While credits are provided to the cultivators for seeds, equipment, fertilisers and other items, there is little aid given to them for preparing land for improved irrigation. Water is the first basic need for irrigated agriculture. If applied to uneven lands its use is not only reduced to 'naught' but sometimes results in negative benefit.

Much of ownership pattern of irrigated land in India is in small holdings. Large-scale levelling operations cannot, therefore, be economically feasible. Besides, equipment therefore may not readily be available within the country. Small land grading equipment has to be evolved for use on irrigated land. If necessary private contractors may be encouraged to take up land grading work or State authorities may organise agencies to take up land grading work in irrigators land, cost thereof being realised on instalment basis. In fact, land preparation cost can be completely repaid in decreased irrigation cost and increased production within a period of a few years. This assistance is as much useful to the irrigators as scientific knowledge about depth of water to be applied to a particular crop and frequency of application depending upon soil-climate and crop, which the Extension Services are expected to provide.

### Simple Irrigation Equipment

There is also need for introduction of simple irrigation equipment for use in the field, so that irrigation water could be applied more scientifically and economically than what has been possible so far. Wood, plastic or metal syphon, furrow

tubes and other similar devices could be very usefully employed by the irrigators. While distributing water within the field compartments even reeds and bamboo pipes could be used successfully. This is generally not done because the cultivators are ignorant about their use. What is required urgently is the introduction of locally made devices, so that this lacuna in the field of management of canal supplies is removed earlier the better.

Another pressing need of irrigated agriculture in the country is the field soil testing equipment facilities. These are required for day-to-day use so that an irrigator could find out actual quantity of water needed for his crop on a particular date. These have to be of a fool-proof type, so that they could be made use of by ordinary cultivators. For a scientific control of this type, collaboration with weather bureau may also be necessary who may provide simple tables for guidance of the irrigators, apart from weather reports generally announced on radios.

This question is different than the general soil classification of soils in irrigated and even un-irrigated areas, which also needs to be done on systematic and detailed basis so that proper crop planning suiting to nature and type of soil could be adopted in various irrigated tracts. As at present there are vast areas in the country, where detailed scientific soil classification has not been done, which fact stands in the way of properly planned scientific field management of canal supplies also, apart from agricultural crop planning.

### Drainage Problems

An important factor, which has not received due attention is the proper drainage of irrigated areas. Though hundred per cent efficiency in irrigation has not been practised for fear of salinity and water-logging, yet introduction of foreign water for irrigation purposes does pose a problem of drainage in most of the irrigated areas. The problem remains unattended primarily because it is difficult to develop a complete drainage diagnosis for irrigated areas, until after water has been used and information has been collected to determine the extent of drainage. This has apparently been the case where water-logging has assumed menacing dimensions in some of the irrigated tracts, more particularly in the Punjab.

What is needed is that drainage portion of a water development scheme should not receive secondary attention. It should be given as much importance as irrigation itself. It is a specialised study requiring development of drainage criteria and investigational tools needing good judgement, local experience along with thorough understanding of basic principles to lay down a successful drainage system. Drainage design is, therefore, an important aspect of field management of canal supplies.

In fact, as irrigation is a continuously changing process with the changing socio-economic requirements of irrigated tracts, so will vary the needs for drainage. The initial installation of drainage in some cases may prove inadequate, if there is increase in the application of foreign water to the land under operation. This is so where more intensive pattern of irrigated agriculture is sought, as is the case in many parts of the country today. A drainage system has, therefore, to be followed by continuous observation of water-table and drain discharge measurement. Any adverse effect so observed should be eliminated through suitable modifications in the field of water management of canal supplies, as well as drainage complex of the land.

### An Emergent Action Programme

The problems outlined above resolve themselves into two distinct classifications namely:

- (i) Institutional and Organisational changes; and
- (ii) Operational field measures. An emergent action programme is called for on both the fronts.

While institutional changes are the primary responsibility of the administrations and organisations responsible for overall control of irrigated agriculture, operational field measures need to be implemented through effective Extension Services. What may seem to be urgently needed is a specific Irrigation Extension Cadre in the Irrigation Departments of the States. These cadres should be staffed by qualified persons agriculturally trained and with sound knowledge of agricultural practices and field irrigation engineering. These extension services should also develop field research on cultivators' own lands to provide positive guidance to the irrigators, to make the best use of the irrigation water available and thus help in improving the productivity per acre from irrigated agriculture to its optimum level.

The institutional changes suggested involve amendment to the existing rules and regulations with regard to irrigation supplies, so as to invoke a sense of cooperative responsibility for enforcement of a water users etiquette among the users, as different from punitive rates now in vogue, which tend to increase corruption. Among other things, action may be caused :

- (i) to revise the present water rate structure so as to be rational and conducive to economy in the use of irrigation supplies;
- (ii) to devise ways and means to tone up the normal fibre of the users of irrigation supplies so as to enable them to appreciate the moral responsibility with regard to proper and economic use of water for irrigation purposes; and

- (iii) to so educate the users in the agronomic practices as to enable them to apply only the necessary quantity of water on scientific basis and to so plan the crops on an overall basis as to yield maximum benefit from supplies available.

### A Composite Plan

With a view to fall in line with the changing order of the society, it is necessary to seek collaboration of cooperative societies and other socio-economic groups for husbanding utilisation of water resources in general, and irrigation supplies in particular. It is also essential to inculcate water conservation consciousness in the minds of users all over the country and more specifically in water scarcity areas. This should dovetail into a composite plan aimed at providing a sound socio-economic basis for co-ordinating irrigation, agriculture, transport and marketing aspects into a well-knit management of irrigated agriculture wherever water resources permit of being exploited for increasing productivity from our lands, both in respect of food and fibre.

As outlined above, the question of water distribution and its use on the land involves a large number of variables and is fairly complex. We have, therefore, to recognise the great variety of problems faced and their apparent unlikelihood that they will be the same in any two cases. We may, however, have a diagnosis appropriate to each, and prescribe remedies only in relation to the causes diagnosed. Nevertheless, there are some fundamental common threads, which when spun together may form anchor of concord and semblance, providing an anchorage to many

a drifting idea applied to the growth and development of irrigated agriculture. In short, our efforts have to be mobilised on all fronts, so that they may bring about a co-ordinated improvement in our irrigation practices resulting in better field water management in irrigated agriculture, and consequent increased production per acre from our land and water resources.

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# MANAGEMENT OF IRRIGATION WATERS IN MAHARASHTRA

by

N. V. Khursale\* and P. R. Gandhi\*\*

## Introduction

### History of Irrigation

Agricultural operations in Maharashtra State are, to a large extent, dependent on the rainfall which is uncertain and undependable; the irrigated area is a very small percentage. Tanks and canals provide irrigation for valuable crops such as sugar-cane, plantains, fruit gardens, etc., and also provide an assured source of supply to seasonal food and fodder crops when the rainfall is deficient or irregular. The old irrigation works consist chiefly of a few small canals and medium sized tanks and a number of minor tanks and *bandharas*, besides protective major works like Bhatgar, *Bhandardara* and *Darna*. The tanks are mostly formed by earthen *bunds*, the larger ones irrigating areas about 485.62 to 607.03 ha. (1,200 to 1,500 acres), and the smaller ones up to 202.34 ha. (500 acres). The chief crops irrigated are paddy, wheat and *Jowar*. The *bandharas* are masonry weirs built across rivers or streams to head up the water to a level sufficient to irrigate lands on the banks of the streams by means of channels taking off from the flanks of the *bandharas*. The areas irrigated are up to 323.75 ha. (800 acres) and the chief crops are sugar-cane, wheat, *bajri* and gram. After the undertaking of Five-Year Plans, this State has constructed and is constructing medium and major irrigation projects which can irrigate thousands of acres of lands along with minor irrigation schemes.

The irrigation works in the Deccan are fundamentally different from those in Sind, the Punjab and Uttar Pradesh, where wide alluvial plains have been formed by great deltaic rivers in perennial flow. The Bombay Deccan consists of a sloping table-land running Eastward from the ridge of the Western *Ghats*. These form a ridge running parallel to the sea-coast at a distance of 80.47 to 160.93 km. (50 to 100 miles), precipitous on the Western side, they fall away more gradually to the East. The heaviest rainfall occurs on the peak of the ridge, where anything up to an average 6.86 m. of rain is recorded in the four monsoon months. The intensity of the rainfall rapidly decreases as we go Eastward from the highest ridge reaching a figure of 50.80 to 63.50 cm. (20 to 25 in.) at a distance of 160.93 to 241.40 km. (100 to 150 miles) East of the *Ghats*. The rivers in the Deccan rise in the valleys close to the ridge,

flow in an Eastward direction and are dry or practically so for 7 or 8 months of the year. The line of the *Ghats*, like the ridge of a roof, divides the flow into two parts; one, the small portion falling Westward into the Indian Ocean, and the other flowing through long lengths of tortuous rivers to the East, which reach the sea on the South-Eastern coast of the Peninsula. These rivers are in flow during the monsoon months only, and if no artificial means of conserving their waters were provided, the whole monsoon rainfall would be wasted and would simply flow away to the sea benefiting but to a small extent the country traversed.

The large irrigation systems in the Deccan are all of the same type. Each depends upon a storage reservoir situated in the higher reaches of the river valleys, where the rainfall is heavy and sufficient water can be impounded during the monsoon to supply water throughout the year to the country on either side of the river valleys below. The water stored during the rains is let out mainly during the dry months of the year in accordance with the requirements of crops. Somewhere down the river which may be as far as 80.47 km. (50 miles) from the main storage lake, a 'pick-up-weir' is usually constructed across the river-course to divert the water into canals which take off on either side of the weir. The river slopes are about 1:1000 or so and consequently the canals are able to diverge from the river itself on each side of the valley. Canals are generally contour canals and as such they irrigate only the land between the canal and the river.

### Irrigation Practices

Up to the recent past the usual practice of irrigating lands in this State was by flow irrigation. Old irrigation systems, medium as well as minor, fall under this category. The work of construction of the storages as well as the pick-up weir and the canals is done by the Government at the cost of the Government. The distribution system such as distributaries, minors and the outlets up to the capacity of 0.042 cumec ( $1\frac{1}{2}$  cusec) is done by the Government at the Government cost. The watercourses and field-channels with capacity of less than 0.042 cumec ( $1\frac{1}{2}$  cusec) are done by the beneficiaries themselves

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Due to the old established irrigation systems as well as the new taken up in the successive Five-Year Plans the people have started realising and appreciating the benefits of the irrigation facilities provided, which increase their crop yields and better their prospects. This resulted in increasing demands for irrigation waters not only from the Flow Irrigation Systems but also from the Lift Irrigation by utilising water from the rivers, *nallas*, streams coming under the command of the irrigation systems. The sizeable Lift Irrigation Scheme is of Radhanagari Dam wherein a storage has been constructed at Radhanagari across the River Bhogawati and 10 weirs are constructed in a length of 144.84 km. (90 miles) downstream covering both Rivers Bhogawati and Panchaganga. Five Kolhapur type weirs are constructed across Bhogawati and five more are constructed across Panchaganga River till the confluence point of the Panchaganga and Krishna Rivers. These weirs are used for maintaining the water-level and making the water available for the Lift Irrigation practised on both the banks of these rivers. The advantage of the flat slope of Bhogawati and Panchaganga Rivers is taken in making the irrigation facilities available to all the lands right from Radhanagari Dam up to the last weir across the Panchaganga River. This peculiar position prevails in the Kolhapur District of this State.

Wherever Government has incurred any expenditure either for the construction of a big storage or even for construction of *Bandhara*, such rivers, *nallas*, etc., are notified by the Government. If beneficiaries intend to take benefits out of the water available either due to storage or due to regeneration below the weirs and dams they have to seek permission of this Department for lifting water. Government charges suitable rates for lifting the waters of the notified *nallas*, rivers and streams according to the crops irrigated by the irrigators and lift involved.

#### *Long-term Sanctions and Blocks*

The original system of irrigation on the Deccan canals was that sanctions were given on annual or seasonal basis. This system, in addition to increasing the administrative work, did not lead to orderly and systematic irrigation and the irrigation engineers in those days were faced with the problem of bringing the irrigation on more systematic lines. The 'Phad System of Irrigation' which was in vogue on *Bandharas* in the Nasik and Khandesh Districts caught the attention of late Shri M. Visveshwaraya, who was then the Executive Engineer of Poona District. The main idea of the system as contemplated for the major canals was to allocate to each village one or more blocks in selected land in which perennial irrigation would be allowed to the extent of one-third of the block in such a way that each holder of land of the village would be entitled to cultivate a part of the block under sugar-cane. It was, however, later realised that

it was not possible to achieve the exchange of land that would be necessary to make this block system a success. A system was, therefore, evolved whereby cane areas were standardised by demarcation but they remained scattered widely over large areas wherever there was demand. These sanctions for cane areas are for a period of six years at a time. Period for fruit-blocks is however twelve years.

The distribution of water became much more economical and the cultivators having an assurance of water for a period of years found it worthwhile to carry out improvements to their lands. The supply of water by measurement, as was originally contemplated, could not be achieved owing to the scattered sugar-cane areas. But the task of measuring crop areas every season was made simpler. As applications were sanctioned at one time for a number of years the trouble to the cultivator of applying for water every season and uncertainty of sanctions every year was also eliminated and irrigation got established compared with earlier conditions. These long-term sanctions are practised only on old established irrigation systems in Western Maharashtra. Whenever surplus quantities of water are available in a particular year, separate sanctions (seasonal) are given on seasonal basis. In Vidarbha region instead of blocks long-term agreements of 10 years duration are prevalent. In Marathwada, Irrigation Ayakat is fixed for the old tanks and water supplied.

Following are the blocks prevalent on various irrigation systems in this State.

(a) *Cane Block*—This is normally a six years sanction in selected land. One-third of the land is allowed to be put under sugar-cane and the remaining two-thirds under seasonals for eight months from 15 June to 14 February, each year. In addition, an overlap between the old cane and the new cane is allowed. These blocks are generally confined to land where the depth of soil is atleast 45.72 cm. (18 in.). Arcas within 0.40 km. ( $\frac{1}{4}$  mile) limits of villages are excluded from the point of view of public health.

(b) *Two Seasonal Blocks*—These are six-year sanctions for areas in which the block holder is entitled for water in monsoon and *Rabi* seasons only.

(c) *Fruit Blocks*—These are 12-year sanctions for long-term fruit trees. Normally they have to be renewed at the end of 12 years because the crops are standing in the ground.

(d) *Garden Blocks*—These are 6-year sanctions for perennial irrigation in which light perennial crops such as lucerne grass, vegetables, papayas, etc., are allowed.

(e) *Garden and Seasonal Blocks*—In this block half the area is grown under a light perennial crop and in the other half light seasonals for 8 months from 15-6 to 14-2 of the following year are allowed to be grown.

(f) *New Type of T. S. Blocks.*—In this block, 30 per cent area is to be put under monsoon crops while 50 per cent is to be put under *Rabi* crops. In respect of irrigators with holdings less than 1.214 ha. (3 acres), they are allowed to grow the full area in *Kharif* and/or *Rabi* seasons. These blocks were introduced on certain canals in 1955-56.

Recently this State had appointed an Irrigation Commission to give their opinion on the irrigation problems existing in the State as well as for deciding the future policy regarding irrigation practices in this State. This Commission has recommended the following types of blocks :

(1) Cane Block 'A' Type	Acres
(i) Basic cane or plantains . . . . .	1
(ii) Overlap Cane . . . . .	½
(iii) Long staple cotton . . . . .	1
(iv) Any crop (excepting long staple cotton or perennial crops in <i>Kharif</i> or <i>Rabi</i> seasons) . . . . .	1½
	4
(2) Cane Block 'B' Type } As per the existing	
(3) Fruit Block } blocks described	
(4) Garden Block } above	
(5) Two seasonal Block, 'A' Type having one-third cotton and two-thirds any other non-perennials.	
(6) Two seasonal Block, 'B' Type having any non-perennials except cotton.	
(7) Optional <i>Rabi</i> Blocks.	

The recommendations of the Maharashtra State Irrigation Commission are under consideration of the Government. Government also proposes to introduce a new block comprising one-third part of *Kharif*, one-third *Rabi* and one-third hot-weather which include cash crops like cotton, groundnut and onions in lieu of 5 above.

*Restrictions on Perennials*

It is the general experience that wherever irrigation is established for a number of years and where perennial irrigation is practised on a large scale the soils in the irrigation command get either water-logged or salt-affected. In order to control this, this State restricts the sanctions of perennial crops on irrigation schemes. A limit for every catchment or sub-catchment under the command of every irrigation scheme is fixed which is known as 'X' limit. The fixation of 'X' limit consists of dividing the command into small catchments

and sub-catchments and then fixing the maximum limit for sanction of sugar-cane in that catchment or sub-catchment. Fixation of 'X' limit is governed by the soil-depth in the catchment or sub-catchment, drainability of the soil in the catchment and sub-catchment and the existing water-table. The area of a particular catchment or sub-catchment is divided into 3 categories and 'X' limit is fixed as shown below :

	"X" Limit fixed
(1) Area with the soil cover of less than 45.72 cm. (18 in.)	Nil
(2) Area with the soil cover of more than 45.72 cm. (18 in.) but less than 20.32 cm. (8 in.)	1/6 to 1/10 of the area.
(3) Area with soil cover of more than 20.32 cm. (8 in.)	1/15 to 1/20 of the area.

Due to the restriction on the perennials in the established irrigation systems in Western Maharashtra there are not very bad effects of the perennial irrigation practised in this State, setting aside a few patches of the lands wherein these defects are noticed. These defects are rectified by this State by undertaking a number of drainage schemes where the effects of water-logging are very prevalent.

In order to distribute the benefits of perennial irrigation to as large a number of irrigators as possible, the maximum limit of sugar-cane is 2.43 ha. (6 acres). In the case of irrigators who had already become the members of the Cooperative Sugar Factories well before 1954 they have got the added advantage to have a maximum perennial sanction of sugar-cane of 10.12 ha. (25 acres). However, whenever new sugar-cane sanctions are to be distributed on the existing canal systems generally the maximum acreage of the sugar-cane is restricted to 0.81 ha. (2 acres) of basic sugar-cane, i.e., 2.43 ha. (6 acres) of sugar-cane block.

**Role played by Irrigation and Power Department**

Creation of irrigation potential and its further utilisation are the two basic needs for increasing the food production and prosperity of the nation. Co-ordination of various departments for the speedy utilisation of the irrigation potential is, therefore, necessary. Responsibility of the creation of the irrigation potential up to the head of outlet of the distributary or minor, fairly and squarely rests on the Irrigation and Power Department alone.

In the creation of irrigation potential construction of storage is essential. Whenever canals do not take off directly from the dam, construction of pick-up weir somewhere downstream is obligatory. Along with the construction of head-works and pick-up weir distribution system is

necessary. After gathering experience on the various irrigation projects taken up after the advent of the First Five-Year Plan this Department generally starts the headworks and the construction work on the canal system simultaneously. This reduces the time-lag in the utilisation of the irrigation potential. Execution of the construction work either on the headwork or of the canal or of the distributary systems right from its reconnaissance survey up to the actual construction work is done by the Irrigation Department. All the distributaries, minors and watercourses having capacity of more than 0.042 cumec ( $1\frac{1}{2}$  cusec) is generally done by Government at its own cost.

In the case of major projects irrigating areas in thousands of acres it is not possible to have all the length of the canal together with its distribution system and headworks completed simultaneously in short time. In the case of such big storages generally benefit of irrigation facilities starts right from the year when the work on the gorge portion of the dam is started. In order to exploit the advantage of the created irrigation potential facilities it is essential not only to start the work on the canal system and distribution system together with the headwork but it is necessary to chalk out the programme in such a manner that the canal in the first 8.05, 16.10, 24.14 km. (5, 10, 15 miles) is completed in all respects inclusive of the distributaries, minor outlets and the watercourses. At present the construction of the watercourses is not done by this Department and the beneficiaries are required to construct the field channels and watercourses carrying less than 0.042 cumec ( $1\frac{1}{2}$  cusec) discharge and of length of 0.80 to 1.61 km. ( $\frac{1}{2}$  to 1 mile).

As the beneficiaries in the irrigation command may not have adequate technical knowledge for aligning the field channels leading water to their fields this department extends technical help in the form of preparing the blue-prints showing alignments of the watercourses in the villages. A copy of such blue-prints is exhibited at prominent place like the village Chawadi from which the irrigators can know the alignment of the watercourses and take up the work of its execution by themselves. Even at the time of actual execution necessary technical help in giving the actual levels on the fields is also extended by this Department.

It is the experience of this Department in the State that for full development of the irrigation potential it takes a number of years say from 10 to 20. In order to give incentive to the irrigators to effect speedy utilisation of the created irrigation potential so as to have some return on the project this Department grants concessions for the first three years on every project. For food and fodder crops no water rates are being charged for first year, for second year one-third, for third year two-thirds rates and for fourth

year full rates are charged. For cash crops half the rates are charged in the first year and for the next year full rates are being charged. During the three years when concessional rates are charged no irrigation cess is levied on the irrigation charges.

Cropping pattern for any irrigation project is first decided in consultation with the Agriculture Department. If however at the time of actual utilisation of irrigation potential it is noticed that cropping pattern needs some change according to the actual circumstances prevailing in the command, this Department takes necessary steps in consultation with the Agriculture Department to change the crop pattern according to the needs of the irrigators and the climatic and soil conditions prevailing in the tract.

In order to help the irrigators to have sufficient manure for crops this Department supplies free water during the monsoon season to green manure crops provided crop is ploughed in. During the hot weather season only a nominal rate of Rs. 4 .94/ha. (Rs. 2 per acre) is being charged.

One of the reasons observed for non-utilisation of irrigation potential was the apathy of the irrigators to excavate the watercourses. In order to overcome this difficulty this Department is considering enacting of legislation for making it compulsory on the beneficiaries to construct the watercourses.

It is observed that utilisation of irrigation potential is not a problem on the old established irrigation systems. Non-utilisation of irrigation potential is observed in the case of new irrigation systems taken up for execution from the First Five-Year Plan. Non-utilisation is particularly noticeable in the case of *Kharif* seasonals. It is the general tendency of the irrigators to wait for the rains in the case of seasonal crops and when they fail, then to rush to Irrigation Department for supply of water for *Kharif* seasonals. This is the main reason why there is no sufficient demand of *Kharif* seasonals. In order to give an incentive to the irrigators to utilise irrigation potential during *Kharif* season it has been decided to allow the following concessions in the water rates on all the irrigation systems in the State :

*Kharif* crops other than cotton and groundnut in Western Maharashtra, Marathwada and districts of Buldhana, Akola, Amravati, Yeotmal and Wardha in Vidarbha.

*Rabi* crops other than cotton and groundnut in the districts of Chanda, Bhandara and Nagpur in Vidharbha Region.

Only one-third of the normal rates to be charged.

Concessions to *Rabi* crops are given in order to encourage a second paddy crop in the paddy growing districts of the State having irrigation works.



### Role played by C. & R.D.D.

The responsibility of the utilisation of irrigation potential beyond the outlet head is required to be shared by the C.&R.D.D. and Agriculture and Food Departments. At present the executive bodies at the district level under the C.&R.D.D. are the *Zilla Parishads*. These *Parishads* get all the work required to be done at the district level through various offices working under them. From the experience of the last 15 years it was seen that the irrigators do not come forward of their own accord for excavating the watercourses despite the technical help and the guidance extended to them by the Irrigation Department. In order to overcome this difficulty and to make the irrigators to take up excavation of the watercourses for leading water to their fields, it has been decided that the work of watercourses should be got executed from the beneficiaries through the officers under the C.&R.D.D. situated at the district level. This work is got done at present through the B.D.Os. All technical help such as supply of alignment maps showing therein the alignment of watercourses and the command of the irrigation channel is given to the B.D.Os. by the officers of the Irrigation and Power Departments. With the help of these maps the B.D.Os. through their subordinate officers get the work of the watercourses executed. At times the difficulties like not allowing to cross the irrigation channel by the irrigators in the upper reaches are required to be solved by the *Mamlatdars* of the *Talukas* concerned. In order to overcome this difficulty quickly the *Mamlatdars* at present are vested with the powers under Sections 66(a) and 66(b) of the Tenancy Act so as to make the land immediately available for the construction of watercourses, to extend the benefits of irrigation to the irrigators in the lower reaches.

After the declaration of the emergency the work of construction of watercourses, which are the important arteries of the utilisation of the irrigation potential, has been taken up on a local campaign basis. The target length of the construction of watercourses during the year 1963 was of 2340 km. against which the State has made progress to construct watercourses of 1440 km. during the year 1963. If concerted efforts are made at the level of the B.D.Os. and other staff to achieve the targets it is likely that during a couple of years to come, better progress on the construction of watercourses can be achieved and construction of watercourses will not remain the root cause for non-utilisation of the irrigation potential.

Even though a number of irrigation schemes have been constructed the irrigators in the irrigation tract do not come forward to take up to seasonal irrigation as they are not irrigation minded and they do not appreciate the increase in their produce by utilising the irrigation potential. In order to make the irrigators irrigation minded it is essential to educate them through

the Agriculture Department either by showing films wherein increase in produce is shown or by actual demonstration on their fields. Of course the existing demonstration farms would help to some extent but propaganda on a large scale at the village level is necessary.

The main difficulty of the irrigators for not taking up to irrigated agriculture is shortage of finance. For irrigation the field is required to be levelled and bunded. Generally the poor farmers do not have sufficient money either to level or bund their fields. It is, therefore, essential to make the credit facilities available for the purposes of levelling and bunding of their fields. The Maharashtra State Irrigation Commission has recommended that the Cooperative Credit Societies should provide adequate credit facilities for the purposes of levelling and bunding of their fields to the irrigators.

The next problem of the irrigators after taking to irrigation is making storage and marketing facilities available to them as the goods produced by them are required to be stored till they fetch good market rates in the market. It is also necessary to have marketing facilities in easy reach of the irrigators. The Maharashtra State Irrigation Commission has recommended that marketing facilities and construction of warehouses should be undertaken by the Government. C.&R.D.D. will be looking after these facilities.

### Role of Agriculture Department

Agriculture Department is in fact an important department which has to deal with speedy utilisation of the irrigation potential created as Irrigation Department creates potential and makes it available at the head of the outlet whereas physical utilisation of the same has to be done through the Agriculture Department. Before actual application of water to the new lands to be brought under irrigation the following things are basically required to be done: (i) Levelling of land and (ii) Bunding of the land to be irrigated. Many a time it happens that the financial position of the irrigators is not sound so as to take up the work of levelling and bunding and it is, therefore, necessary to make available the financial assistance either from Cooperative Societies or if the latter is not possible, the work of levelling and bunding of the land is required to be done departmentally by the Agriculture Department with the help of the machinery at its disposal such as tractors and bull-dozers, etc.

It is the practice with the Irrigation Department to inform the local officers of the Agriculture Department about a year in advance of the land for which the water is going to be made available for the first time from the irrigation schemes undertaken by the Irrigation Department. It is thus possible for the Agriculture Department to plan in advance for the work of levelling and bunding of the lands to be commanded by the irrigation projects.

At the time of formulation of the various irrigation schemes the crop pattern provided in the projects is finalised in consultation with the Agriculture Department. Moreover at the time of intimating the local officers of the Agriculture Department regarding the availability of water for the first time from the irrigation schemes, crop pattern provided in the scheme and crops to be sanctioned immediately, are also informed. It will be thus possible for the Agriculture Department to make the necessary arrangements to persuade the irrigators to take up the crops provided in the project. Generally, crops which can be grown in the particular soil climatic complex are provided in the irrigation scheme supplying water to the particular area. If after trying a number of years for the crops provided in the crop pattern it is observed by the Agriculture Department that the crops provided in the crop pattern of a particular irrigation scheme are not finding favour with the irrigators as well as might not be given sufficient income to the irrigators or if the particular soil climatic complex is not suitable to the crops provided in the crop pattern, the Agriculture Department shall consider suitable changes in the crop pattern and make necessary recommendations for other crops which will be suitable in the particular soil climatic complex and rainfall conditions. On the recommendations of the Agriculture Department the Irrigation and Power Department should take suitable steps for modifying the crop pattern as well as the total irrigation potential of the project depending upon the quantity of the water required to meet the modified crop pattern.

After the work of levelling and bunding of the lands the further necessity is regarding timely supply of pure seeds. Agriculture Department is already having centres for the manufacture of foundation seeds. These foundation seeds are required to be multiplied further by the registered seed growers and are to be further distributed among the irrigators so as to make them available to the beneficiaries quite in time. It is, therefore, necessary to have proper arrangement for the multiplication of the seeds and distribution of good seeds. It is also necessary for the Agriculture Department to make propaganda and convince the irrigators of the genuineness of the seeds that will be distributed to them by the Agriculture Department. This will help in accelerating the utilisation of the irrigation potential.

The basic necessity for increasing the utilisation is the application of the proper type of manure at the proper time to the crops. Generally, the manures are supplied to the irrigators by the Agriculture Department after testing them. Agriculture Department is required to make proper arrangements for the storages of quality manures and their proper distribution among the beneficiaries.

Next problem that is required to be dealt with by the Agriculture Department is regarding pest control. It has been experienced that in

most parts of the irrigation command there is trouble on account of pests which ultimately affects the yield of the crops. It is, therefore, necessary to find some effective remedy for the pest control.

A useful medium for making the propaganda for taking to the crops provided in the crop pattern is the T.C.D. Farms. These farms are in-charge of the Agriculture Department wherein the Agriculture Department takes suitable trials before making propaganda of the particular crop regarding its suitability. Its demonstration can be made even on the fields of some of the irrigators in the command of the irrigation works.

#### Co-ordinating Department and Co-operation of Different Departments

The important subject of agriculture is basically dealt with by the Agriculture Department and as such it is proper for that department to play the first fiddle and bear burden of the important problem of increasing the food production in the State. The Irrigation Department and the C.&R.D.D. are complementary departments and as such will play the second fiddle. The Irrigation Department creates irrigation potential whereas C.&R.D.D. makes necessary arrangements for the utilisation of the irrigation potential through construction of watercourses through the agency of *Zilla Parishads* as well as makes arrangements for making finance available to the irrigators through the Cooperative Credit Societies, and land mortgage banks. Thus the Agriculture Department should be the right department for co-ordinating the activities of all the departments for increasing the food production and utilisation of the irrigation potential created by the Irrigation Department through the various irrigation schemes undertaken by it.

Irrigation Department has appointed Regional Committees for making suggestions to the Department for the speedy utilisation of the irrigation potential. These regional committees consist of representatives of the various departments at the district level as well as the non-official members either from the leading persons from the irrigation command or members of the Legislative Assembly and Legislative Council.

After the declaration of the emergency, Agriculture Department has appointed one Agricultural Production Committee at the State level, members of which are Secretaries of various departments and Chairman is the Chief Secretary. This committee makes necessary recommendations for the utilisation of the irrigation potential. The recommendations made by the Agricultural Production Committee are considered by the High Level Committee headed by the Chief Minister, members of which are ministers of various departments. After the approval of the recommendations of the Agricultural Production Committee by the High Level Committee

the action on the various recommendations is speedily taken by all the departments of this State. Some of the recommendations of the Agricultural Production Committee have helped in speedy utilisation of the irrigation potential and difficulties of the irrigators have been overcome to a large extent.

The problem of non-utilisation of irrigation potential on the Ghod and Gangapur Projects was more pronounced. It, therefore, led Government to appoint a Study Group for these two projects on the lines of the one appointed for the Musi Project in the Andhra Pradesh. This Study Group has made various recommendations for these two projects right from the changes in the crop pattern to the reduction in water rates wherever necessary. One of the important recommendations of this Study Group is the appointment of an Agricultural Irrigation Unit for every block of 4046·86 to 6070·29 ha. (10,000 to 15,000 acres) of irrigation. Staff of this unit consists of one Agricultural Assistant for each 1000 to 1500 acres. The unit is headed by one Agricultural Extension Officer. These units are to work on these projects for a period of three years; thereafter these units will be discontinued or sent to other Projects. The question of appointing such Study Groups on other projects where the problem of non-utilisation of the irrigation potential is pronounced is under consideration of the Government. After implementation of the recommendations of this Study Group it is expected that the figure of the percentage utilisation of irrigation potential will improve.

This State is making every attempt for the speedy utilisation of the irrigation potential. Recently a post of an Additional Director of Agriculture has been created in the Agriculture Department, who has to look after the problem of the utilisation of the irrigation potential on Gangapur and Ghod Projects in particular and other projects in general.

### Realistic Forecast and Appraisal of the Utilisation

The created irrigation potential is defined as that acreage for which the quantity of water is available in the storage and for which complete distribution system is ready. Targets for the creation of the irrigation potential for various years are fixed. Targets for their further utilisation are also fixed. The irrigation potential which is created up to June of a particular year is considered for its utilisation during the next year (i.e., up to next June). The Irrigation Department keeps proper watch on the creation of the irrigation potential as per the target as well as its further utilisation according to the targets fixed.

In the case of old irrigation projects it has been observed that even though the project provides for large acreage to be brought under

irrigation, actual irrigation done by these irrigation projects falls short of the figure provided in the project even though the full storage is consumed. This may be due to :—

- (i) The run-off being overestimated.
- (ii) The Duties being overestimated.
- (iii) The crop pattern being unrealistic.

There are further changes in the crop pattern and against the small provision of the perennial crops actual sanctions to the perennial crops are more. It is, therefore, necessary that after the irrigation on a project is established say after about a period of 10 years it is necessary to recast the crop pattern according to the crops sanctioned and developed on a particular irrigation scheme, according to the observed actual run-off and duties of irrigation. This will enable to give a correct comparison of the total potential created and its further utilisation.

As various crops are done on every irrigation scheme and the consumption of water for different crops varies, it will not be perhaps proper to compare the utilisation of the irrigation potential in terms of acreage. In fact once the full storage water is consumed in every year it should be treated that there is full utilisation of the irrigation potential whatever may be the acreage irrigated. The yield of the catchment at the site of the storage is generally more than the capacity of the dam. Thus, during monsoon season more quantity of water is available over and above the stored quantity proposed to be utilised during the fair seasons of *Rabi* and hot-weather. Realistic forecast of utilisation is actually required to be based on the total quantity of water available at the site of the storage, which can be utilised during monsoon considering the capacity of the canals and a realistic crop pattern. It should be seen whether this total quantity of water which will be more than the stored capacity of the storage can be actually utilised for the purposes of irrigation every year.

### Mode of Assessment ✓

Assessment of water rates is preferred thrice in an irrigation year, as detailed below :

- (i) 15th September : All perennial crops in blocks or on annual sanction, all hot-weather seasonals and all seasonals to which water supply is sanctioned for part of the season.
- (ii) 15th January : All seasonal and two seasonal crops of *Kharif* season, in or outside blocks and all two seasonal blocks.
- (iii) 15th April : All *Rabi* seasonals and two seasonals or the preceding *Kharif* season, extending partly or fully into the *Rabi* season.

Statements of demand for water rates are prepared by villages under a canal, on each of the above three occasions. Each irrigator's name with his sanctioned irrigation, water rate and

water rate assesment, also unauthorised irrigation and its water rates, are shown in these statements. These are sent to the Collector of the District by the Executive Engineer, for realisation. If the payment of water rates is not made at the end of the revenue year concerned, an irrigator is treated as a defaulter and his water supply for a new crop is stopped until he produces a 'No-arrears certificate'. If he continues to be in arrears, his sanction in block is discontinued from 15 February following.

### Rotation System

#### *Types of Outlets*

The most common type of outlets practised for the head regulators of the distributaries and minors on the canal systems in this State is rectangular steel gate type operated by screw. The discharge through these outlets is controlled by controlling their opening according to the demands on the distributary. For measuring discharges passing through the outlet generally a Standing Wave Flume is constructed just below the off-take point of the distributary. Canals are generally run full and the irrigation is started from the tail end of the canal, opening the tail outlet first. System of rush irrigation is generally practised in Deccan which curtails the losses in the distribution system as well as in the canals. In this system the distributaries and the minors are also run full.

#### Rotation Period

Rotation period can be defined as an interval at which canal water is supplied to the crops. This varies according to the types of crops irrigated on a particular irrigation scheme. Various types of crops are grown on irrigation schemes. Lighter crops are supplied water in alternate or third rotations. The heavy perennial crop in the Deccan is sugar-cane for which water is supplied at a rotation period of 12 to 14 days, minimum being practised in the hot weather season and the latter in the *Rabi* season. Of this period the canals run for 8 to 10 days and they are closed for 4 days. Maximum three waterings are given to the *Rabi* crops irrigated in this State, advantage being taken of late showers generally received in the months of September or October, in the Deccan.

Under the Bombay Canal Rules 1934 in force in the Western Maharashtra, the Executive Engineer is authorised to fix the order in which water is to be supplied on the canals in his charge. The programme of rotations is prepared and submitted to the Superintending Engineer at the beginning of each season and copies thereof are supplied to the Joint Stock Sugar Factories, Cooperative Sugar Factories, so that they could get an idea of the rotation period. Copies of such notices are pasted on the notice boards of sub-divisional and sectional offices. The irrigators could get the idea of the rotation period from these notices. Changes are made in such

periods due to any reason normally beyond control or favourable weather and rainfall conditions in the interests of the irrigation on canal system as a whole without loss of time.

The period of rotations is fixed in such a way as to give the just adequate dose to give a good yield of the crop. The period of rotation varies directly with the acreage; if it is reduced, acreage that can be irrigated should also reduce. These days there is a general demand for reduction in the period of rotation particularly in the case of heavy perennial crops like sugar-cane.

#### Dating of the Passes

Passes are issued for each sanction. On these passes the date on which an irrigator will be given canal water to his sanctioned crop or crops are noted by the canal inspector or *patkari*. Generally, such dating of the passes is done at least one day in advance of the actual water supply. Generally, the *patkari* or the canal inspector of the beat goes at a particular spot previously decided for dating the passes. Then it is the responsibility of the irrigator to see that his pass-book is dated by the canal inspector or *patkari* for getting the water on the said dates in every rotation.

*Pali Patrak* is prepared before the start of irrigation season. This is the list of areas arranged serially to receive water in each rotation, in strict sequence. As the irrigation starts from tail end of channel, last area in last survey number of tail outlet should be taken first, upper survey number next and so on so as to reach the head of the tail outlet. Then second outlet from tail should be taken and areas noted in *pali patrak* along with all other details. In this way, outlet No. 1 of a channel should come last. After completing sequence of the outlet No. 1, *Pali Patrak* of a channel is completed. Subsequent additions or deletion of areas should be effected by inserting or removing the details of areas to befit in the sequence from the *pali patrak*, respectively. Canal inspector can make out at a glance the area to which water is due on a particular day and thus he can date the passes of each outlet very conveniently. Further, it can be verified whether certain area is irrigated on the scheduled date but out of sequence and action taken suitably.

#### Penal Action against Unauthorised Irrigation

When irrigators use water without permission or out of turn or waste it, *Panchanama* is held for such offence and the Executive Engineer is empowered to charge penal rates at his discretion up to 3 times of the normal rate for each watering. The field staff inspect irrigation from time to time and book offences of such a nature. During every season, the Executive Engineer, the sub-divisional officer and the sectional officer have to exercise a suitable percentage check on the *Panchanamas* of unauthorised irrigation.

# MANAGEMENT OF IRRIGATION WATERS IN GUJARAT STATE WITH PARTICULAR EMPHASIS ON AIMING AT INCREASED UTILIZATION

by

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## Introduction

Soil, water, manure and seeds, these four elements rank foremost among the primary requirements of an enterprising agriculturist. Soil comes to him as a gift from nature. He owns the land if he is fortunately affluent or gets the tilling rights as a tenant. From the experience gained in years, he knows the characteristics of the soil and methods to revitalise it, by judicious use of manures, if it starts losing quality. He preserves some selected seeds from a previous harvest for sowing. Only when it comes to fetching water for the consumption of the process, he faces the prospect of uncertainty and inadequacy. He desires that he had a constant and dependable source of water supply, such as an irrigation canal.

In the absence of a canal, he invariably lays dependence on the favours of nature by rains and supplementary sources like a well, if he is fortunate to have one. The capricious nature of monsoon allows him to reap a good harvest only sporadically. Therefore, every one of the millions of agriculturists in the country would naturally aspire to have irrigation facilities. A steady progress is being made in the nation's efforts to provide these facilities.

## Irrigation Development in Gujarat

Before the advent of the era of planning for steady economic development, in which construction of irrigation works received high priority, the area that had irrigation facilities in Gujarat State was hardly of any significance. Nevertheless, even with large-scale development of irrigation works, a major portion of the requirement of water for agricultural purposes in Gujarat State is catered to by wells.

In Gujarat State, prior to the First Five-Year Plan, an area of only 51,395 ha. (1.27 lakh acres) was having facilities of irrigation. During the First Five-Year Plan, an additional area of 76,890 ha. (1.90 lakh acres) was provided with irrigation facilities, thus bringing the total irrigation potential to 1,49,734 ha. (3.17 lakh acres). Against this irrigation potential, an area of 80,937 ha. (2.00 lakh acres) was actually

irrigated by the end of the First Five-Year Plan. Efforts to bring in larger areas under irrigation continued in the Second Five-Year Plan also during which an additional irrigation potential of 2,70,614 ha. (6.86 lakh acres) was created. This increased the total irrigation potential to 4,04,900 ha. (10.03 lakh acres) at the end of the Second Five-Year Plan, out of which an area of 1,78,062 ha. (4.40 lakh acres) was actually irrigated.

Continued efforts to provide more irrigation facilities in the State have resulted in an increase of 67,583 ha. (1.67 lakh acres) in the irrigation potential during the first two years of the Third Five-Year Plan. This has brought the total irrigation potential to 4,73,482 ha. (11.70 lakh acres) at the end of the year 1962-63, out of which an area of 2,15,293 ha. (5.32 lakh acres) was actually irrigated. It is anticipated that at the end of the Third Five-Year Plan, the total irrigation potential in Gujarat State will be 8,49,840 ha. (21 lakh acres) and an area of 4,11,565 ha. (10.17 lakh acres) will be actually irrigated.

## Time-lag in Utilisation of Irrigation Facilities

Any discussion on management of irrigation waters cannot be made independently of a detailed review of the utilisation of irrigation waters. The two aspects are so closely inter-related that the utilisation of canal waters itself will be an index of the system of management, or forms the basis for establishing any pattern for management of irrigation waters. In fact, a very efficiently managed irrigation system, where every drop of water is scrupulously conserved for use, may not show good utilisation, as greater attention is perhaps paid to finer aspects of administrative matters than on rendering service to the cultivators. This article emphasises on a system of management of irrigation works where there is a large scope for increasing utilisation of irrigation facilities and thereby increasing agricultural production.

A precacious response to the full use of the immense irrigation facilities offered by the number of irrigation works that have been constructed and

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put to commission, either in parts or in full, cannot, obviously, be anticipated. Nevertheless, only a reasonable period should be necessary to accomplish irrigation in every small piece of land in the area that is brought under command. The profound influence of time in the process is not a characteristic phenomenon of any country in particular. Natural factors pervading almost identical influences everywhere have, ostensibly, given this a status of universality. To quote Mr. Nelson of the United States, Bureau of Reclamation from 'Water and Our Future', "Irrigation projects are not built, settled and brought into full production overnight."

In Gujarat, too, the comparatively slow tempo of the development of irrigation utilisation has been a matter of good deal of concern to the authorities. For decades beyond count the cultivators had been depending only on the favours of nature for the maturity of their crops. The capricious nature of rainfall, both in intensity and in distribution, had been kidding the agriculturists in this gamble. Obviously, therefore, it provided no opportunity for them to attempt any advantageous variations in the farming practices. Thus, they are resigned to traditional dry farming and are considerably averse to sudden transition to irrigated farming.

The agriculturists have the credence that water forms the lifestream for their vocational success. But for some inexplicable reasons, however, most of them have not shed their conviction to old, conservative farming practices and evinced as much interest in the use of irrigation water as was expected of them. Dedicated as they are to dry farming methods, evidently they seem to require proper guidance and education for economic use and conservation of irrigation water for getting maximum benefits.

In certain instances, however, where some enterprising cultivators have perceived the economic advantages of irrigated farming, the utilisation of canal waters has shown a phenomenal development. In some places of Gujarat State, notably in the Saurashtra region, the demand has been so overwhelmingly large, especially for some cash crops such as sugar-cane and groundnuts that the supply position itself imposes limitations to meet the avidity for canal water. In contrast to this, particularly in the Mahi and Kakrapar command areas in the State, where the predominant crops are tobacco, cotton, and *Jowar*, all requiring very little water for maturity, the demand for canal water is very low. It may be stated here that these two major projects have their limitations at present as they only divert the run of the river and hence water is available principally in monsoon and to a limited quantum in winter seasons. The outlook of these projects will greatly improve after the construction of storage reservoirs for these two projects.

### Responsibilities of Functionaries in Efficient Management of Irrigation Works

The contrasting pictures of the response of cultivators to the use of irrigation water evidently tend to indicate that something is amiss in our efforts to promote irrigation. Years of experience have paved the way to make inquisitive efforts to analyse the deterrent factors and prepare and implement progressive measures to overcome them.

Agricultural operations, with the use of irrigation facilities, obviously involve the co-ordinated association of several departments in the implementation of a successful programme. The principal departments concerned are irrigation, agriculture and cooperation. A very close and harmonious liaison among officers of these departments at various levels is a primary prerequisite to achieve the desired results.

The practice till recently was to discharge the functions at various levels of the different departments independently, without considerations for the collective impact on the economy of the cultivators. The exclusive implementation of the programme of one department without regard to the extent of services available from others obviously confused the beneficiary. Instead of availing of the disconcerted services, many preferred to stick to old practices.

Irrigation works can be managed efficiently and good results assured if the responsibilities of the functionaries at various levels of the concerned departments are properly defined and implemented on the basis of realistic targets fixed for each of them. However, coordinated planning of all the departments and timely advice to the cultivators would encourage them to take full advantage of irrigation facilities. Herein lies the importance of the realisation of the scope and limitations of functional responsibilities of various officers and implementation of a coordinated programme. The role of each of the different functionaries is discussed in the succeeding paragraphs.

### Role of Irrigation Engineer

The popular notion that has come to stay, by an environ of circumstances, both in the official circles and in public, is that the irrigation engineer is responsible for the ultimate utilisation of irrigation facilities. The fact that he is responsible to the creation of irrigation facilities is amplified to charge him with the additional responsibility of seeing to the ultimate utilisation of irrigation waters. It is worthwhile to emphasise here that beyond the maintenance and operation of canals the management involves primarily in dealing with the less informed mass of cultivators, who require to be properly guided not only in direction of economic use of water but also in other allied aspects of irrigated farming concerning field preparation, changes in cropping pattern, application of fertilisers and manures and so on.

The irrigation engineer is a technical expert in his own field of construction of dams, canal system and proper and efficient maintenance of these. Once the canals are ready, he will be preoccupied with the more important engineering works like proper maintenance of the canals, upkeep of vulnerable structures and regulation of flow in the canals.

He may possess a fair knowledge of agriculture but he can never be expected to handle the job of offering expert advice to cultivators on essential matters like the dosage of fertilisers and manures to be applied, the right type of crop to be grown at the right time and so on, which depend mainly on several other factors including soil characteristics. It is, therefore, fair to limit his responsibility to the programming of irrigation and the release of water up to the outlets. It is reassuring that the recent trend has been to recognise this primary limitation and other functionaries have also been applying themselves in their respective departments of activity. This will infuse confidence in the cultivators as they get proper advice from experts in different aspects of irrigated agriculture.

#### Water courses—The Path to Prosperity

A very important matter that contributes in a large measure to the increase in utilisation of irrigation facilities is the timely construction of the network of watercourses. According to the Irrigation Act of the Gujarat State, it is the obligation of the beneficiaries to construct and maintain the watercourses beyond the Government outlet.

In Gujarat State, formerly these watercourses, which the beneficiaries had to construct, had a carrying capacity up to 0.14 cumec (5 cusec). It was realised that channels with such high discharging capacity needed better engineering considerations and involved some cross-drainage works, construction of which the ordinary cultivators could not be expected to afford. The criterion was, therefore, reviewed and the capacity of the water courses has now been limited to 0.028 to 0.042 cumec (1 to 1½ cusec) only. This will have the capacity to irrigate about 20.23 to 40.47 ha. (50 to 100 acres) and the usual length will be only 0.8 to 1.2 km. (½ to ¾ miles).

In spite of the minimal size of the watercourses the response from the beneficiaries to construct and maintain them has been far from satisfactory. The irrigation department is aware of some of the difficulties usually encountered by the cultivators, in discharging their obligation in this regard. In order to facilitate the cultivators, village maps showing the most economical alignment of watercourses from each outlet, indicating the normal sections, are supplied by the Irrigation Department. Any other assistance of a technical nature is also given whenever needed.

It has been argued sometimes that Government should take up the work of constructing the watercourses. The expansive network of these small channels requires a large establishment to undertake the work and it would certainly mean large investments on the projects themselves. Even if the work of constructing the watercourses is taken up by Government, with the prospects of recovering the cost later on, it should be realised that large sums of money will be locked up on this account, as recovery of the amounts from the farmers will be slow and difficult. If construction is undertaken by Government, in the words of Dr. K. L. Rao, "it would kill the spirit of initiative and self-reliance that has been carefully nurtured during all these years of irrigation practice in this country." It is, therefore, not desirable for Government to undertake the construction of these watercourses on a mass scale. However, under the provisions of the Irrigation Act of the State, Government is empowered to construct watercourses on behalf of the beneficiaries at the cost of the beneficiaries. It would be proper to utilise this power only in special cases either to help a group of cultivators experiencing any special difficulties or to set an example to a group of recalcitrant cultivators neglecting to use the costly irrigation facilities provided by the State.

#### Role of Block Development Staff

The importance of timely construction of watercourses hardly needs further emphasis. Persuasive measures are required to stimulate the spirit of initiative in the cultivators to construct these watercourses. They will require assistance in certain other fields also which include mainly financial assistance, building up cooperative and competitive spirit and above all proper advice to shed their apprehension of ill-effects of canal water.

The Block Development Organisation is the most expedient institution that can effectively handle this aspect of management. The extension staff maintain close relations with the rural population and can certainly render able service in this regard. This State, has geared up the Block Development Organisation to persuade the cultivators to construct and maintain the watercourses voluntarily. The organisation will also advance financial assistance, wherever necessary, from the block funds to enable cultivators to take this work.

To facilitate the organisation to pursue an effective and decisive programme, targets will have to be built up from the village level. The village level workers, in association with the influential leaders of the locality, will persuade the cultivators. They can take assistance from the irrigation staff in the supply of alignment plans and any other necessary guidance.

It cannot be gainsaid that the Block Development Staff which is closely associated with the manifold development of the rural areas, is the best medium to take up educative measures also for the propagation of irrigated farming. They can also provide the cultivators with proper guidance to obtain credit facilities, marketing and communication facilities and so on.

### Role of Agriculture Staff

In an earlier paragraph it has been mentioned that there is comparatively high demand, especially for cash crops, in some areas in Gujarat State. This is primarily due to the realisation on the part of the cultivators of the economic benefits of canal water. Lack of adequate irrigation facilities had always yielded very limited returns and the efforts spent by the cultivators were not being properly rewarded. Moreover, those who had alternate means of water supply such as wells were convinced that canal water was very much cheaper than well water and could be easily obtained. As a contrast to the avidity for canal water in some places, the demand is considerably low in *Kharif* season and very high in *Rabi* and hot-weather seasons (when the supplies are limited) notably in Mahi and Kikrapar projects. In these parts, apart from good rainfall in monsoon in most of the years the predominant crops are tobacco, cotton and *Jawar*, which require very little water for maturity. In these instances, the cropping practice has a dominant influence on the pace of utilisation.

The contrasting pictures of the performance of irrigation works naturally suggest that an appraisal of current agricultural practices in relation to soils, rainfall and irrigation is absolutely necessary before popularising irrigated farming methods. With sustained and coordinated efforts it should not be difficult to accelerate utilisation of irrigation facilities, wherever it is not up to the mark. Promotional measures to enthuse the lethargic and nonchalant cultivators to appreciate the advantages of irrigated agriculture are a primary necessity in this direction which should be effectively taken by the agriculture department.

In order to encourage optimum utilisation of irrigation, the introduction of certain essential modifications or adjustments in the existing agricultural practices is an imperative measure, so as to make the transition from dry farming to irrigated agriculture more attractive and advantageous. A significant aspect that is revealing in a large portion of the command areas of irrigation projects, is the proclivity of many cultivators to refrain from using canal water for certain predominant crops that are usually cultivated namely tobacco, cotton, *bajri*, *Jawar*, etc. Apparently they are under the apprehension of adverse effects of canal water on such crops. If more advantageous modifications in the agricultural pattern which require the use of irrigation water are developed and the cultivators are properly

educated and persuaded to adopt, then it would result in accelerated utilisation of irrigation facilities.

### Role of Agricultural Demonstration Farms

The cultivator, when he takes recourse to irrigated agriculture has, out of necessity, to attend to some ancillary requirements. He has to know the amount of water that he has to let in to the fields the frequency at which he has to do so, the use of improved varieties of seeds, dosage and frequency of manuring and so on. These are some of the very important matters on which he requires proper guidance.

What is usually lacking in most of the cultivators is the realisation of the relationship between water, soil, plant food and plant. In majority of cases water is applied in an unknown amount for an unknown time, usually without considerations for the relative characteristics of the soil and plant. Unseen factors such as poor water penetration, removal of nutrients by leaching, development of conditions favourable for plant diseases, accumulation of harmful salts, excess water in contact with the plant or the roots, are all consequences of such unsystematic use of water and definitely affect the production and quality of the harvested crops.

The role of the Trial-cum-Demonstration Farms and the Irrigation Agriculture Demonstration Plots in forming the right avenues for demonstrating scientific methods to achieve the primary objective of popularising new farming practices can hardly be emphasised. The experimental studies in these farms should cover a variety of agronomical problems such as soil conditions and characteristics, adaptability of new varieties of irrigated crops, limitations of supply of irrigation water, drainability of the irrigated tracts and impact of irrigation facilities on the economic standards of the agriculturists and so on.

Another vital factor that these experimental demonstration farms should realise and base their experiments on, is that agriculture under irrigated conditions is very different from cultivation under wells or dry conditions. It is necessary to understand the discipline of irrigated agriculture to streamline the activities of these farms. In this lies the importance of these farms in furthering the introduction of economic cropping practice suitable to the existing soil characteristics under irrigated conditions. Then only will the efforts of the farms be efficacious and ably render it possible to reorient the trend of thinking in the common agriculturist on matters concerning irrigation and bring about progressive reforms in the field practice.

A very significant point of cardinal importance is the timing of the establishment of the Trial-cum-Demonstration Farms. It has been the experience to wake up to the necessity of setting up these farms only when the canals are ready. Considerable time is naturally lost in the process of establishment and planning the experiments. By the time the



farms come out with concrete recommendations, quite a few years pass by during which the cultivators, continuously hoping to get proper advice on his crop planning, will have lost interest in irrigation. It is a matter of paramount importance that these farms are planned and set up in the command area a few years in advance of the provision of irrigation facilities. These farms can carry out experiments taking interim recourse to alternative means of water supply from wells, keeping in view the ultimate deviation to canal supply.

The experimental farms will thus be ready with schemes for introducing necessary modifications in the agricultural practice, which can be broadcast simultaneously soon after the canals are ready to serve the cultivators. As an additional measure to propagate these innovations in a very direct and methodical way it will be very expedient to set out a number of demonstration plots, say of 0.2 ha. ( $\frac{1}{2}$  acre) each, scattered all over the command area. These plots are to be selected for one or two seasons from enterprising cultivators who volunteer to participate in the programme for disseminating new methods of irrigated agriculture. In such plots irrigation water should be supplied free of cost, the other services in respect of agricultural and other matters should be subsidised (or even given free) and the recommendations of the farms demonstrated to the farmer in his own field. This will be a service at the door of the farmer and the fact that the benefits considerably by taking recourse to modified cropping practice with the advent of irrigation, not only enthuses himself, but his neighbours will also be prone to emulate his example.

In Gujarat State there are over a dozen Trial-cum-Demonstration Farms distributed over a number of irrigation projects. In Kakrapar command area 121.4 ha. (300 acre) demonstration plots have also been set up where field demonstration on the use of irrigation facilities is given, with free supply of irrigation water, fertilisers, etc. Ninety similar demonstration plots are to be set up in the Mahi command area in *kharif* season of 1964.

In Gujarat State a specialist, with adequate staff under him, is being appointed, exclusively for the purpose of handling the activities of the Trial-cum-Demonstration Farms. He will be an agronomist with specialised knowledge in irrigated agriculture. He will be in overall charge of the technical programme of all the experimental farms and demonstration plots in the irrigated areas throughout the State. The programme will include investigations of the irrigation practices for existing varieties and also for new varieties of crops, the mode of field irrigation, water requirement of different crops, interval and intensity of irrigation. It also includes agronomic trials on cultural practices dosage and application of manures, judicious and optimum use of irrigation water, crop rotations and so on. The agronomist will also maintain the collateral relations with

officers of irrigation, agriculture and other concerned departments and bring about adequate interplay of thought to encourage promotion of irrigation on methodical lines.

### Other Important Factors affecting Irrigation Development

So far, only the roles played by engineering and agricultural factors in the development and management of irrigation have been discussed. There are certain other fields where some difficulties are likely to be experienced by the cultivators. Without timely compromise of these difficulties, the utilisation of canal facilities cannot be expected to accelerate.

An important factor is that the farmers should prepare the lands for taking irrigation water. When the lands in the command area are cut up and uneven, it is prone to result in flooding on the lower sides and dryness on the higher, thereby telling upon the quality of the crop and its economic potentiality. In order to ensure uniform distribution of canal water the lands should be properly levelled. This is, evidently, a hard job for the cultivators to do by themselves. Tractorisation and levelling of the fields in the command areas should be undertaken by the agricultural extension agencies on priority basis.

The cultivators who take recourse to irrigation require to use improved types of seeds, fertilisers and manures, modern agricultural implements adaptable to irrigated conditions. Farmers' Credit Cooperatives are assisted and guided by Agriculture and Cooperative Departments should be able to meet the credit requirements of the cultivators to meet these necessities.

Apart from these services which the cultivator needs on field, it is of utmost importance for him that he has a nearby outlet to sell the agricultural produce. He naturally requires adequate marketing facilities and good roads to reach the market. Cooperatives should come forward to provide these marketing facilities. At the same time the local *Panchayats* should improve the communications in the irrigated tracts. In Gujarat State there is a legislative provision to enable *Panchayats* to levy a cess (20 P. in a rupee) over water rates charged and a substantial part of the amount realised from this cess is intended to be used for improving and providing communication facilities in the irrigated areas.

### Importance of Coordination in Management of Irrigation Works

It is imminent from this dissertation that a well-knit coordinated organisation among the concerned departments at all levels is a fundamental necessity in the process of planned development of irrigation. The collective and harmonious

Efforts of the functionaries at all levels will naturally enthuse the cultivators and bestow on them the confidence to embark on progressive farming methods making use of irrigation facilities.

Very good results could be obtained provided the programmes of all the different functionaries are properly planned in advance and targets are set out at various levels for each functionary. Both at the State level and the district level, an officer should be entrusted with the work of watching the achievements of each functionary and the contribution made to the utilisation of irrigation facilities.

In Gujarat State, the Development Commissioner has been made the Focal Officer, to coordinate the activities of the concerned departments. At the district level the District Development Officer who is the Chief Executive of the District *Panchayat*, will coordinate the function of all the field officers engaged in accelerating utilisation of irrigation facilities and keep the Government informed of the contribution made by the different officers. The District Development Officer will assign specific tasks based on realistic targets to each officer concerned with utilisation of irrigation at the district and *taluka* level. The progress achieved is reviewed in a coordination meeting every month and the contribution made by each officer is reported to Government. At the State headquarters, a High Level Committee under the chairmanship of Chief Secretary constantly reviews the position and directs implementation of measures to improve the position.

In addition to these, a Canal Advisory Committee is set up for each project to advise the officers on matters concerned with efficient administration of irrigation works. Water *Panchayat* Committees have also been set up at the village level. These *Panchayats* decide matters concerning the distribution of water, frequency of watering, rotation and such matters concerned with the actual field work in the management of irrigation works.

### System of Water Distribution

The scope of different functionaries and the role they have to play in effective management of irrigation works, with the specific aim of accelerating utilisation of irrigation facilities, have been discussed. It will be relevant to touch upon the actual distribution and control of canal water and the impact of effective management of irrigation works. In the course of presenting this aspect of management of irrigation works, the system followed in Gujarat State is kept in mind.

Before a cultivator is entitled to get water from a canal, he has to file an application in the prescribed form, before the date specified for the season. These applications are sanctioned by the competent canal officer, in most cases the Sub-Divisional Officer and intimation of sanction together with a ~~pass~~ <sup>pass</sup> is sent to the applicant. The canal officer will prepare a programme for the supply of water from each outlet and the date of each turn of watering

is decided taking into consideration the standard interval between waterings, capacity of the canal system and the requirements in other sections. The dates prescribed for release of water will be noted on the pass by the Irrigation *Karkoon* as and when the water is supplied in each rotation.

The distribution programme is normally done from the tail end towards the outlet. This will enable to exercise sufficient control on the flow of water and also to conserve water otherwise lost in transit. In very few cases only, owing to special considerations dictated by local conditions, field to field supply is being followed. Such supplies are restricted only to paddy fields.

The keynote of success in efficient distribution of water in a canal system lies in the maintenance of adequate discharge at different gauging stations, so that the discharge at the head is regulated correctly. The responsibility to maintain appropriate gauge discharges devolves on the Section Officer.

In extensive canal systems where there has to be joint control of two or more Sub-Divisional Officers, the Sub-Division Officers of the upper reaches have to provide for the demand of the officers of the lower reaches.

The total quantity of water required for each section on each day of the flow period should be communicated to the Sub-Divisional Officers well in advance. The controlling Sub-Divisional Officer should prepare the distribution programme on these figures and tentative levels for maintenance of gauge at several sections worked out. In maintaining proper and efficient control on water distribution in this manner, a network of telephones along the canals is very necessary. In Gujarat State such a telephone network is operated on Mahi and Kakrapar Canals and a number of medium irrigation works.

In order to enable canal officers to maintain proper account of the water requirements and plan the irrigation programme and regulation of water distribution, Gauge Registers and Water Accounts are maintained during the irrigation season. All these form the basis for keeping a watch on the water supplied and subsequently check with the help of measurements taken for assessment purposes.

### Assessment of Rates

In flow irrigation works, the water rates are associated with the areas actually irrigated. A careful watch is maintained that the area irrigated does not exceed the sanctioned limits. To this end, in the middle of each crop season, all cropped areas irrigated by the canal system are measured by the Measurer and recorded in the Irrigation Field Book. Ten per cent of this measurement is checked by superior officer, viz., Section Officers and Sub-Divisional Officers.

✓ On the basis of these measurements the statements of demand are prepared showing relevant details and the amount of charges leviable. A notice is then given to each irrigator that the details of the charges made will be explained in a *Kulrajat* which will be held in the village. This notice is given at least one week in advance through the *Talati* (village officer). Any objection received during the *Kulrajat* will be considered by the Sub-Divisional Officer immediately and modifications in the statement of demand made, if warranted.

✓ When the crop has sustained damages or loss on account of any conditions of regulation, inadequacy of the discharge, closure of canals for sudden repair during irrigation, remission of the whole or part of the irrigation charges is admissible subject to the proviso that the outturn is not more than twenty-five per cent of the normal yield. Such remissions will be admitted after proper certification following a *panchnama*.

✓ The statements of demand and also the statements of remission if any, will be forwarded to the revenue officials to effect the recoveries of the amounts before the dates specified.

### Impact of Irrigation Charges

In addition to water rates, a small nominal charge called Irrigation Cess is recovered at Rs. 2.50 per acre per year. This is levied on all lands in the irrigable command irrespective of whether water is taken or not. This compulsory cess is expected to induce even recalcitrant cultivators to take advantages of irrigation facilities.

The establishment of long-term clientele is another ambition of this State. This will not only enable an assured demand for irrigation water but will also render it possible for the irrigators to grow several varieties of crops and also get assurance of water on priority as well as some reduction in water rates. This also saves them the botheration of getting water application sanctioned as and when required. To the department also it means a lot of good, as advance and efficient planning for distribution of canal water can be made, as known demands are created at known locations.

To achieve this, a scheme for registration of regular irrigators has been introduced in the command of tube-wells.

In the flow irrigation works also a system of block sanctions will be introduced shortly. This system envisages contracts for supply of water for a period of 6 years.

In sanctioning these blocks, especially for perennial crops where heavy irrigation becomes necessary, care will be taken to see that sanctions are made keeping in view the drainage characteristics of the soils. On the basis of soil survey results, perennial crops will be restricted in the proportion of 0.40 to 1.21 ha. (1 to 3 acres) of other crops. This will minimise, perhaps even avoid, the incidence of water-logging problems as measures to prevent them are proposed to be taken from the beginning itself.

### Recommendations

The following are some of the more important points which, if properly attended to, are sure to bring about more effective management of irrigation works and consequent increase in the utilisation of irrigation facilities:—

(1) The role of Irrigation Engineer should be limited to programming of irrigation and regulating water supply in the canal, and his active cooperation with the programmes of the other associated departments.

(2) The Block Development Staff should muster positive response from cultivators to the discharge of their obligations especially in construction of watercourses.

(3) The Agricultural Department should be responsible to introduce necessary changes in the cropping practice. If need be an officer should be appointed exclusively for this purpose.

(4) Adequate credit facilities should be given to the farmers.

(5) Specific tasks and targets should be assigned to the functionaries of concerned departments at various levels. Their achievement should be reviewed at a co-ordination meeting to be convened by a Focal Officer at both District and State levels and measures taken to overcome the procedural and administrative impediments to see that the targets are reached.

(6) Long-term customership should be encouraged by registration of cultivators or sanctioning blocks and offering concessions in rates.

# IRRIGATION MANAGEMENT IN PUNJAB

by

Madan Lal Wahi\*

## SYNOPSIS

*The note briefly outlines the irrigation management policy in Punjab and recommends radical changes in the policy to be tried on an experimental measure in Bhakra Nangal Project areas. Changes recommended are in regard to setting up of irrigation districts controlled by board of directors elected from amongst the farmers who should take on the responsibilities of constructing and maintaining field channels, distributing irrigation supplies, ensuring farm drainage and collecting charges for water delivered. Intensive irrigation coupled with efficient farm drainage is recommended in this note on the basic assumption that good land fit for irrigation should get supply according to its needs.*

## Introduction

The irrigation management in the Punjab today is no different from what it was towards the end of 19th century. The main object in the earlier years of irrigated agriculture was to provide some irrigational facility for lands on a uniform basis and was not aimed at achieving the maximum agricultural production per acre, since the requirement of agricultural products and food crops in the earlier years was not that high on account of less population pressure on land. During the last 50 years the population has more than doubled.

Again in the recent past river supplies were being made use of by building diversion weirs across rivers, as such only a small fraction of run-off in the rivers was utilised for irrigated agriculture. With the partition of the country, waters of main rivers, Indus Chenab and Jhelum have been allocated to West Pakistan and the Punjab is left to meet its needs from Ravi, Beas and Sutlej, comparatively smaller rivers jointly with the Rajasthan State. This has made incumbent on the nation to store waters on all these rivers. The storage on the Sutlej has already been built and that on the river Beas is under construction. The construction of a dam on the Ravi is planned to be taken up towards the end of the Fourth Plan. It means during the course of the next 10 years or so, all rivers in Punjab will have their waters stored for full utilisation partly in Punjab and partly in Rajasthan, supplies having been already allocated at the Government of India level. The rivers have been inter-linked with the result that supplies of these rivers can be utilised according to an integrated plan.

With the stored supplies being more or less precisely known after having conducted hydrological studies on these rivers for several years

past, it is time that we should plan our optimum utilisation of these supplies and should earmark lands that should receive intensive irrigation.

Areas for which irrigation supplies are not available should be mapped out and alternative source of irrigation for these areas should be explored. In case no alternative irrigation source is possible, it would be worthwhile practicing dry farming on such areas. In other words, the irrigation management policy needs reorientation.

## Irrigation Policy of To-day

Some aspects of the irrigation policy of today as in the past are discussed as under :

(i) *Water allowance*—Taking into consideration factors such as climate, texture of soil, rainfall, etc., the water allowance, i.e., quantum of discharge per thousand acres of C.C.A. for the project area is fixed. The water allowance as adopted on some of the main canals of Punjab lying in West Pakistan and Punjab (India) are given in Table I. Taking into consideration requirements of water in different months for kind of crops sown in the project area, capacity factor of canal is also fixed. Capacity factors as fixed in the case of Bhakra Canals are given in Table II. In case of projects dependent on run-off of river supply statistical mean of minimum discharge in the river over a large number of years for which the hydrological data is available, fixes the *Rabi* discharge of the canal. The *Kharif* discharge is generally taken as twice the *Rabi* discharge and the capacity of a main canal is designed for *Kharif* discharge. Taking into consideration the water allowance, absorption losses and the designed discharge capacity of the main canal, total C.C.A. is estimated and a compact block of area equal to the estimated C.C.A. plus 10 per cent is taken to be the project area to be served by a canal.

\*Chief Engineer, Irrigation Works, Punjab.

In case of storage projects total run-off of river in a year of average rainfall can be computed and taking into consideration capacity factors the designed discharge of the canal can be fixed. Based on the water allowance for the project area total C.C.A. corresponding to the designed discharge can be fixed.

(ii) *Water distribution system*—The project area is surveyed and 1 ft. (0.3 m.) contours are plotted over the entire area. On the contour maps the alignment of main canals, branch canals, distributaries and minors is laid from the consideration that the length of a watercourse required for irrigating the furthestmost area from an irrigation channel should not exceed 3.22 km. (2 miles). The construction of all irrigation channels except watercourses is undertaken by the Project. The construction of watercourses is required to be done by cultivators themselves according to an alignment determined by them according to their best judgement. It is only recently in the year 1958 that the Northern India Canal and Drainage Act was amended and under Section 30(A) to (F) provisions have been made for undertaking construction of watercourses at the cost of cultivators if a request is made in that regard by cultivators or if the engineer in-charge of the canal considers it necessary in the interest of irrigation development.

TABLE I

Water Allowances for Different Canals in Punjab\*

Sl. No.	Name of Canal	Water allowances % 0 acres at Disty. head
1.	Western Yamuna	0.83 cuses
2.	Sirhind	2.44 "
3.	Upper Bari Doab	3.82 "
4.	Lower Bari Doab	3.85 "
5.	Upper Chenab	3.00 "
6.	Lower Chenab	3.02 "
7.	Upper Jhelum	3.43 "
8.	Lower Jhelum	2.70 "
9.	Pak Patten Canal	3.70 "
10.	Haveli Canal	3.73 "
11.	Bhakra Canals	2.75 "

\*Page 16, B. N. Project 1955—Volume I, Part I.

TABLE II

BHAKRA NANGAL PROJECT		Statement showing	Designed Capacity	Factors.*
Month				Remarks
April			0.50	
May			0.90	
June			0.90	
July			0.80	
August			0.80	
September			0.90	
Mean Kharif			0.80	
October			0.90	
November			0.90	
December	1—10		0.90	
	11—31		0.50	
January			0.50	
February	1—10		0.50	
	11—28		0.75	
March			0.75	
Mean Rabi			0.72	

$$\text{Mean capacity factor for the year} = \frac{0.80 + 0.72}{2} = 0$$

\*Page 23, B. N. Project, 1955—Vol. I, Part I.

From the study of the contours, outlet *chaks* are proposed taking into consideration the fact that (1) *chak* should not require discharge in excess of 0.0566 cusec (2 cusec) or so and (2) so far as possible, it should be wholly in one village to avoid disputes amongst shareholders which would be the case if an outlet *chak* lies in two villages or more. Final boundaries of outlet *chaks* are fixed in consultation with cultivators under section 20 of the Canal Act and suitable sites of outlets for *chaks* are fixed from consideration of command.

As soon as channels attain their regime pipe outlets fixed earlier in irrigation channels are replaced by proper outlets that would ensure delivery of designed discharge independent of the water-level in a water course. Discharge through outlets such as open flume and adjustable proportionate module and a few other similar types depends only on the water surface level in the irrigation channel and is independent of water-level in watercourse.

Discharge from an outlet in a certain period is distributed to holdings by the cultivators themselves on the understanding that each cultivator

will be entitled to duration of supply in proportion to the area of his entire holding in the outlet *chak*. In case there is dispute amongst cultivators regarding distribution of supply from outlet, *warabandi* or turn can be fixed under Section 68 of the Canal Act. Appendix I outlines the details regarding *warabandi* as being practiced in Punjab Irrigation.

(iii) *Assessment of Water Charges*—Water charges are recovered from cultivators on the basis of area irrigated. Schedule of charges specified for kinds of crops in Bhakra Canals are given in the Appendix II. In order to ensure that the project is productive (*viz.*, net revenue receipts after deducting the working expenses inclusive of maintenance costs are not less than interest payable on the capital outlay) betterment levy is fixed on project area. Betterment levy being realised on Bhakra canals on *ad hoc* basis for the present is given in Appendix III.

(iv) *Agricultural Practices*—The utilisation of irrigation supplies is left entirely to the cultivator who is under no obligation to sow any particular crop and its variety. Land use is entirely at the discretion of the cultivator except when the land is taken over under either Punjab Land Improvement Schemes Act, 1963 or Punjab *Thur* and *Sem* Lands (Reclamation) Act, 1963. Farm drainage is left to cultivators' initiative and more often than not it remains neglected.

### Drawbacks in the Irrigation Management of Today

From what is given above it is obvious that there is little or no management of irrigation supplies beyond the outlet. The use of water is entirely at the discretion of a cultivator and he is leviable little or no charge for irrigation supply unless he puts it to productive use in the form of areas matured under some crop. He is not economical in the use of water. He displays little or no interest in soil and water conservation. He is under no obligation to prepare land, use manures, sow crops in certain rotation and ensure good field drainage. Each of these factors effects the agricultural production from the land with a certain quantum of supply available.

To ensure optimum use of irrigation supply *vis-a-vis* maximum agricultural production from these lands, irrigation management policy needs reorientation in all its important aspects. Some of these are discussed in this note.

### New Irrigation Policy

(i) *Basic Factors*—The reorientation of irrigation management policy should be considered taking into consideration the following essential factors:—

- (a) Irrigation waters should be made available to such lands only as are declared to be good, as a result of detailed soil survey taking into consideration its physical as well as chemical characteristics.

(b) The quantum of supply to be made available to good land should be according to its needs.

(c) The distribution of supplies should be left in the hands of users.

(ii) *Financing of Irrigation Projects*—During the course of next ten years or so, all main rivers of the Punjab will have storage dams with the result that almost the entire run-off from the catchment of these rivers will become available for utilisation partly in the Punjab and partly in the Rajasthan according to the allocations made by the Government of India. Again, the inter-linking of the rivers would also be complete which will enable utilisation of the available supplies in the most appropriate manner. The entire capital outlay required for the construction of the necessary works including the capital outlay so far incurred on various irrigation projects in Punjab old and new should be met with from the consolidated fund known as 'Reclamation and Irrigation Fund'.

The State should utilise this fund in the construction, maintenance and operation of storage works, diversions, link channels main carrier channels, distributaries and minors flood protection works and drainage system.

A detailed soil survey of lands of the entire State likely to be commanded by flow irrigation should be got completed as early as possible and good land fit for intensive cultivation should be selected since valuable stored supplies in the interest of increased agricultural production should not be wasted on deteriorated and inferior lands. Total C.C.A. in the Punjab found fit for canal irrigation should be given irrigation supplies according to its needs and should pay back to the Irrigation fund the following charges:—

(a) Irrigation cess.

(b) Water charges on the basis of volume of irrigation supply actually utilised.

(a) *Irrigation Cess*—Flat rate per acre should be levied on the entire C.C.A. (all lands planned to be provided irrigation from network of storages in Punjab). This rate should be uniform over the entire State, old areas as well as new areas and should be taken to be about 50 per cent of the average water rate being levied on the irrigated tract in the Punjab at present.

The levy of this rate will ensure that a farmer would keep all lands under crops both in *Kharif* and *Rabi*.

(b) *Charges for Supply on Volumetric Basis*—The State should also realise water charges for volume of irrigation supply delivered to distributaries and minors from main canals and storage. This rate should be on the basis of 1233.48 cu.m

(acre-ft.) of water delivered into distributary. The rate to be levied should be enough to ensure that the maintenance, working expenses, depreciation and interest on total capital outlay are fully covered. A rate of nearly Rs. 5/- per acre should be reasonable charge taking into consideration the present costs of construction and maintenance.

(iii) *Water Requirements and Availability*—

In larger part of the irrigated tract of Punjab quantum of discharge being allowed for irrigation at distributary heads is in the range of 2 to 3 cusec per thousand acres, arid areas of Hissar being allowed 2.4 cusec per thousand acres. Taking average capacity factor on Bhakra canals as 0.76 this would amount to  $2 \times 2.4 \times 0.76 \times 365$

1000

$= 0.40$  m. (1.3 ft.) of water per acre. This value of delta may hardly be adequate for crop pattern of wheat in *Rabi*, *Jowar*, *maize* and *bajra* in *Kharif* and a little area about 10 per cent under cotton. This pattern of cropping would not pay farmers and would be no inducement of intensive cultivation and increased agricultural production.

Again total supply in acre-feet that will eventually become available to Punjab during the course of next 10 years or so would not exceed 27136.6 cu m. (22 million acre-ft.) during a year. Total C.C.A in Punjab ranking for irrigation excluding tubewell areas is nearly 6.07 million ha. (15 million acres). Allowing 30 per cent loss in transit, we shall on an average get 1 ft. (0.3 m.) irrigation in Punjab irrigated tract. This value of delta is not much different from what is given above in case of Bhakra canals.

This would immediately suggest that in the Punjab we have got to tap on a very extensive scale the underground water resources. That will naturally take some time, besides, arranging financial resources for 20,000 tube-wells it would be necessary to explore the quantity and quality of underground waters, plan tube-well projects before the actual sinking of tub-wells is taken in hand. In the meanwhile, it is necessary that the available irrigation waters should be applied to good lands which are capable of increased agricultural production.

The requirement in that regard is careful mapping of the soil data all over the irrigated tract of Punjab taking into consideration the soil structure, physical and chemical properties of soils within 3.05 m. (10 ft.) depth to begin with. Some area has already been surveyed; the balance should be surveyed in as short a period as possible. As a result of soil surveys deteriorated lands should be excluded from canal irrigation.

The exclusion of poor soil should be done in a very judicious manner so that some channels already built are not thrown out of commission. Even if some channels are rendered surplus to irrigation projects, they can be made use of in

conjunction with tube-well projects. Total canal irrigated area in the State should be worked out on the basis of an average water allowance of 0.14 cumec (5 cusec) at distributary heads. This would permit 50 per cent of the area under cash crops such as sugar-cane and cotton and 50 per cent of the area under fodder and food crops.

What is given above in matter of availability of waters and requirements of water is an approximate appraisal. A detailed study should be undertaken of the utilisation of waters as available partly for irrigation of good lands and partly for reclamation of damaged lands, in conjunction with underground irrigation supplies lifted from tube-wells, percolation wells and seepage drains. But the fact has to be brought out that intensive cultivation can be done only with intensive irrigation and that requires making available to a farmer in the field adequate quantum of irrigation supplies. According to the present practice, quantum of irrigation supplies being allowed to cultivator does not give any incentive for intensive cultivation.

Another source of increased irrigation supplies in Punjab can be built up in an indirect manner either by lining irrigation channels or by digging seepage drains parallel to the channels, seepage being pumped back into irrigation channels. A considerable volume of water that goes into the underground reservoir can be saved.

(iv) *Crop Planning and Rotation*—Closely interlinked with the question of water allowance is the cropping pattern for the soil. It is very necessary that the Agriculture Department should lose no time in preparing a master plan of crop pattern for irrigated areas of Punjab selected for intensive irrigation as a result of soil survey. Based on this crop pattern plan requirements of water in various regions of Punjab will be worked out and the irrigation channels built for delivering the required quantum of supplies. Here again, the co-ordination between the Irrigation Engineers and Agricultural Officers of the State is very essential so that the additional length of irrigation channels required for the purpose should be reduced to the minimum.

(v) *Distribution System*.—With increased water allowance as recommended above, it would be necessary to increase the capacity of irrigation channels or build additional channels in the areas selected for intensive irrigation. There is another reason as well for building additional distribution channels. The distribution channels as presently planned and built are on the basis of having outlet *chaks* of 3.22 km. (2 miles) length or so. This length of outlet *chak* is excessive and leads to considerable loss of valuable waters through absorption and excessive evaporation. It will be advisable to cut short the size of outlet *chaks* to almost half. Additional channels to be built in various irrigation zones should be carefully planned and aligned.

(vi) *Watercourse system*—Delivery of irrigation supplies to farms will be affected through watercourses which should be built along correct alignments and to proper levels so that the entire land fit for irrigation can be irrigated satisfactorily. These watercourses should in due course of time be made *pacca* and impervious by using one or other type of lining materials. It will be beyond the scope of this note to go into different types of lining that are being tried in the field and the research institutes. It will suffice to mention that quite 25 per cent of irrigation supplies delivered through an outlet goes waste due to absorption losses.

While planning and laying out water courses system great thought has to be given to the points wherefrom each individual field is to be supplied irrigation water. In other words, such points or *Nakkas* should be fixed and should not be altered without proper authorisation by the management. The construction of watercourses and their maintenance should be undertaken by the management at the cost of farmers, in case they do not come forward to do the job themselves under the supervision of the management.

(vii) *Organisational Set-up of Irrigation Management in the field*.—The State is responsible for irrigation works and the main drainage system in the State and it should continue to shoulder this responsibility. The management of waters beyond the outlet in the field should be the responsibility of some organisational set-up since the present practice of holding individual farmer responsible is not satisfactory. The organisational set-up proposed is on the pattern of what obtains in the United States of America.

In the project area different irrigation districts are set up, each district being responsible for a block of area 20234.30 to 28328.02 ha. (50,000 to 70,000 acres). The irrigation district management looks into the following aspects of the irrigated agriculture :—

- (1) Indenting and distribution of irrigation supplies.
- (2) Construction and maintenance of watercourses.
- (3) Planning and execution of farm drainage.
- (4) Rendering technical advice on irrigation and agriculture to farmers.
- (5) Assessment of water charges.

Before discussing these items of responsibilities of the irrigation district management, it should be necessary to outline the constitution of the management. The irrigation district should be under the control of a Board of Directors that should have 5 directors elected from amongst farmers in the district and should have 3 official members each nominated by Irrigation Department, Agriculture Department and the Revenue

Department. The election of non-official members should be done every 3 years and one amongst them should be the Chairman of the Board. The Irrigation representative should function ex-officio as Manager and the Revenue representative should function ex-officio as Secretary of the Board with the powers of Assistant Collector. The District Board should have some staff for ensuring distribution of supplies and for collection of water charges. Other staff required in connection with watercourses, farm drainage preparation of land and other connected matters can be drafted as and when required. Details of the staff required by the irrigation district can be worked out after 3-4 irrigation districts are set up in Bhakra areas of Punjab on experimental basis.

(1) *Distribution of Water*.—The irrigation district will be split up into number of farms, each farm being fed by an outlet. A farm or outlet *chak* will be made up of number of holdings of individual farmers. The distribution of water will be affected to cultivators on indents being placed by cultivators who will state the number of hours for which irrigation supply is required from an outlet. The irrigation supply will be made available to a cultivator strictly in accordance with the indent being placed by him with the district board office. Based on these indents placed by individual farmers total requirement of water in each distributary will be worked out and drawn from main canals and branches.

Timely information will be furnished to individual farmer regarding the quantum of supply that will be allowed to him and the period during which it will be made available. A whole time *Zilladar* employed by the Irrigation District Board should be able to ensure water being delivered with the help of 5 or 6 Irrigation Booking clerks correct to time and indent.

There should be no difficulty in obtaining complete information regarding quantum of discharge that should be available in each month of the year since as stated above. Punjab will have stored supplies on all its rivers during the course of next 10—12 years.

(2) *Watercourses—Construction and Maintenance*—Construction and maintenance of watercourses is the primary duty of irrigation district. This will be ensured by keeping skeleton Engineering staff in the District. Manager of the irrigation district being an irrigation officer will have the requisite powers under the Canal Act and will ensure that the charges for maintenance and construction where necessary are recovered from farmers.

(3) *Planning and Execution of Farm Drainage*—In tracts where intensive irrigation is practiced, it is necessary that the water-table is kept depressed to requisite level. This can be done by having proper farm drainage in form of surface drains as well as sub-surface drains. The implementation



of the farm drainage scheme considered necessary by the Board can be got carried out at the cost of beneficiaries by the Irrigation representative on the Board under his powers as a Canal Officer.

(4) *Technical Advice on Drainage and Agriculture matters*—The Board can render great help on all technical matters to individual farmers by looking into their problems and finding solutions for the same. The best way in which the help can be given is for the Government to set up model farms where best demonstration can be given in farm drainage technique, use of green and artificial manures, crop pattern and rotation, land preparation, levelling and ploughing, irrigation requirements, etc.

(5) *Assessment*—As discussed above the Government being responsible for construction and maintenance of all irrigation works except field watercourses and the main drainage system except farm drainage should levy fixed amount of irrigation cess on lands selected for irrigation all over the State and should recover from several irrigation districts payment for the volume of water actually delivered at distributary heads. The irrigation districts in turn should collect the payment for water delivered to individual farmers on the basis of a uniform charge per acre-ft. of water delivered, the rate levied by irrigation district on farmers being kept nearly 25 per cent higher than that levied by the Government on the irrigation districts for the volume of water delivered at distributary heads. The higher rate levied by Irrigation district will meet partly with the loss of irrigation supply due to absorption and evaporation, etc., in distribution system and

partly the expenditure on office establishment and the establishment engaged by the management for various purposes such as the distribution of water through watercourses.

Charges for water delivered to farmers being on the basis of acre-feet of water delivered should be recovered from a cultivator every month by sending a bill to him at the end of the month. To ensure that the farmer pays the bill, he should be allowed 5 per cent rebate if the payment is made by due date. In case he fails to make the payment by due date further irrigation supply to his farm should be stopped and the amount due should be recovered as arrears of land revenue.

A farmer will not feel handicapped in making ready payment of water charges since he can raise loan from Credit and Service Society functioning in the countryside nearest to his village. It may be mentioned that in Punjab there are 20,000 or so of Credit and Service Societies functioning who advance loans to farmers during 1962-63 to the tune of nearly 16 crores. These credit societies can be readily depended on for payment of water charges by a cultivator regularly every month.

The irrigation district functioning under the control of a Board of Directors is being recommended as an experimental measure to begin with in the Bhakra Nangal Project areas of Punjab. These districts will be responsible for water management in the field. At a later stage of development, the irrigation districts can be confidently depended on to maintain and operate and manage waters in the distribution system as well as in the field watercourses.

## APPENDIX I

### Instructions for the guidance of Canal Officers in the preparation and modification of Warabandis

#### INTRODUCTORY

These instructions are intended primarily for guidance on the colony canals, but should be followed wherever applicable on the old canals, and where the scope and provisions of the *Panchayat* Act permit.

Irrigation Officers should generally interfere as little as possible in the internal distribution of water on watercourses. When disputes arise, they should endeavour to persuade the parties to settle the matter by mutual agreement, or if a *Panchayat* has been instituted in the village concerned to refer the matter to that body. The following general instructions are intended for the guidance of officers in cases where official interference cannot be avoided.

#### PROCEDURE

Canal Officers have no power to interfere in the internal distribution of water on a watercourse except under Section 68 of the Canal

Act. This section gives power to Divisional Canal Officers only, and not to officers of higher or lower rank.

The Divisional Canal Officer may only take up a *warabandi* case on receipt of written petition from a land owner or a tenant bearing a court fee stamp of Re. 1 from one or more of the shareholders, stating that a dispute has arisen regarding his rights in respect of the use of the water and detailing the matter in dispute.

On receipt of such a petition, the Divisional Canal Officer must take up the case. His enquiry must be confined to the matter detailed in the petition, and the preparation of a complete new *warabandi* can only be undertaken when the petition is so worded as to justify this. In order to avoid useless work, it is advisable that the petition should be carefully studied before the case is taken up. If the petition is not suitable, it should be filed and the petitioner informed accordingly.

The wording of Section 68 should not be taken to mean that the whole enquiry should be carried out by the Divisional Canal Officer in person. The preliminary enquiry and preparation of the *warabandi* or modification thereof will be carried out by the *Zilladar* under the supervision of the Deputy Collector; but this should not result in petitions being dealt with tardily. Cases of preparation and modification of *Warabandis* should be dealt with by all concerned as expeditiously as possible; strong disciplinary action will be taken against those found guilty of delaying the disposal of *warabandi* cases. The 'ownership' column in *warabandi* cases must be verified by the Civil *Patwaris*, who have orders to do this as promptly as possible, before the Divisional Canal Officer hears the case. Before passing orders on the proposed *warabandi* or the proposed modifications, the Divisional Canal Officer must hold an enquiry as laid down in Section 68 of the Act. A notice must be issued by the Divisional Canal Officer fixing the date of the enquiry (for which 14 days' clear notice should be given), and stating the subject, time and place of the enquiry in accordance with the procedure laid down in Rules 79-A to 79-I of the Act. The maximum time allowed for completion of a new *warabandi* case will be 5 months between the date of application for the *warabandi* and its announcement by the Divisional Canal Officer. In case of revision applications the period allowed for the completion of the case will be 3 months.

At the enquiry the Divisional Canal Officer should explain the proposed *warabandi* to the shareholders present, and should then hear and record any objections raised thereto. The enquiry should then close.

The Divisional Canal Officer's decision in the case should subsequently issue in the form of an order under Section 68 of the Canal Act. The orders should be in the form of a judgement. It should record the alteration desired in the petition and the objections raised, should state which points of the petition and objections have been accepted, and which over-ruled giving reasons in each case. A copy of the *warabandi* as modified should accompany the order. A copy of the *warabandi* should accompany the order which should normally be enforced from the beginning of the next crop. If it is to be enforced with immediate effect, reasons for the emergency should be stated in the order.

The order should be announced to the shareholders by the *Zilladar* personally and a copy handed over to the *Lambardar* and *Sarpanch* of the village. Any other copies required by shareholders should be supplied on payment of the usual copying fee.

An order of the Divisional Canal Officer under Section 68 can only be set aside by the decree of a Civil Court. It can, however, be altered by himself or his successor in the event of a different disputes arising and a written petition

to this effect being received, upon which a fresh enquiry will be instituted under Section 68, Canal Act.

#### METHOD OF FRAMING A WARABANDI

*Warabandi* should be framed in accordance with the following principles. When alterations are proposed, the principle to be followed should be that those desired by the majority of the shareholders should be accepted, subject in equity to the interests of the minority being safeguarded.

#### PERIOD OF ROTATION

The period of rotation of a *warabandi* may be fixed :—

(a) As an integral number of days :

The numbers most usually used are seven and ten. The former has the advantage that, when operation is continuous, a shareholder's turn always occurs at the same time on the same day of the week. The length should generally conform with that usual in the district, which will be suitable for use with the periods of the rotational distribution of the canal concerned.

(b) An odd number of half days :

A disadvantage of the integral number of days is that in the continuous operation it affords no relief from turns occurring at night. This is avoided by this method.

(c) From the size of the *chaks* :

In this case, the turns are calculated from a fixed time allowance per unit of area, usually 12 hours per square. This system has the disadvantage that in the case of very large or small *chaks*, the water received during a turn may be more or less than is suitable for a single watering.

#### OPERATIONS

Operations may be either :

(a) Continuous, *i.e.*, the turns are considered to be operative whether water is present or not. In this case the turns occur at regular intervals.

(b) Non-continuous, *i.e.*, operative only when water is available.

This latter system is preferable if the shareholders are sufficiently united to operate it amicably. Where disputes are likely to occur, responsibility is more easily fixed under the former system.

## ORDER OF TURNS

The order of turns should be definitely laid down in accordance with one of the following systems :

- (a) Down the watercourse, *i.e.*, in order of distance of the off-take from the outlet. In this case, the order proceeds down the main watercourse to the head of the first branch; then down the branch before continuing down the main watercourse. Similarly, as regards sub-branches.
- (b) Round the watercourse, *i.e.*, down one bank and up the other; branches being treated as in (a) above.

The latter system has the advantage that it distributes lead and *nikal* more evenly but the former system is generally preferable as holdings usually lie on both sides of a watercourse.

Where two or more holdings are served by off-takes close together, and lead or *nikal* is of importance, the order of turns should alternate between the holdings.

## LENGTH OF TURNS

The length of turns should be strictly proportional to the area of the units and should be regulated by the common village clock.

Variation should not be permitted on account of variations in soil, and should only be allowed on account of the level of the land in exceptional circumstances.

## PLAN OF CHAK

The sanctioned *warabandi* should be accompanied by a copy of the *shajra*, on which the watercourse, the established off-take, the *nakkas* and the boundaries of the units are shown.

## FORM OF WARABANDI

The *warabandi* should be arranged in tabular form showing the following columns :

- (1) Order of turn.
- (2) Field numbers comprised in unit.
- (3) Name of shareholder.
- (4) Areas of units.
- (5) Length of turn in strict proportion to area.
- (6) Any additions or deductions.
- (7) Length of turn allotted.
- (8) Remarks : in this column "any additions or deductions" as per column 6 and any orders for "*Nikal*" will be made and every such entry will be signed and dated by the Divisional Canal Officer.

The method of operation laid down should be noted on the form. When the period is seven days and operation is continuous, the day and time of commencement of turn may be substituted for 7.

## APPENDIX II

## Schedule of charges in respect of principal crops on Bhakra Nangal Project

	By flow	By lift		By flow	By lift	
1. Sugar-cane (except on <i>Kharif</i> channels)	16-8-0	8-4-0	Crop	6. Oilseeds (except on <i>Kharif</i> channels)	6-6-0	3-3-0 Crop
2. Rice . . . . .	9-12-0	4-14-0	Do.	7. Wheat and Gram on <i>Kharif</i> channels	2-12-0	1-6-0 Do.
3. Gardens and orchards and vegetables except turnips . . . . .	8-4-0	4-3-0	Garden and orchards per half year, the rest per crop.	8. <i>Bajra</i> , <i>Masur</i> and Pulses . . . . .	4-14-0	2-7-0 Do.
4. Wheat (except on <i>Kharif</i> channels)	5-13-0	2-14-0	Crop	9. Gram . . . . .	4-7-6	3-3-0
5. Maize . . . . .	6-6-0	3-3-0	Do.	10. <i>Jowar</i> , <i>Cheena</i> , Grass which has received two or more waterings and all fodder crops including turnips . . . . .	3-12-0	1-14-0 Grass per half year and the rest per crop.

## APPENDIX III

**Rates for advance payment of betterment charges in respect of Bhakra Nangal Project**

	<i>Rate per matured acre</i>			<i>Rate per matured acre</i>	
	Gravity flow Irrigation Rs.	Lift irrigation maintained and operated by land- owners Rs.		Gravity flow Irrigation Rs.	Lift irrigation maintained and operated by land- owners Rs.
1. Areas which will ultimately receive perennial irrigation .	10.00	5.00	4. Areas where the type of irrigation is to remain the same but ultimately there is to be an improvement in capacity factor or intensity or water allowance .	2.50	1.25
2. Areas which will ultimately receive non-perennial irrigation	5.00	2.50	5. Areas where non-perennial irrigation is ultimately to be converted into perennial irrigation . . . . .	5.00	2.50
3. Areas which will ultimately receive restricted perennial irrigation . . . . .	7.50	3.75	6. Areas where non-perennial irrigation is ultimately to be converted into restricted perennial irrigation . . . . .	2.50	1.25

# MANAGEMENT OF IRRIGATION WATERS

by

Chief Engineer, Irrigation, Madhya Pradesh

## Introduction

The present state of Madhya Pradesh was evolved out of the merger of four units—(1) Mahakoshal area of old Madhya Pradesh, (2) Madhya Bharat, (3) Vindhya Pradesh and (4) Bhopal. The different units had their own systems of management of irrigation practice.

Figures 1, 2, 3 & 4 show the (1) Geological factors, (2) Soils, (3) Dominant crops, and (4) Rainfall isohyets. In regard to crops, it can broadly be said that rice predominates in the South while wheat dominates the Northern area of the State, with *jowar*, cotton, pulses, *etc.*, being grown in the wheat zone. In paddy area, 'Utera' crop, consisting of coarse cereals or pulses, sown in the paddy fields nearabout the maturity stage of paddy, is taken with the help of the residual moisture in the soil.

Though, these days considerable progress has been made in the matter of construction of irrigation works in the country, utilisation of irrigation water has not been as speedy or effective, with the result that we do not get full value out of the capital outlay on irrigation works. A little reflection on the present method of management of irrigation works in various states in the country would at once bring out the following points :—

- (1) The execution on irrigation works as carried out by the Irrigation Department of various States make for availability of water at or near the field level and there is a definite executive agency of the Irrigation Department for the purpose, charged with specific responsibility in this behalf.
- (2) From the point where water is made available by the Irrigation Department from irrigation works, construction of channels, their operation, control and distribution of water, rotation of crops, evolution of crop pattern, *etc.* and innumerable other items that make for proper utilisation of both water and land are left to various agencies without effective co-ordinating and controlling authority charged with specific responsibility and powers. It is assumed in the circumstances

that the Irrigation Department, that creates irrigation potential is responsible for its utilisation.

The necessity of proper attention to Item (2) above is obvious and urgent. The responsibilities have to be fixed in a defined manner and the work of various departments involved co-ordinated for best use of land and water under irrigation projects.

The large mass of our population lives on agriculture. To get the best out of it, it has to be raised to the level of an organised industry. Where irrigation water is made available, it has to be seen that most intensive use is made both of water and land as speedily as possible.

The different aspects, as they pertain to M. P. are discussed below.

## Construction of watercourses and Field Channels

The Irrigation Act of the Madhya Pradesh State provides for the following :—

- (1) Channels supplied with water from a canal : These channels which are termed as "Watercourses", are constructed by the State and maintained by the beneficiaries. Regulations have also been made where watercourses may be constructed at the cost of the beneficiaries.
- (2) Smaller channels taking off from the end of watercourses or directly from outlets of the watercourses, called 'field channels' are constructed and maintained by the beneficiaries.
- (3) Where beneficiaries do not carry out their obligations, there is a provision in the Act for the State to intervene and construct the channels at the cost of beneficiaries.

Further, in this State—

- (1) The Irrigation Department helps in the Survey, design and alignment of the field channel, if so desired by the beneficiaries, construction being the responsibility of the beneficiaries.

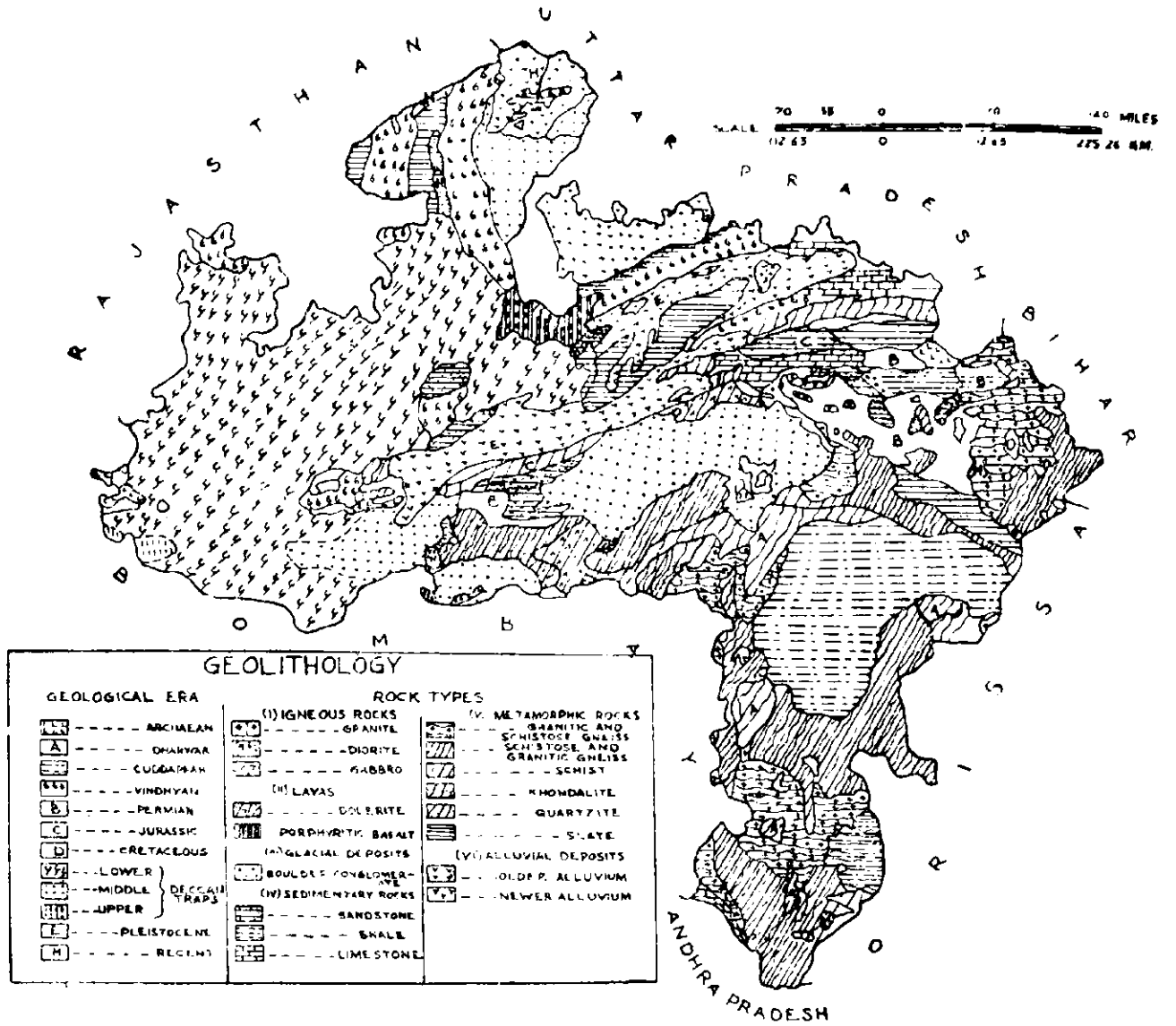


FIGURE 1 : Geological Factors.

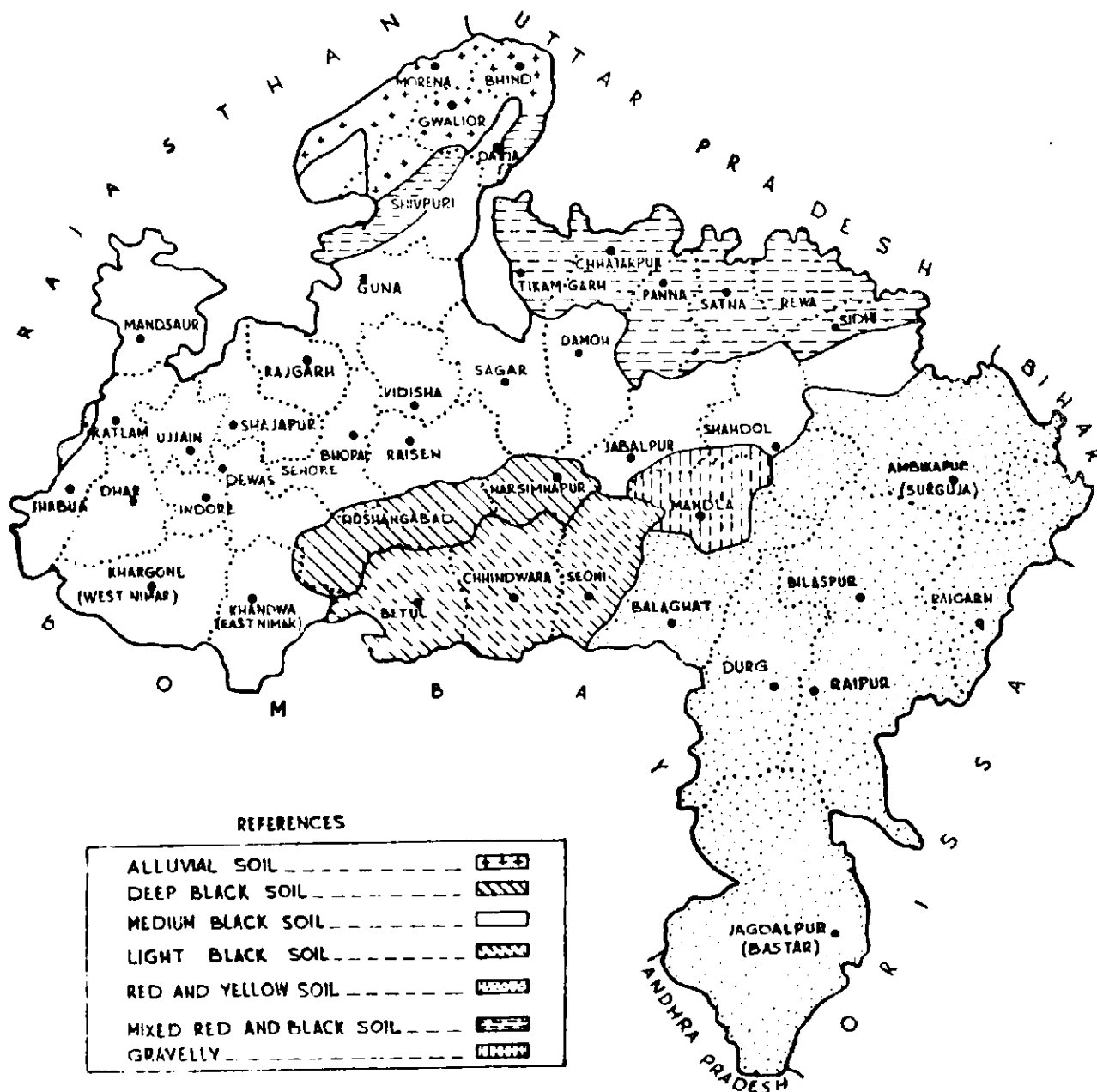


FIGURE 2 : Soil Types.

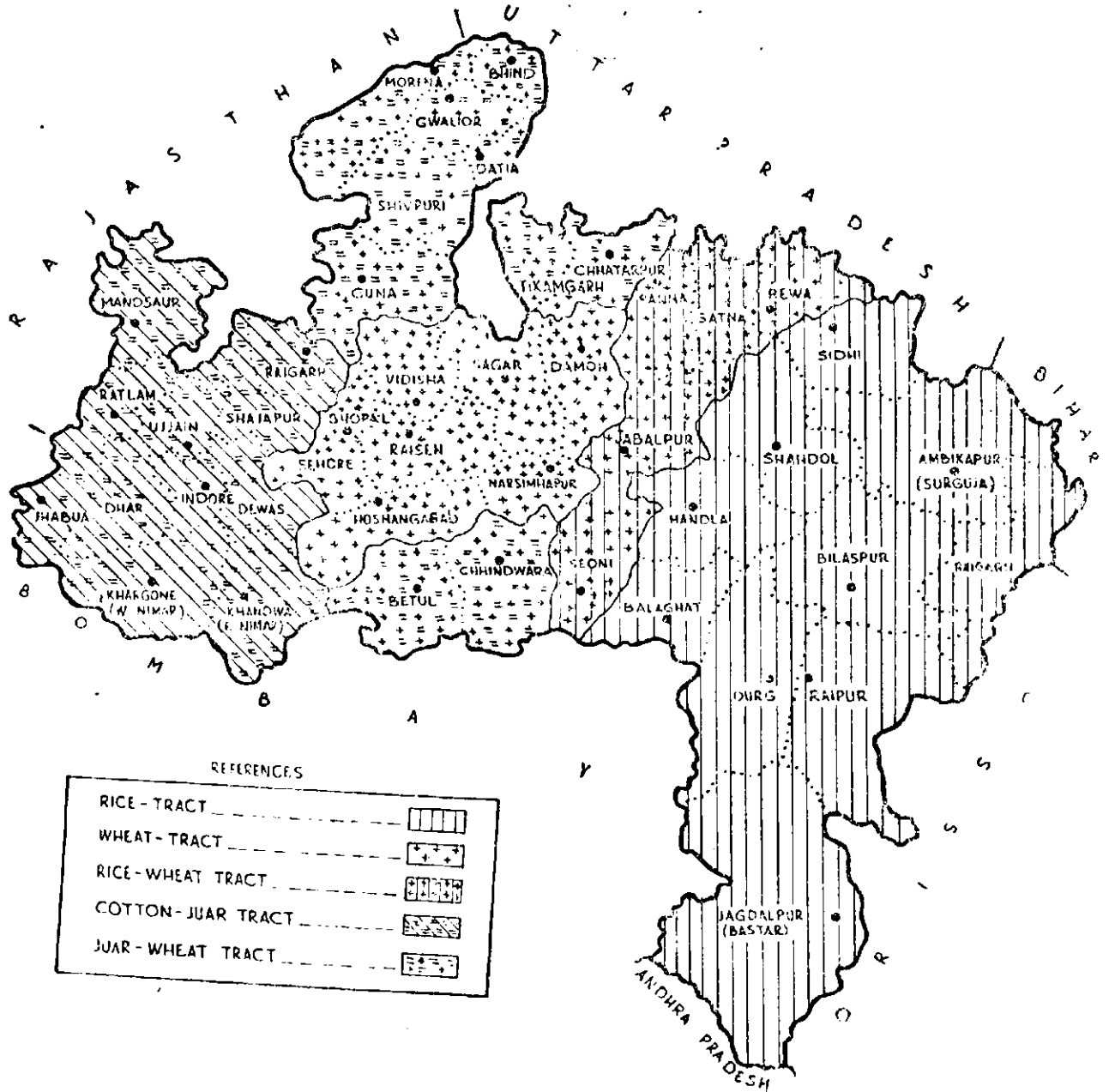


FIGURE 3 : Principal Crop Zones.



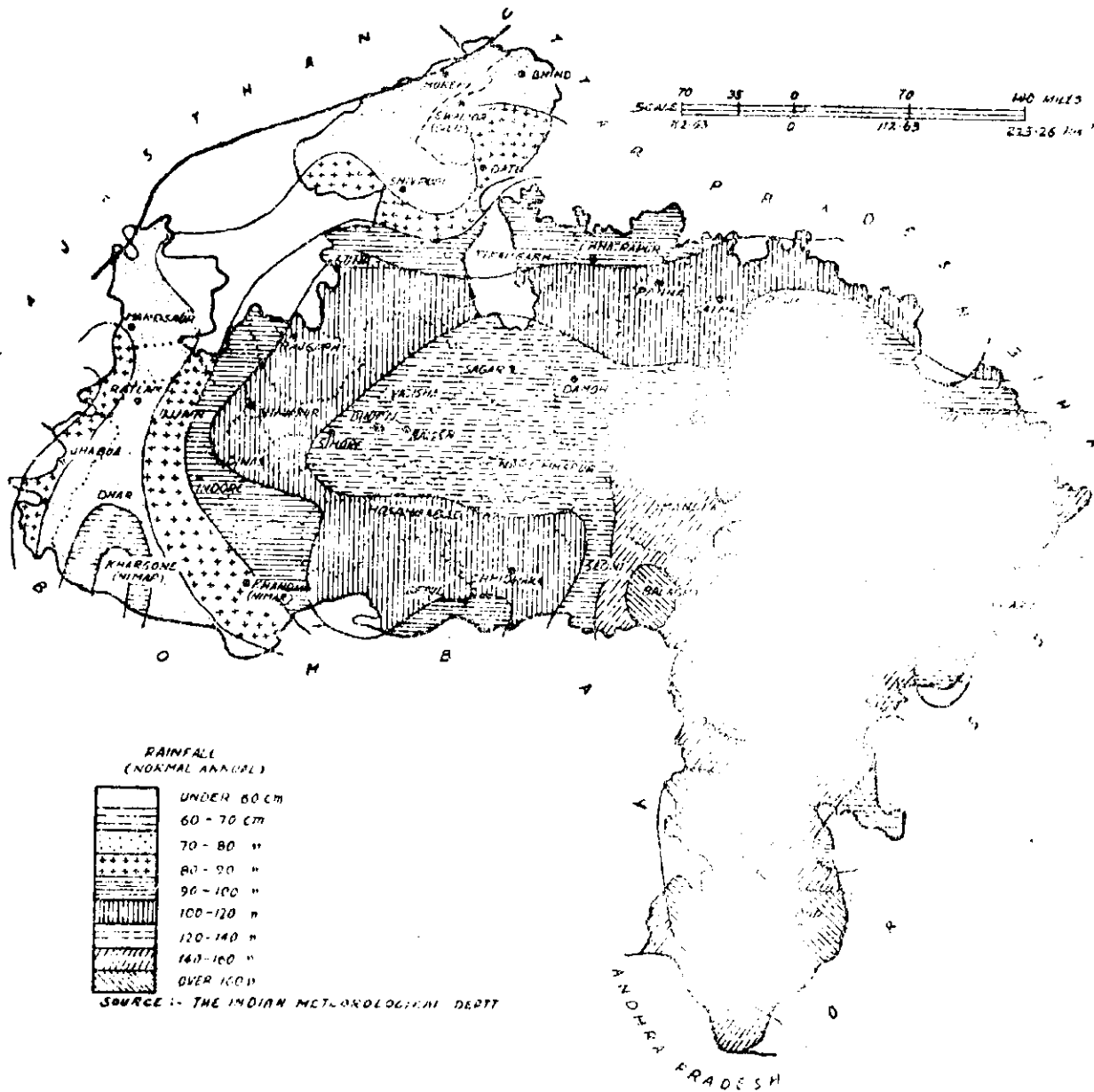


FIGURE 4 : Rainfall in Madhya Pradesh.

- (2) Under Section 76 of the Madhya Pradesh Irrigation Act, the Government grants loan of money to permanent holders towards cost of construction or improvement or private irrigation works; subject to the condition that the beneficiary maintains the work in good state of repair.
- (3) If, as usually happens, the field channel serves quite a number of cultivators whose fields are separated from the canal outlet by fields and other cultivators, who do not want irrigation, the department assists the beneficiaries in acquisition of the land required for the purpose.

The Irrigation Department, therefore, constructs channels carrying a discharge of not less than 0.028 cumec (one cusec) minimum. In regard to field channels, the officials of the Irrigation Department carry out surveys of cultivated land under each outlet and prepare plans showing alignment of field channels to be constructed by the beneficiaries. Notices are served on the beneficiaries to construct the field channels. If this is not done within a specified time limit, action is taken by the Department to get the work executed at the cost of beneficiaries.

In the commanded area of the Chambal scheme, field channels have been constructed by the Government at the cost of cultivators in an area of about 37635.80 ha. (93,000 acres) already and money is being recovered in instalments from the beneficiaries.

The Irrigation *Panchayat* constituted under the Act has no responsibility in the matter of digging up the watercourses. The *Panchayat* could be given powers of constructing watercourses at the cost of beneficiaries subject to the some conditions as would hold if they had been constructed by the Government.

Subject to the overall control of the Irrigation Department, fixing up "*Warabandis*" and settlement of disputes regarding distribution of water are the responsibility of the Irrigation *Panchayats* in Mahakoshal region of this State. These matters will be the responsibility of Irrigation *Panchayats* in other parts of the State when they are formed.

### Distribution of Water

In the matter of distribution of water, at present, there are different agencies in this State. In the old Mahakoshal region mostly paddy tract, the distribution of water beyond the outlet is the responsibility of Irrigation *Panchayats* duly elected under Section 93 (a-1) of the Irrigation Act, (Appendix I). For discharge of this function, the Irrigation *Panchayat* is given a share of the water rates under Rule 19(3) Section 62 of the Irrigation Act at a rate of 9 P. per acre of area irrigated. In the Act for this region, there is also a provision for distribution of water by employing *Banihar* by the Irrigation Department

under Section 93(a-1) of the Act. In this case *Banihar* is a paid employee, (elected by 95 per cent beneficiaries) responsible for distribution of water to the cultivators, under the personal responsibility of the Irrigation Officers. His wages are recoverable from the commission payable to the *Panchayat*. If the latter falls short of the required amount, it is made good from the beneficiaries. This system of distribution of water through Irrigation *Panchayats* by *Banihar*s has worked quite satisfactorily.

In the erstwhile Madhya Bharat, Vindhya Pradesh and Bhopal regions, where *rabi* irrigation is comparatively much more than *kharif* irrigation and Government irrigation works are far flung the responsibility for irrigation beyond the outlet still vests with Irrigation Department. This is an avoidable strain on the Irrigation Department. Action is being taken to extend the Mahakoshal system of water distribution to the rest of the State. Necessary legislation in this respect has been enacted. On enforcement, the responsibility of the Irrigation Department in the matter of water distribution beyond the outlet will be to see that the Irrigation *Panchayats* carry out their duties properly and to take up water distribution through "*Banihar*s" only in such cases where net loss than 2/3rd of area or not less than 95 per cent of the permanent holder of all land ask for it.

From the prevailing practice in Madhya Pradesh, it would be seen that the ultimate responsibility of construction of even the smallest channels for conveyance of water rests with the Irrigation Department, whether the work is done at the cost of the Government or at the cost of the beneficiaries. In regard to operation and maintenance, though Irrigation *Panchayats* are attending the actual distribution of water in some area and would be doing so progressively in other areas the fact remains that the responsibility for distribution and control over outlets for distribution rests with the Irrigation Department. This department is considered responsible if an area does not receive water in time. It has to fix the *Warabandi* and regulate control at a channel heads.

### Assessment and Collection of Revenue

The system of assessment of Irrigation Revenue and its collection in the State are different in Mahakoshal region from that in Madhya Bharat, Bhopal and Vindhya Pradesh.

The revenue establishment in Madhya Bharat consists of (1) Superintendent, *Abiyana*; (2) *Zilledar*; (3) *Naib Tehasildar* (Irrigation); (4) *Amin*; and (5) *Patrol*. The patrol makes the initial entries in the *Khasra Shudkar*. His duties are analogous to that of a revenue *patwari*. His work is checked by the *Amin* whose main function is to do the *Girdawari*, prepare *Jamabani* and *Parchas* as per entries in the *Shudkar*, *Naib Tehsildar* is subordinate to the *Zilledar*. His

principal duties are, to make village-wise allocation of areas declared under 'Ailan' by the Executive Engineer. He is responsible for recording of irrigation by the patrol and *Amin* and also for collection of revenue in his jurisdiction. He investigates cases of unauthorised irrigation and remission and submits the report to the Executive Engineer. The *Zilledar* is the reserve head of *Abiyana* in the division and is responsible for correctness of all such records and full realisation of irrigation revenue. The Superintendent, *Abiyana*, is subordinate to the Superintending Engineer, and is responsible for checking revenue receipts of the Circle.

In Mahakoshal, irrigation is done mainly for single crop of paddy. Here the revenue establishment is (1) Canal Deputy Collector; (2) Irrigation Inspector; and (3) *Amin*.

The Irrigation of paddy is generally done under A-I Form of agreement which greatly simplifies the assessment of irrigated area. By this system, which is binding for five or ten years, the areas to be assessed are fixed by *Girdawari* done by the Sectional Officers and Irrigation Inspectors, prior to the drawing of the agreement. The water charges on the fixed areas are leviable during the currency of the agreement whether water is taken or not. There is no charge on additional area brought under irrigation during the agreement period.

The collection of water rates is initially done by the Irrigation *Panchayat* up to a fixed date according to the demand statement (*Jamabandi*) prepared by Canal Deputy Collector. Later, the arrears are recovered as that of land revenue by the Canal Deputy Collector by issue of warrants.

In the Bhopal region, *Zilledar* with the help of *Amins* and Patrols assesses the area irrigated from the State tanks and compiles assessment papers which are sent to the revenue authorities, i.e., the Collector, for collecting the assessed revenue. In Vindhya Pradesh area, the system of assessment and collection is analogous to that in the Bhopal region.

The authority responsible for the assessment is the Irrigation Department. No change in this procedure is called for. It is, however, proposed to entrust all collection of revenue to the Revenue Department.

Though, as a result of large-scale irrigation work recently constructed, irrigation potential is continuously increasing utilisation is lagging behind. At present, the Government is calling attention of the Irrigation Authorities to this lag in utilisation, in the absence of any other authority definitely charged with the responsibility of this aspect of irrigation works.

(1) *The responsibility of the engineers in the field distribution of water and how it can be implemented and in what manner should this be further enhanced or reduced to ensure optimum utilisation.*

Though the Irrigation Department is empowered in the State to undertake construction of watercourses at State cost and of field channels at the cost of beneficiaries if they do not construct themselves, there is no provision in the Irrigation Act for some sort of compulsory levy from the beneficiaries whether they utilise the water or not. When the Government can undertake to construct field channels and recover the cost from the beneficiaries, it stands to reason that there should be some compulsion on the cultivators to use the water. This compulsion may take the form of compulsory water rate, or at least a water cess that would meet the cost of maintenance of the irrigation system.

The responsibility of the engineers in the matter of field distribution of water should, therefore, extend up to the construction even of field channels. The maintenance of water courses and field channels should, however, be left to beneficiaries or to Irrigation *Panchayats*, who should be made jointly responsible for it. It is, therefore, suggested that—

- (i) It should be the responsibility of the engineers to construct channels carrying a discharge up to 0.028 cumec (one cusec) minimum. The beneficiaries or the Irrigation *Panchayat* should construct field channels carrying a discharge of less than 0.028 cumec (one cusec).
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- (iii) There should be compulsory water cess to be levied from the beneficiaries, whether they use the water or not.
- (iv) Maintenance of watercourses and field channels should be the responsibility of the beneficiaries or the *Panchayats*. It is not possible for the irrigation Department to maintain them as they lie in the fields and cannot be controlled by the engineers effectively from trespass by cattle, etc., in the fields.

In the matter of distribution of water regulation of discharges for various channels in the irrigation season should be in charge of the Irrigation Department, who should deliver water at outlet or watercourse on the basis of water allowances fixed for different crops at different periods by the Project Development Committee (discussed below).

- (v) Utilisation of water by the beneficiaries beyond the outlets should be the concern of the Project Development Committee

- (2) Under Section 76 of the Madhya Pradesh Irrigation Act, the Government grants loan of money to permanent holders towards cost of construction or improvement or private irrigation works; subject to the condition that the beneficiary maintains the work in good state of repair.
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In the matter of distribution of water regulation of discharges for various channels in the irrigation season should be in charge of the Irrigation Department, who should deliver water at outlet or watercourse on the basis of water allowances fixed for different crops at different periods by the Project Development Committee (discussed below).

- (v) Utilisation of water by the beneficiaries beyond the outlets should be the concern of the Project Development Committee

with the district Collector or his representative as the presiding officer and representatives of the Agriculture and the Irrigation Departments on it, as discussed further in the note.

(2) *The role of agricultural department regarding land levelling, supply of manure, etc., and how far and in what manner the responsibility for field utilisation can be laid on them.*

The Department of Agriculture has a very effective role to play in the matter of development of irrigation. They have to carry out soil surveys to advise cultivators on the right type of crops, crop seasons, manures and fertilisers corresponding to different crops, crop pattern and rotation of crops. The depth of periodicity of irrigation watering, etc., they have also to concern themselves with distribution of improved seeds, fertilisers, etc. They have also to lend agricultural implements if necessary. They have to organise demonstration farms if called for. Land levelling in individual fields at the cost of beneficiaries and land reclamation in general, should also be the responsibility of the Department of Agriculture. In fact, most of the functions bearing of utilisation of water fall to the lot of the Agriculture Department, so that the general responsibility for utilisation should devolve on this department. The Department of Agriculture should frame proposals with estimates for development of the tract as soon as the project is sanctioned and should have funds placed at its disposal to the Project Development Committee, if approved extension services for purpose of speedy utilisation in the area.

(3) *The responsibility of Panchayats in digging up of watercourses, fixing of warabandis and settlement of disputes regarding distribution of water, their present performance and future set-up.*

As explained earlier, distinction is being made in this State between a watercourse and field channel. The watercourse from an outlet extends to the point the discharge gets reduced to 0.028 cumec (one cusec). Beyond this point, the channel and its branches are termed field channels. They carry a discharge of less than 0.028 cumec (one cusec).

The responsibility of construction of these channels has been discussed earlier in the note. While the Irrigation Department constructs the watercourses at the cost of the State, the responsibility of construction of field channels rests with the beneficiaries and, in case of any default, they are constructed at their cost by the Government. The maintenance of both watercourses and field channels is the responsibility of the beneficiaries. The Irrigation Panchayats can be made responsible for construction of field channels and maintenance of watercourses and field channels in their area. If concerned beneficiaries fail to carry out the work in their fields or areas.

In any case, it is impossible for the irrigation department to maintain field channels as they cannot effectively control them, lying as they do in the fields of cultivators. Fixing of warabandis and settlement of disputes should also be the responsibility of the Irrigation Panchayats. In the event of their failure to resolve any dispute, a reference should be made to the Irrigation Authorities in this respect.

(4) *Who should be responsible for changing the crop pattern occasionally in order to get the maximum utilisation of irrigation water.*

The initial crop pattern under unirrigated conditions, which would form the criterion of design of distribution system, should be provided by the Agriculture Department after necessary soil surveys, staple food in the area, genius of the cultivation, rainfall in the area, etc. This would have to be the crop pattern of best returns to the cultivators under prevailing conditions. The Agriculture Department has to be responsible for revising the crop pattern, as and when necessary. The revision of crop pattern will have to be done by Agricultural Officers in consultation with the Irrigation Officers as the canal capacities are very much linked with the question of crop pattern and duties and deltas. The responsibility, that the crop pattern adopted in the project is actually followed in the field, should be that of the Agriculture Department, as this department is best suited for guiding and moulding the crop pattern in the ayacut.

At present, in the absence of soil surveys, the trend of evolution of a crop pattern under irrigated conditions is not known in tracts where irrigation is being freshly introduced. For a sizeable project, the Agriculture Department is being consulted for irrigated crop pattern. Their suggestions often lack realism as they are not based on scientific data of soil surveys, etc. In regard to requirement of water for crops also, very reliable figures are not available from the Agriculture Department. It is necessary, therefore, that there should be a separate agricultural extension service for irrigated areas or areas to come under irrigation. Units of this service should start functioning as soon as a project is sanctioned. This service and its units have to work in close liaison with the Irrigation Department of the State.

(5) *The relative responsibility of the various units responsible for these activities and how they can be inter-related and co-ordinated.*

It happens that cultivators, in some cases, are not willing to take water for their crops. They do not come forward easily to adopt the new crop pattern under irrigated conditions. They also have numerous difficulties in the matter of proper seeds, fertilisers, levelling of their fields, marketing facilities, credit, etc., which militate against full value being derived from the use of water given to them. In cases where proper

utilisation of water is not being done even though water is available at the required points in required discharges, the blame should not be laid at the door of the engineer. He cannot control any factors beyond the last point in the field at which he makes water available. If the potential is thus created but not utilised, the responsibility must devolve on other concerned departments of the State.

When the potential has been created in such a manner that water is available at the field, the responsibility for further measures to see the utilisation of water should rest with the Agriculture Department through the Project Development Committee.

It is essential that an Irrigation Development Committee is formed under each project immediately it is sanctioned. These committees should consist of representatives of the Revenue, Agriculture and Irrigation Departments with representatives of other departments like Co-operation, etc., co-opted if felt necessary by the Collector, who should be made responsible for proper development of the commanded area under the project. The responsibility of the engineer must cease when he has created potential at the field level though he can go on assisting the Development Committee. He also has to issue water as required for crops, from time to time, and manage the flow in channels in the Irrigation Season.

Proper development in the commanded area cannot be confined to agriculture only as a number of socio-economic problems will also be required to be tackled. The Revenue Department can only deal effectively with such connected problems.

The help of Block Development Officers in the Community Development Programme should be available in full to the Development Committee.

The following procedure would help accelerate rapid utilisation of the potential created :

- (i) As soon as a project is sanctioned the Irrigation Department will make the plan of the tank basin and the commanded area available to the local officers of the above departments who will form the Project Development Committee under the Collector or his representative. The status of officers on the committee will be determined by the size of the project.
- (ii) The B.D.O. or *Naib Tehsildar* of the commanded area will collect basic data in a standard proforma to be evolved for the purpose. The Project Development Committee will go through the data, decide the line of action on the different items and ask the departments concerned to submit estimates for work concerning activities of these departments.

(iii) It will also decide the work to be carried out by cultivators in the area and recommend loans and subsidies to be provided for the purpose.

(iv) The estimates received from the different departments will be scrutinized by the Committee and approved so that works pertaining to respective departments could be undertaken.

(v) The Committee will directly undertake tours of the villages, commanded by their projects, and will ensure that all necessary steps are taken to see that the cultivators do not suffer from any one of the handicaps pointed out earlier. Deficiencies, if any, should be got rectified in time.

(vi) Collector or his local representative will be responsible to see to co-ordination of efforts of different departments. In fact, development of irrigation under each individual project during the incumbency of a member of committee should form one of the important points of confidential reports on his work.

(6) *The present method of assessment, the authority responsible for assessment and the effect of such assessment on the total water management.*

The present system of assessment has been discussed earlier in the note. It is proposed that assessment of irrigated areas of different crops should continue with the Irrigation Department under the control of Project Development Committee.

(7) *The present system of rotation and its effect on the development of irrigation in the project area.*

In the Mahakoshal area of old Madhya Pradesh, the most predominant crop is paddy. In the Chhattisgarh tract of the State, there is practically no irrigated crop except paddy. In Madhya Bharat, Bhopal and Vindhya Pradesh regions, however mixed crops are taken. In the old Gwalior State area, under well developed Harsi and Bind canal systems, paddy, wheat and sugar-cane are the irrigated crops. The soil is suited for all these crops. There is a tendency of cultivators to take increasingly to paddy in preference to wheat and, where they can afford it, to sugar-cane also. In practice, increasing demand of water for paddy irrigation in these tracts has to be discouraged in the interests of *rabi* crops, the storage of water being limited.

While, therefore, there is no system of rotation in the Chhattisgarh tract where paddy is the only crop taken, rotation is in practice in other regions between paddy, wheat, sugar-cane and dry crops like *jawar*.

(8) *The types of outlets mainly used in the area and how they effect the utilisation.*

In this state, mostly uncontrolled types of outlets are in use for small distributaries, minors, sub-minors, etc., controlled outlets being restricted to main canals and their branches. The outlets do not provide for constant discharge with varying head. They are capable of being tampered with by cultivators.

Close and suitable watch over the working of these outlets by the departmental staff has, however, avoided much of the difficulty and, by and large, they have worked satisfactorily. They are simple, economical, easy to instal and maintain. For *Rabi* areas or mixed crop areas which are comparatively small, other types of outlets are being tried and their effect on utilisation watched. It will take some time before any definite recommendations in the matter of outlets can be made.

## APPENDIX I

### Extract of Section 93 (a-1) of the Central Provinces Irrigation Act

#### SECTION 93 (a-1)

(1) In these rules:—

- (a) 'Banihar' means any person belonging to labour class, selected by permanent holders of land under agreement in a village to supervise and control the field to field and day to day distribution of water beyond the outlet.
- (b) 'Section-subordinate' means a section-subordinate of the Public Works Department.

(2) The distribution of irrigation beyond the outlet shall be controlled by either of the following agencies according as the permanent holders of the land under agreement in a village, *mahal* or *chak* may elect, namely:—

- (a) the Irrigation *Panchayat* constituted in accordance with rules made under sections 62 and 93; or
- (b) *banihars* selected by the permanent holders.

(3) When either the permanent holders of not less than two-thirds of, or not less than 35 per cent of the permanent holders of, all land under agreement in a village, *mahal* or *chak* desire that the control of irrigation beyond the outlet in their village, *mahal* or *chak*, should be vested in one or more *banihars*, they shall intimate their assent in writing to the section-subordinate.

(4) On receiving the intimation under Rule 3, the section-subordinate shall intimate the same to the Sub-Divisional Officer who shall fix the number of *banihars* to be selected in each village, *mahal* or *chak* and the date, time and place for the selection of *banihars* and cause the same to be proclaimed in the villages concerned not less than seven days before hand.

(5) All permanent holders of land desiring to take part in the selection of a *banihar* or *banihars*, as the case may be, shall attend on the date and at the time and place fixed under Rule 4. The section-subordinate shall hold the selection of a *banihar* or *banihars*, as the case may be, in such manner as may be determined by him and shall inform the Sub-Divisional Officer the result of the selection.

(6) The *banihar* or *banihars*, selected under Rule 5 shall be appointed by the Sub-Divisional Officer to hold their posts for the period of currency of the irrigation agreement of the village, *mahal* or *chak* unless they are previously dismissed by the Sub-Divisional Officer for recorded reasons.

(7) Irrigation *Panchayat* or *banihar*, as the case may be, in the performance of its or his duty to control the distributions of irrigation beyond the outlet, considers that it is expedient to pass the water received by a person in his field for irrigation beyond such field the *Panchayat* or *banihar* shall see such person to allow the water so to pass to the satisfaction of the *Panchayat* or the *banihar*. If such person refuses to allow the water to pass, the *Panchayat* or *banihar* may enter upon such field and take such action as it deems fit for the passage of water beyond that field.

(8) The Irrigation *Panchayat* in a village, *mahal* or *chak* in which *banihars* have been appointed for controlling the distribution of irrigation beyond the outlet, shall not be paid any commission for administrative work under Rule 20(3) of the rules framed under sections 62 and 93. The amount of such commission shall be utilised for remunerating the *banihars*.

(9) The remuneration of *banihars* shall be determined and paid by the Executive Engineer. It shall be met from the commission for administrative work which would have been payable to irrigation *Panchayat* under Rule 20(i) of the rules framed under sections 62 and 93. If the amount of such commission falls short of the remunerations fixed the difference shall be recovered from the permanent holders of the land under agreement in the village, *mahal* or *chak*, the amount recoverable from each permanent holder being get remind in proportion to the area under agreement held by him.

If permanent holder commits a default in payment of the sum payable by him for the remuneration of a *banihar* under sub-rule (1) the Tehsildar shall recover the amount by process (b) in section 128 of the Central Provinces Land Act, 1917, and follow as far may be the same procedure as is followed in the recovery of the arrears of land revenue by the said process.



# LAND AND WATER MANAGEMENT IN ANDHRA PRADESH OUTLINING RECOMMENDATIONS FOR EFFICIENT WATER USE

by

P. T. Malla Reddy\*

Andhra Pradesh popularly known as river State, is noted for its fertile land and abundant water resources. Two of the biggest inter-state rivers in India, i.e., the Godavari and the Krishna with some of their major tributaries pass through the heart of the State providing irrigation facilities and potentialities, to large extent, of fertile lands. Other rivers like the Pennar, Vamsadhra, Nagavalli and number of minor coastal rivers also provide some irrigation facilities and have immense potentialities, for irrigating a considerable part of the land in the State.

The prosperity and well being of the state greatly depends upon the developments of its water and land resources for the purposes of irrigation and power. It may be interesting to note that out of the State's total geographical area of 274150.44 sq. km. (1,05,850 sq. miles), an area of 16586.30 sq. km. (57,704 sq. miles), i.e., more than 50 per cent of the total area lies in the Krishna and Godavari basins. Out of the total area of 2524004.73 ha. (62,36,946 acres) irrigated in the state under Government canals and tanks (as during 1959-60) the extent irrigated from the waters in the Krishna and Godavari basins is as much as 1532234.27 ha. (37,86,230 acres) which works out to nearly 61 per cent of the total. The total culturable commanded area in the Krishna and Godavari basins lying in Andhra Pradesh State is nearly 80.94 lakh ha. (200 lakh acres) of which only an extent of 15.32 lakh ha. (37.86 lakh acres) is at present being irrigated. From this it should be obvious that there are immense possibilities of further development of irrigation in the State under the Krishna and Godavari basins.

The areas in Andhra Pradesh where waters can be used for irrigation are very fertile and productive. Andhra Pradesh has been playing a vital role in the rice economy of the country. At present Andhra Pradesh stands foremost among all the States of India in giving surplus rice to the nation. Andhra farmers have the advantage of accumulated experience, of several centuries in productive rice cultivation. This is largely due to the existence in the State of ancient and big irrigation reservoirs such as Pakhal, Laknavaram, Ramappa Gumbum, Badvel, and Ananta-Sagaram not to

mention the century old deltas of the Godavari-Krishna and Pennar. The soils, the climate and the husbandry in Andhra Pradesh are best suited to rice production.

## Control of Supplies in River and Stream for Public Purposes

At present the Government have full powers to control for public use, the water supplies in all rivers, streams, natural lakes and reservoirs. No one can utilise water from any of these sources without obtaining the specific sanction from the Government. Penal clauses are applied whenever cases of unauthorised usage of water are detected. Construction and maintenance of all works intended for utilisation of water for irrigation, water supply and other needs rest with the Government. Whenever new works are sanctioned, care is taken to assure supplies to the already existing demands lower down the river so as to safeguard the lower riparian rights. While designing new works, due allowance is also made for requirements of all existing upstream demands and net utilisable yield, at the point of the proposed work, only is taken into consideration. Reasonable compensation is paid to the persons affected by the construction of any new projects and steps are also taken to rehabilitate all the displaced persons at the cost of the project.

## Classification of Irrigation Works

In Andhra Pradesh Irrigation works are divided into three classes :—

- (a) Private irrigation works.
- (b) Minor irrigation works and tanks with ayacut less than 80.94 ha. (200 acres) each in Andhra Pradesh area and 40.47 ha. (100 acres) each in Telangana area.
- (c) Major tanks and other irrigation works.

The number of works of category (a) referred to above are very small.

Works under category (b) have been always maintained by the Revenue Department. After the formation of Zilla Parishad works in this category were transferred to them and

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put under the control of Superintending Engineer, Local Administration, under the Chief Engineer, Buildings and Public Health, Public Works Department. The Superintending Engineer, Local Administration, maintains all minor tanks within his competency of sanction. Funds required for such works are provided by the *Zilla Parishad*.

Works in category (c) above comprise large sized tanks or systems of tanks built one below the other on a single stream, operation and regulation of which would be fairly involved. Such works are built and maintained by the Public Works Department, Irrigation Branch of the State.

All other major and medium canal systems with appurtenant works also fall in category (c) and are constructed and maintained by the Public Works Department, Irrigation Branch.

#### Localisation of Ayacut, Regulation of Supplies and Distribution of Water

In this State cultivators are entitled to supplies from old tanks and old irrigation works if their lands are classified wet for purposes of assessment. In case of new irrigation works like Tungabhadra Project, supplies are given only to 'localised' areas. Irrigated, dry and precarious wet lands are also entitled for supplies along with classified wet lands. Localised areas under new irrigation works include all the above three categories, *i.e.*, wet, precarious and irrigated dry.

Supplies are also sanctioned by an Executive Engineer on a temporary annual basis, on receipt of application from cultivators, if there are any waters surplus to earlier commitments. If such supplies are sanctioned continuously for a period of 3 years, they are made permanent with the concurrence of the Collector.

The work of 'localisation', for new major and medium irrigation schemes is done by a team consisting of an officer each from the Irrigation Branch, Agricultural Department and the Revenue Department. The Irrigation Officer prepares a contour map of each village showing contours at 0.3 m. or 0.6 m. (1 ft. or 2 ft.) intervals of the area which can be commanded. The agricultural officer on the basis of soil-surveys specially made for the purpose, classifies each field indicating its suitability for different irrigated crops. After this information has been collected, the team visits each field and prepares the 'localisation scheme' for each village, indicating the area to which irrigation facilities are to be extended and the crops to be grown. In doing this work, the following points are required to be taken into consideration:—

(a) The benefits of irrigation be extended to as large an area as possible, in consistent with the economic utility of water and other local considerations.

- (b) Demand for irrigation supplies should be steady in a year of normal rainfall.
- (c) The economic conditions of the people and their willingness to take to irrigation.
- (d) The adequacy of the existing resources in the village with regard to cattle population, transport facilities, *etc.*
- (e) The prospect of developing irrigation in the 'localised' area within a reasonable time.

The lands considered suitable for different types of crops are generally kept in large compact blocks and as far as practicable, separate outlets are provided for wet crops and dry crops. Irrigation around the periphery of a village for a distance of two furlongs is generally avoided as an anti-malaria measure.

The scheme for 'localisation', as drawn out by the team is sent by the revenue officer to the Collector who gives due publicity to it in the village and, on an appointed date, calls a meeting of the villagers to ascertain their views and objections, if any. After taking these into consideration, the scheme is finalised and a copy of the final scheme is posted in the village for information of the cultivators concerned. On the basis of the localisation scheme, an ayacut register is prepared and individual notices are issued to persons whose lands are included in the localization scheme directing them to prepare their land for receiving water before the prescribed date. For all areas included in the localization scheme it shall be compulsory for the land owner to pay consolidated wet assessment rate as may be approved by the Government irrespective of the facts whether he takes canal water or not.

Each cultivator thus acquires a right to get irrigation supplies according to the classification of his land, either as recorded in the settlement records or as decided at the time of localization. The cultivator is required to pay water rates according to the classification of his land.

Canals and distributary channels are fitted with regulators having sluice gates to enable regulation and distribution of supplies on a proportionate basis. On distributaries, outlets more than 15.24 cm. (6 in.) in size are generally of orifice type, fitted with sluice gates. Smaller outlets are generally pipe outlets.

To ensure equitable distribution of supplies all channels are run proportionately on a day-to-day basis. It is the primary duty of the sub-divisional officers to issue instructions for regulation and distribution of supplies every morning on the basis of supplies available at head. It is only in case when supplies available are very low that on a distributary system rotational running of outlets is adopted. Channels are seldom run in rotation.

To ensure equitable distribution of supplies 'Irrigation conservancy subordinates' and 'delta laskars' are employed under overseers. Their main duty is regulation and distribution of supplies. Irrigation conservancy subordinates and delta laskars also maintain a record of area irrigated from day-to-day. This is just to watch the progress of irrigation and does not form the basis of assessment of water rates.

There are two main irrigation seasons :

- (i) June to December.
- (ii) January to April.

The channels are generally kept closed during the month of May.

#### **Measures adopted in Andhra Pradesh for the Development of Ayacut under Major and Medium Schemes**

The Irrigation potential created by the construction of reservoirs or diversion schemes and excavation of the canal and distributary system is defined as the scope for development of commandable land in terms of acres under each scheme. The total potential is the area proposed and localised for development by the Public Works Department, Revenue and Agriculture Departments.

Actual development of area irrigable under the projects is being looked after by the Board of Revenue under the coordinated guidance of the allied departments. For this purpose, the Government have constituted the Irrigation Development Board with the Member Board of Revenue incharge of Irrigation as Chairman and the Heads of Departments of P.W.D., Agriculture, Co-operation and the Additional Development Commissioner as members at the State level. District Irrigation Development Boards have also been constituted for each district with the District Collector, as Chairman with Superintending Engineer concerned or his nominee and the District Agricultural Officer or Deputy Registrar as members. The progress on development of ayacut under various plan projects is being reviewed by the Irrigation Development Boards at the State and the District levels in their meetings. The State Irrigation Development Board is fixing targets of development for each project every year and reviewing their achievement periodically. Any difficulties and bottle-necks noticed impeding the progress of development of ayacuts are being examined at the meeting; instructions thereon are being given to set right the bottle-necks. The Board of Revenue is watching the progress by obtaining monthly progress reports from the Collectors concerned and also by obtaining copies of the proceedings of the District Irrigation Development Board meetings and the quarterly resume of discussions held by the Collectors with the Superintending Engineers concerned.

In order to accelerate the utilisation of waters and to step up the food production the Government of Andhra Pradesh have laid down the following procedure for excavation of field channels under the Irrigation Projects in the State :

- “(a) The field channels in any new irrigation scheme should be excavated at Government cost up to the periphery of each district wet block irrespective of the areas of such blocks subject to a maximum limit of Ac. 25-00. In old delta areas, however, the existing practice of excavating distributary channels at Government cost up to Ac. 150-00 limit and acquiring land at Government cost for the field channels up to Ac. 25-00 blocks only should be continued.
- (b) The field channel should be excavated to each individual survey number in the case of blocks of irrigated dry crops.
- (c) The funds required for the excavation of channels and distributaries under (a) and (b) should be found from the concerned project estimates.”

#### **Recommendations for Effective Management of Irrigation Works and to achieve Optimum Utilisation of Water**

As a first step, the Public Works Department should be empowered to manage all irrigation projects—major, medium, minor or small tanks—and all stages of planning, construction, operation and development including the assessment of water charges. It is necessary that all the development of water resources for irrigation and of their ultimate use should be under unified control.

While no control need be exercised, at this stage, with regard to development of irrigation from wells, except where such development is an integral part of a canal system, it is necessary to have in the Irrigation Department Officers to advise cultivators with regard to developments from wells and who should maintain a record of well operations. These officers should also maintain records of the operation of private irrigation works and watch the effect on the hydrology of the basin, of contour bunding and land treatment in non-irrigated areas.

It is also necessary to introduce necessary legislation along uniform set of principles to facilitate optimum development of the water resources available laying down appropriate powers for the Government and the rights and obligations of the cultivators. A more or less uniform basis for charges for irrigation water supplies and betterment levy, etc., should be established.

The present system of administrative account of irrigation projects should be reviewed and revised to take note of the changed conditions such as the new direct receipts from agricultural commodities. An appropriate basis should be established for taking note of indirect benefits in the administrative accounts.

There should be in every Irrigation Department, a soil survey wing, whose duty should be not only to carry out a scientific soil survey of all areas proposed to be supplied with irrigation waters but also, periodically, to carry out soil survey of the areas already under irrigation in order to study the effect of irrigation supplies on the soil characteristics so that necessary ameliorative measures can be taken and irrigation ensured as a permanent feature of agriculture.

An Irrigation extension service should be introduced as a part of Irrigation Department.

The main functions of the proposed Irrigation Extension Service should be :

- (i) To carry out systematic studies on the economic use of irrigation waters, in consistent with maximisation of agriculture output; to determine for each region or district the best crop pattern so as to make maximum use of seasonal rainfall, to co-operate with regional research stations of the Agricultural Department in research on new varieties of crops best suited to the nature of irrigation supplies available in any area.
- (ii) To determine the consumptive use of water by major agricultural and garden crops.
- (iii) To set up a number of demonstration centres and arrange for field demonstrations to show to the cultivators how they can use the available irrigation supplies for maximum benefit, proper land treatment required for each field, proper method of irrigating the field, when to apply irrigation water and how much.

- (iv) In conjunction with the soil wing, proposed in the previous paragraph, advise the cultivators on soil problems.

An organisation of the type described above, as a part of the Irrigation Department, is indispensable in any State where large-scale irrigation is being introduced in the uplands for the first time, water is scarce and expensive, but irrigation use to date has been somewhat extravagant. The change-over from un-irrigated to irrigated agriculture in large areas requires expert guidance and supervision.

The proposed Irrigation Extension Service would supplement the present activities of the Agriculture Department. While the Agriculture Department can concentrate on improvements in un-irrigated areas, research on new varieties of crops both irrigated and un-irrigated seed multiplication, *etc.*, the Irrigation Extension Service would show the irrigators how irrigation waters can be used economically to maximum advantage, how land must be prepared for irrigation, the importance of watercourses and explain to them the inter-relation between irrigation and soil.

### Conclusion

The functions of the Public Works Department should cover not only the construction and maintenance of engineering works but also the development of ayacut which involves construction of watercourses, soil surveys, localization works, *etc.* The work connected with the setting up of agricultural research stations and demonstration farms, advancement of loans for levelling of lands, purchasing of manure, seeds, live stock, *etc.*, should also preferably be kept in charge of the Public Works Department so as to enable keeping a close watch on the proper utilisation of irrigation waters and to solve all problems arising in the process of irrigation. This is very essential for achieving efficiency in water and land management and for obtaining optimum water utilisation.

# MANAGEMENT OF IRRIGATION WATER

by

V. Rama Rao\*

The older system of Irrigation in Orissa comprises (i) Rushikulya System and (ii) Orissa Canal System.

In Rushikulya System, which was formerly under Madras Government prior to formation of Orissa in 1936, there exists permanent system of ayacut assessment which is still continuing.

In the Orissa Canal System, where Bengal Irrigation Act was applicable, the system of ayacut assessment is on lease basis and only if 85 per cent of the land holders apply for a lease then the lease is granted and water supplied to the area. There are cases where some blocks refuse to take water. This system is not at all a satisfactory system and resulted in wastage and unauthorised use of water. In 1959 Government of Orissa have passed an Act called 'Orissa Irrigation Act' and rules framed thereunder in 1961. This Act with its rules has come into effect since April 1963. As per the above Act permanent assessment of ayacut is enforced throughout the State. This eliminates bad effect of lease system hitherto enforced.

It is recommended that in all States, where lease system prevails this system of permanent assessment of ayacut should be adopted for efficient and economic use of irrigation water.

*Controlled Supply of Water to Smaller Blocks—*  
In the old system water was let out from the outlets of distributaries and minors to blocks exceeding 40·47 ha. (100 acres) in extent. Some of the blocks are as much as 121·41 to 167·87 ha. (300 to 400 acres). The internal distribution of water in these large blocks is done by the cultivators themselves by field to field flow. This resulted in unequal distribution of water and also large wastage. The Orissa Government in their rules have now decided that Irrigation Department should supply water through minors or sub-minors up to 40·47 ha. (100 acres) blocks and the cost of these channels will be charged to the projects. Below 40·47 ha. (100 acres) blocks for the internal distribution, the field channels have to be excavated by the cultivators at their own cost.

This system is now being adopted in all the Irrigation Projects under execution and all the

existing projects including Hirakud Project are being remodelled to ensure supply of water to 40·47 ha. (100 acres) blocks.

The responsibility of Irrigation Engineers is to supply water to blocks of 40·47 ha. (100 acres) and the internal distribution of water within the 40·47 ha. (100 acres) blocks is the responsibility of the Village *Panchayats*.

To enable efficient control and distribution of water blocking arrangements are provided to outlets in the main canals, distributaries and part of the minors towards the head. This will enable reduction of water supply in areas where there is less demand and *vice versa*. Also regulating arrangements are provided in the canals and distributaries to head up water in reaches so that even with reduced supply in canals distribution of water in that reach of the canal can be efficiently done.

*Supply of Water during Rabi period—*For the Rabi crop supply has to be made from the storage reservoirs or from the summer flow in the rivers in case of diversion schemes. Also during Rabi season only about 50 per cent of the irrigated areas are cropped. Some areas do not require any water and Rabi cultivation is done in patches distributed over the entire commanded area. In this period with the help of regulators and locking arrangements, economic distribution of water to the blocks is possible, but it is observed that in a block of 40·47 ha. (100 acres) Rabi cultivation is done for only 12·14 to 16·19 ha. (30 to 40 acres) scattered in the area. In this case the field channels can reduce the wastage by supplying water only to the cultivated plots. All the same there will be wastage of water in seepage and it is desirable to plan Rabi cultivation in complete blocks of contiguous area. This will be possible only if the village *Panchayats* and agricultural department plan properly and the cultivators co-operate. This involves laying of proper crop pattern by the Agricultural Department in consultation with the *Gram Panchayat* and cultivators.

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The main wastage of water occurs in the field over which the Irrigation Engineer has no control. The efficient distribution of water rests with the *Gram Panchayat* and the cultivators. The general tendency of the cultivators is to clamour for more water than actually required for the crop and they should be educated to use only the quantity of water required for the crop and not more. The agricultural department should maintain demonstration farms in irrigated areas to educate the people in the economic use of water required

for a particular crop. The farms can also educate the people in the use of proper manures and adoption of suitable crop pattern.

The students in the engineering colleges cannot understand the field conditions and introduction of course for efficient management of supply and control of irrigation water will not be helpful. They can pick up the necessary experience when they are actually in-charge of irrigation systems.

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# MANAGEMENT OF IRRIGATION WATERS

by

G. S. Parthasarathy\*

## SYNOPSIS

*This paper deals with the management of irrigation waters beyond the outlet point in a canal system. After a brief introduction of the subject, it sets out the steps and measures involved in the management of irrigation waters beyond the outlet, namely, marking out of alignment of field channels on village maps, construction of field channels by beneficiaries, carrying out detailed soil surveys, tractorisation and levelling of fields, setting up of experimental and demonstration farms, supply of improved seeds, fertilisers, etc., credit and marketing facilities, provision of warehouses and godowns, opening of communications, etc. These steps and measures and the authorities and agencies responsible for them are described in some detail in the paper. Definitions of 'watercourse' and 'field channel' are given. It is emphasised that there should be co-ordination between agricultural and engineering aspects of irrigation projects. The paper points out that a new sub-head of development called "Area programmes for irrigation projects" under the major head "Agricultural Programmes" in the Annual Plans of States has been created, in order that an integrated programme of agricultural development is carried out simultaneously with the construction of the projects to ensure that benefits accruing from construction of major and medium irrigation projects are immediately available. The penultimate para gives the conclusion.*

A symposium on the subject of "Economic and Optimum Utilisation of Irrigation Potential" was arranged in 1957 by the Central Board of Irrigation and Power. The conclusion arrived at the symposium was that full development of irrigation potential calls for co-ordinated efforts by the Irrigation Engineers, Agricultural Experts, Revenue Authorities, Community Development Organisation, the beneficiaries, etc. and efficient management of irrigation waters devolves not only on the irrigation engineers but also on the other authorities concerned.

The subject of framing suitable recommendations for effective operation and control of water management in the areas served by major and medium irrigation projects came up for discussion during the 36th Annual Session of the Central Board of Irrigation and Power held in November 1963. It was unanimously agreed that the role and responsibility of irrigation engineers should be clearly defined, as also those of the other departments and organisation concerned with the management of irrigation waters. With this object in view, the Board has arranged a Symposium on the subject of "Management of Irrigation Waters" at the time of the forthcoming Annual Research Session of the Board in July 1964.

There are no two opinions as regards the responsibility for management and supply of irrigation waters up to the outlet point in a canal system, which is recognised as the responsibility

of the irrigation engineers; but scientific and efficient management of the irrigation waters beyond the outlet point requires great attention and care on the part of all concerned authorities.

Broadly speaking, management of irrigation waters beyond the outlet involves :

- ✓ (i) Marking out alignment of field channels by project authorities on village maps;
- (ii) Construction or excavation of field channels by beneficiaries;
- (iii) Carrying out detailed soil surveys;
- (iv) Tractorisation and levelling of fields, where necessary;
- (v) Setting up of experimental farms for determining and evolving new cropping patterns, variety of crops, etc.;
- (vi) Setting up of demonstration farms/plots to propagate scientific irrigation practices, particularly economical use of water;
- (vii) Supply of improved seeds, fertilisers and development of local manurial resources;
- (viii) Credit and marketing facilities—establishment of warehouses and godowns; and

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- (ix) Opening of communications in the project area.

This paper attempts to describe briefly the steps and measures mentioned above.

### Watercourses and Field Channels

✓ An important step for speeding up utilisation of the water made available at the channel outlets is to ensure that watercourses and field channels for conveying it to the fields are ready simultaneously with the completion of canals and distributaries. On certain projects, the size of some of the outlets has been kept so large that water in the watercourse becomes unmanageable for the cultivators, and it is considered that there should be an upper limit of 0.057 to 0.085 cumec (2 to 3 cusec) for the discharge from an outlet into a watercourse, depending upon the type of soil, cropping pattern, etc. In cases where the discharges from outlets are higher than this, the command may be split up and served by two or more outlets or the outlet converted into or replaced by a minor/sub-minor with suitable number of outlets, constructed at Government expense to facilitate serving the command by easily manageable discharges. It is considered that this arrangement would improve the distribution of water among the cultivators and also avoid wastage of water. It has been suggested by the Planning Commission that project authorities should be responsible for the construction of watercourses at Government cost for *chaks* or blocks up to 40.47 ha. (100 acres) in area. This limit may, however, be varied in different areas according to local conditions relating to topography, crop pattern, etc. The authorities concerned may consult local opinion in fixing the alignment of these water courses.

✓ It has been suggested by the Planning Commission and the Ministry of Irrigation and Power that watercourse and field channel may be defined in the following terms :

- (i) A watercourse is a channel, built at Government expense to convey water from an outlet to a 40.47 ha. (hundred-acre) block or as may be prescribed by the State authorities.
- (ii) A field channel is a channel constructed by cultivators at their own cost beyond the watercourse to serve the various fields within the block.

Where the block is small, watercourse may not be necessary and field channels may take water directly from the outlet.

### Marking out Alignment of Field Channels on Village Maps

✓ In order to eliminate delay in the excavation of watercourses and field channels, their alignment should be marked out by the Irrigation Department/Project authorities on village

maps, and these maps should be supplied to the district and block authorities for getting the field channels excavated by the beneficiaries in good time. The cost of this item should be included in the estimate for the irrigation project.

### ✓ Excavation of Field Channels

It has been suggested to the State Governments that legislative provision should be made for fixing the responsibility for the excavation and maintenance of field channels on the beneficiaries and, in case of default, this work should be executed by the *Panchayats*/the State Government at the expense of the beneficiaries. The necessary legislation already exists in the States of Madras, Madhya Pradesh, Rajasthan, Orissa, Jammu & Kashmir, Punjab, Gujarat, West Bengal and Uttar Pradesh. Andhra Pradesh and Bihar are considering Draft Bills, while Maharashtra is preparing one. The remaining States, namely, Assam, Kerala and Mysore are yet to promote and enact such legislation.

The Union Ministry of Community Development and Co-operation has suggested that the function of getting the excavation of field channels done by beneficiaries be entrusted to the Community Development Organisation through *Panchayet Samities* and *Village Panchayats* and that, to cover cases of default by beneficiaries, arrangements may be made to give advances to *Panchayats* from the Block funds, and that if the Block funds do not suffice, additional funds may be made available by the State authorities for the purpose. The excavation of field channels can also be included among the items of work to be taken up under the Rural Works Programme of the Plan, which concentrates on works relating to agricultural production.

### Carrying out Detailed Soil Surveys

This is to be the responsibility of the Agriculture Department. It has been suggested to the State Governments that provision of funds for this purpose may be made under the new head 'Area Programmes for Irrigation Projects', described below :

### Tractorisation and Levelling of Fields

This is to be the responsibility of the agriculture or other concerned Department. Provision for tractorisation would be necessary in the case of large projects where levelling by manual labour may not be feasible.

- (a) Setting up of experimental farms for determining and evolving new cropping patterns, variety of crops, etc.
- (b) Setting up of demonstration farms/plots to propagate scientific irrigation practices, particularly economical use of water.



- (c) Supply of improved seeds, fertilizers and development of local manurial resources.

These are to be the responsibility of the Agriculture Department. Provision of funds for these programmes should also be made in the new head 'Area Programmes for Irrigation Projects', referred to below.

#### **Credit and Marketing Facilities—Establishment of Warehouses and Godowns**

These will be the responsibility of the Agriculture and Co-operative Departments. The Planning Commission has suggested that the possibility of the Agricultural Refinance Corporation and land mortgage banks providing long-term credit facilities to cultivators for development of land in irrigation project areas should be considered.

#### **Opening of Communications in the Project Area**

This will be the responsibility of the Public Works Department/*Zila Parishads* and the provision of funds for the programme should be made by the concerned agencies.

#### **Co-ordination between Agricultural and Engineering Aspects**

Further, to facilitate close and necessary co-ordination between agricultural and engineering aspects of irrigation projects in the interest of optimum utilisation of water and land resources, it is suggested that State Irrigation Departments should have agricultural specialists on their staff, who can work hand in hand with irrigation engineers at various levels.

#### **Area Programmes for Irrigation Projects**

It has been suggested in the Third Five-Year Plan that, in order to ensure that the benefits which accrue from the construction of major and medium irrigation projects are immediately available, an integrated programme of agricultural development should be carried out simultaneously with the construction of the projects. This matter has received further consideration

at the Centre and in the States and a new sub-head of development 'Area Programmes for Irrigation Projects' under the major head 'Agricultural Programmes' has been created to ensure that a planned agricultural development programme is prepared for each project area, in which the tasks and responsibilities of all the agencies concerned, as mentioned in the foregoing paragraphs, are clearly specified. The responsibility for the formulation of this programme would be that of the Agriculture Department acting in collaboration with the Department of Irrigation and the Department of Community Development and Cooperation. This new head of development has been introduced in the Annual Plans of States from 1964-65.

#### **Conclusion**

To sum up, efficient management of irrigation waters beyond the outlets calls for the following principal measures :—

- (i) Marking out alignment of field channels by project authorities on village maps.
- (ii) Promotion and enactment of legislation for field channels by State authorities.
- (iii) Excavation of field channels by beneficiaries.
- (iv) Carrying out detailed soil surveys.
- (v) Setting up of experimental and demonstration farms.
- (vi) Advance planning for supply of improved seeds and fertilisers.

To facilitate action along the lines mentioned above, a new sub-head of development called 'Area Programmes for Irrigation Projects' has been introduced, under the major head 'Agricultural Programmes', in the Annual Plans of States from 1964-65.

It is made clear that whatever views and opinions have been expressed in this paper are the author's own and not necessarily of the organisation in which he works.

# AN APPRAISAL OF THE SYSTEM OF DISTRIBUTION OF CANAL IRRIGATION WATERS IN PUNJAB

by

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and

G. P. Malhotra\*\*

## Introduction

The role of the engineers in the field responsible for distributing canal irrigation waters is complex, full of distractions and requires of him the discharge of both technical and non-technical duties. Sometimes the balance of engineering and other responsibilities is so uneven that one part of his duties requires overwhelming attention at the expense of the other. Although the distribution of water is the primary duty of the engineer and he must devise ways and means to ensure as fair and equitable a distribution as possible, a time has come when the various agencies in the governmental machinery should join hands to achieve the all important objective of increased food production. It is, therefore, imperative that the whole thinking regarding the distribution and utilisation of irrigation waters should be reoriented to shift from water-bias to food production-bias.

## Need for Better Engineering Techniques for Water Distribution

Although great progress has been made in the design and construction of main and branch canals and the associated works, the improvements in regard to the outlets and the watercourses have not received due attention. The whole progress, therefore, becomes rather anomalous inasmuch as the major means of distribution from the farmer's point of view are left to the care of the cultivators themselves who have very little knowledge of proper upkeep and maintenance of these works. The distribution and the utilisation of water by the farmer has, therefore, inevitably tended to become unscientific and attention should be given to these aspects for achieving better results.

Steps should be taken to ensure that the discharge through the outlets is neither less nor more than the authorised supply. It will not only foster better supplier-consumer relationships but also make it possible to supply the water to those fields where it is most needed.

An ideal would be to instal automatic mechanical gauges to meter the supplies passing through the outlets. However, since such installations would take time to develop, certain measures, e.g., fixing of Cipolletti Weirs or V-notches can be taken so that visual inspection of the supplies going through a watercourse is possible. These gauges can also be occasionally inspected by the cultivator, the *Panchayats* and, of course, the Department. Neither the Irrigation Department nor the consumer can thus have any cause for complaint as the approximate measure of discharge will be subject to a visual inspection. It will also help in speedily detecting the cases of tampering with the outlets. It may be mentioned that it is the practice in all advanced countries of the world to instal such devices and measuring gauges to achieve effective control on water distribution. This method will be inexpensive and will serve as a first step to ultimately introduce fuller measures for volumetric measurement of irrigation waters.

It is felt that the volumetric distribution of water will be conducive to increased food production and would reduce the wastage of water which is inherent in the present system of distribution. The cultivator at present is entitled to the supplies of water based on his culturable commanded area, whereas the area for which this water is actually used may be only a part of the whole area. The tendency to over-irrigate the fields is, therefore, present in most cases. The charges for the water are also levied on the area irrigated and matured and not on the quantity of water used. The changeover to volumetric assessment of charges and distribution of water will not only encourage the cultivator to use only that amount of water which is absolutely necessary but also would help in educating him towards better methods of watering to achieve best yield from his farms and to improve his distribution of watercourses. The research carried out in various agricultural institutions all over the country have revealed that certain pattern of watering with definite intervals for different crops is most beneficial and results in optimum crop yield.

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More waterings are harmful and reduce the yield. With the controlled supplies at a pre-determined rate it will be possible to come quite near to the ideals laid down by the research institutions. In the present system, even if the cultivator has been educated to make use of the results obtained from various agricultural experiments, the temptation of using the available water and thus irrigating the field very much in excess of what is necessary, is always there and very hard for him to resist. He would be able to discipline himself if he is encouraged by the idea that he will have to pay less for the waters if he consumes less with equal or even better results of the yield from his farms.

### Re-appraisal of Duties of Engineer in Field

As already mentioned the engineer in the field is over-burdened with the multifarious activities of revenue assessment; holding enquiries regarding cases of stealth of water, concealment of irrigation and other offences; deciding cases of failure of crops and various other disputes among the cultivators. The cases concerning these miscellaneous items are so supernumerary that he hardly finds time for giving some thought to the quarters where his engineering knowledge is required in a larger degree. No doubt, the spirit of research and improvement of these works on the canals is lying dormant over the years and no permanent solution of the problems have so far been evolved. For creating conditions for the engineer to undertake studies of the various problems involved, it is essential that he should be relieved of his miscellaneous duties which can be easily handled by non-technical personnel. He would then be able to devote more time to problems directly connected with improvement of irrigation, e.g., the transfer of areas from one *chak* to another, the splitting and amalgamation of outlets, devising ways and means to minimize the incidence of breaches, reducing the maintenance costs, etc. In the purely technical sphere his authority should be enhanced so that the decision based on engineering considerations and thus conducive to optimum utilisation of water, are not subordinate to legal objections. As an example, the engineer should be the final authority to decide as to which areas are commanded best from a particular outlet and the procedure for enforcing this decision should be simple and free from legal complications.

In the context of better utilisation of water, another problem which might need consideration is the sanctioning of temporary outlets. According to the prevalent practice in Punjab additional outlets are sanctioned to individuals during the season of abundant supplies for promoting irrigation of larger areas. In the present system temporary outlets are sanctioned at random on the basis of casual applications. May be, it leads to better yield in some particular

farms but this system does not benefit the area as a whole and the increase in food production is not commensurate with the additional irrigation supplies available. It is, therefore, felt that instead of sanctioning temporary outlets to individual farmers, the water allowance of the existing outlets should be temporarily increased so that the benefit accrues to all the fields being served by the distributary.

The design and approval of alignment of watercourses as well as the laying down of criteria for their maintenance should also be the responsibility of the engineer. The actual maintenance may, however, be done either by the *Panchayats* or by the cultivators themselves. At present the watercourses are, generally, so unscientifically constructed and their maintenance is so poor that it defeats the purpose of the entire distribution system to a certain extent. With their layout, etc., being supervised by the engineer, it would definitely improve the utilisation of water by the cultivated farms.

It, thus, seems imminent that the duties of the engineer in the field should be reviewed with the clear objective of improving water distribution and ultimately increasing food production. The suggestion made is by no means a plea to reduce the work of the engineer but to relieve him of certain non-technical charge and give him additional work which calls for the exercise of his engineering knowledge and creates an atmosphere which enthralls him to think about improved methods of water distribution which might prove highly beneficial.

### Liaison with Meteorological Observatories

It is felt that in the administration of water management, a closer liaison with the Meteorological Department should be established. The meteorological observatories exist in many areas but at present they are just recording certain data and transferring them to the head office from where these are very seldom obtained and made use of. There should be full co-ordination between the observatory management and the Irrigation Officers in charge of regulation at the headworks of main and branch canals, so that in the event of a prospective heavy rainfall the releases may be adjusted. Such a system is being followed in major projects but needs to be extended to smaller irrigation systems. It is felt that with the improved equipment which is being used in the meteorological observatories, more exact and useful information can be obtained than it was possible before.

### Role of Panchayats

For improving the water distribution system and to educate the cultivators, the *Panchayats* have a big role to play. The departmental codes

which are in vogue at present have a bias toward penalising the offender. The whole system was built by the British Government to work on a sense of fear of authority and penalty. The *Panchayats* and the Irrigation Department should inculcate a sense of responsibility in the cultivators so that the canal offences are minimised. The cultivators should feel that the entire canal system is for their benefit alone and offences like cutting the distributaries or tampering with the outlets harms them more than anybody else. The lawful elements should be encouraged by announcing awards and prizes for good conduct. Those villages or units from which the least number of offences are reported should be encouraged by way of allowing some rebates, etc. The whole approach should be towards the goal of increased production of food and not *sha* authority, rule or penalty.

Although it has been suggested that the layout and formulation of specifications for the maintenance of watercourses should be the work of the engineer, the maintenance of the watercourses should be taken up by the *Panchayats* in a more scientific way. If necessary, they should employ a junior technical hand who would survey and maintain these watercourses and advise the cultivators regarding the proper alignment of the field channels and the levelling of the fields. As the watercourse is the property of the community as a whole, the *Panchayat* is the most rightful body for taking up their maintenance and settling the disputes among the farmers regarding sharing of irrigation waters.

#### **Agriculture Department**

Basic research for evolving patterns of waterings for maximum yields, best types of manure, crop pattern and crop rotation, etc., is being conducted in various research laboratories under the Agriculture Department of the Government of Punjab as well as in other States. However,

the essential conclusions drawn from these researches seldom find their way to the cultivator. If at all the suggestions are communicated to the farmer, these are not followed by him on account of various anomalies in the present water distribution system. It is, therefore, very essential that the pattern of water distribution is evolved jointly by the offices of the Irrigation and the Agriculture Department for optimum utilisation. The Agriculture Department should emphasize to the cultivator the fact that only a certain amount of water is necessary for maximum yield and no more. The cultivator should feel that the consumption of water by him is based on the lines laid down by the agricultural research and that any excess water used by him will not only damage his crop but will also be responsible for certain other areas remaining unirrigated or under-irrigated. The Agriculture Department should strive to bring the research down to the field in as large a measure as possible with particular reference to water distribution.

#### **Conclusion**

It is felt that a new approach and enthusiasm should be inculcated in all concerned, i.e., the Departments of Irrigation and Agriculture, the *Panchayats* and the cultivators to work as a team towards the end of wiping out the deficit in food production which prevails in India today. It is an ironical fact that India is short by a small margin of 1 per cent in the production of rice. For this small deficiency, we have to beg from countries all over the world including Asian countries like Burma and Cambodia. It is thus a question of national honour and is felt that our present resources can be geared to produce the desired effect if these are judiciously utilised and adjusted in accordance with the needs rather than according to rules and laws. The water is the primary instrument of food production and its proper use is of utmost importance to India.

# ECONOMIC UTILISATION OF WATER FOR IRRIGATION

by

B. S. Sivan\*

## Introduction

✓ Agriculture is the mother of all industries and maintenance of human life, standing at the head of civilization and progress. In India it constitutes the very base of national economy. Land is India's largest resource, contributing nearly 50 per cent of Nation's production by agriculture. Nearly 70 per cent of India's population of 438 million depend on agriculture for occupation and livelihood. It contributes a sizable portion to the country's export of sugar, cotton, jute and textiles.

✓ India has become the second largest producer of rice. Irrigation has been practised in India even from ancient times, and today we find a network of irrigation works in the country serving the needs of agriculture. Out of the total area of 328.20 million ha. (811 million acres) of the Republic, about 168.99 million ha. (467 million acres) are culturable and the rest is forest 53.82 million ha. (133 million acres) fallows and unculturable land. About 149.7 million ha. (370 million acres) are under cultivation and out of this only 20.84 million ha. (51.5 million acres) were receiving irrigation facilities from all sources, before the beginning of the First Five-Year Plan. Total water resources is 1672698.88 million cu. m (1356 million acre-ft.) of which about 555075 million cu.m. (450 million acre-ft.) is assessed to be economically utilised for beneficial use and about 96212 million cu. m. (78 million acre-ft.) had been utilised for irrigation before commencement of the Five-Year Plans.

✓ With so much of culturable land yet to receive irrigation facilities and so much of water available for utilisation, it is rather apparent that by a judicious harnessing of the river waters and utilising the same to the needy fertile land, India's food wealth could be increased considerably to annihilate the chronic food deficiency in the country. A series of Five-Year Plans have been embarked upon, from 1951, for the development of the country as a whole, in which irrigation plays an important role. At the end of Second Five-Year Plan the net area irrigated was 28.33 million ha. (70 million acres) including major, medium and minor irrigation schemes and it is expected to increase this area by another 7.30 million ha. (18.6 million acres) by the end of Third Five-Year Plan.

The problem of economic use of water for irrigation has been engaging the attention of Irrigation Engineers for many years.

This paper deals with the problems of economic use of water to the best advantage of successful irrigation by increasing the duty of water under an irrigation work, so that the cultivators may have the maximum utilisation of the available supply for an increased yield. The author who has worked in the management of several irrigation works in Mysore State such as Kanva Reservoir, Byramangala Reservoir and Nelligadda Reservoir in Bangalore District and Krishnarajasagar Irrigation Works in Maddur Taluk (Mandya District) points out certain difficulties encountered in the efficient management of irrigation works and suggests some improvements over the existing system to have effective measures to reduce the wastage of useful water and help the maximum utilisation of the available water for an increased yield.

The problem as to how best to conserve the rain water and its utilisation in the most economical way has been a major problem of an Irrigation Engineer, even from pre-historic period and this problem has given a challenge to the present day engineers who are engaged in the development of major, medium and minor irrigation schemes in the country, so that India's agricultural production is increased making the country self-sufficient in food. An Irrigation Engineer has to endeavour a lot for the successful planning of an irrigation project, both for conserving the irrigation potential and its economic utilisation. Before entering into the main part of the paper, we should make a short summary of the objectives of providing the land with water taking note of its cultivation and the various factors affecting the same, in order to suggest any improvement on the existing system of regulation of water. When applying water to the land, it is necessary to design carefully the intakes and channels which will distribute the water over land, so that the undertaking may be economical and successful and the required quantity is assured for irrigation.

✓ The duty of water being defined as the area of crop which can mature, by flowing 0.028 cumec (one cusec) of water for the entire

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growing season, it is mainly depending upon the following factors:—

- (1) Duration of the season.
- (2) Climate.
- (3) Type of soil.
- (4) Topography of the country.
- (5) Condition of channels and conveyance losses.
- (6) Methods of cultivation and crop pattern.
- (7) Use of manures.
- (8) Field control and regulation rules.

The success of any irrigation project depends upon its proper layout, provision of properly constructed channels and its management of application of water to the lands to obtain maximum return from the available capacity of an irrigation work and hence it is necessary to unify the rules determining the necessary data for irrigation and its regulation both technically and economically. Proper maintenance of irrigation and field channels contributes to the maximum utilisation of water for irrigation. It is estimated that about 10 per cent of the stored water is lost by evaporation, 25 per cent of the canal discharge will be lost by transmission, 6 per cent in distributaries and 22 per cent in field channels.

Any irrigation system will be successful only when it is developed by the co-ordinated efforts of Irrigation, Agricultural and Revenue Departments. After the construction of the project with its allied works, is completed by the Irrigation Department, the Agricultural Department has to determine the particular crops to be grown, depending upon the suitability of the crops for the area, only after which irrigation can be developed with the close cooperation of the Revenue Department and the cultivators. A scientific basis giving a correct estimate of the quantity of water to be used, to achieve the best results, should be determined by the Irrigation and Agricultural Departments of the States, with a common object of arriving at the most economic use of water to obtain maximum results. It is usually found out that after the irrigation project is completed and water allowed for irrigation, the area developed under the project would be less than the anticipated area. In Mysore State, it is found out to be varying between 70 to 80 per cent, which may be accounted for the long length of channels giving rise to transmission losses and losses in field channels.

Having understood the various factors affecting the duty of water, we may now divert our attention towards the major problem of economic utilisation of water for irrigation and how best we can achieve better results in bringing about effective measures to control the wastage in channels. To do this, different departments

engaged in Irrigation and Agriculture should make a co-ordinated effort to lay down better methods by which they can have a smooth running of an irrigation work for the full development of agriculture. Brief details of the existing practices of irrigation, in Mysore State are given with some suggestions to have an improvement over this system, which are considered to give better results in water conservation and economic utilisation for irrigation.

### Role of Irrigation Department

All the irrigation works of the State are managed by the Revenue Department, which looks after both their maintenance as also regulation of water for irrigation. However, some major irrigation works are maintained by the Irrigation Department (P.W.D.) in respect of their maintenance and regulation of water. The Revenue Authorities are supposed to manage these irrigation works (major and minor tanks) with the assistance of the local village officers. They are also to maintain these works by means of periodical repairs, to keep them in sound condition. Maintenance of *bund* and field channels are the ryots liability and these were previously being maintained regularly by the ryots on 'weekly labour' system. But these primary responsibilities of the ryots are being neglected in the recent times and they are not being properly warned by the Revenue Authorities as per revenue manual of the State, due to various reasons. Consequently, most of the irrigation works are in a very dilapidated condition and in a state of disrepair, requiring immediate attention to make them function properly. This has resulted in a lot of wastage of useful water, due to poor maintenance of *bund* and negligence of ryots in proper upkeep of the field channels. Some of these works are, however, being taken up by the Irrigation Department for repairs, depending upon the availability of funds from Revenue Department, the entire cost of earthwork to *bund*, jungle clearing, turfing and repairs to field channels, being recovered from the ryots under the head of account "22E charges, recoverable from ryots". The estimates have to be countersigned by the Revenue Department and necessary amount has to be set apart by them only after which the works can be taken up. This has led to lot of delay resulting in further deterioration of *bunds* and sometimes breaching of tanks causing wastage of useful water, which directly tells upon the food production.

Hence, in order to ensure that all the irrigation works of the States are maintained well, it is suggested that they are transferred to the maintenance of Irrigation Department (P.W.D.) and an uniform levy may be fixed by the Government and collected from the beneficiaries under such irrigation work, under a common head of 'Irrigation Fund', which may be operated by Chief Engineer of the State's Irrigation Department

Management of water supply under all the tanks of 202.34 ha. (500 acres) and below may however remain with the Revenue Department and village *Panchayats*. Tanks having an *atehkat* (area of land irrigated) of more than 202.34 ha. (500 acres) may be looked after by the Irrigation Department both for maintenance and regulation of water supply. This change, will ensure an efficient management of irrigation works.

The Revenue Sub-Divisional Officers of the State are the 'Irrigation Officers' in their jurisdiction as per the existing Irrigation Act. He is vested with powers to prevent any malpractices by the ryots, such as obstructing the flow in the channels, cutting the channel *bunds*, diverting the watercourses, and closing the field channel, which add to the losses of useful water. Due to heavy works of other miscellaneous nature, the Sub-Divisional Officers cannot devote sufficient time to these channel offences and hence a good lot of delay is being experienced in settling the disputes among the ryots. In some of the major irrigation works the local Assistant Engineers have been declared as the Irrigation Officers, who can afford to pay immediate attention to prevent cases of such nature. In the interest of safety of all irrigation works and better regulation of water, it is suggested that the Assistant Engineers of Irrigation Department (P.W.D.) may be made the 'Irrigation Officers'. This will be more advantageous in reducing the wastage of water since the Assistant Engineers, being mainly responsible for irrigation, can take immediate decisions and act to prevent such offences.

In the present system of irrigation, the State is to supply the requisite quantity of water at the outlet head of the distributary channel of an irrigation work, beyond which point, the beneficiaries have to open and maintain the field channels. The procedure suggested is that the alignment of these field channels, be marked out by the project authorities on village maps which may be supplied to the district or the block authorities for getting them excavated and maintained thereafter, by the beneficiaries. It is experienced that these field channels are not being excavated and maintained properly. In some cases the courses will either be closed or deviated by the ryots, thus preventing the flow to the adjoining land. This happens in many cases due to ill-will and family quarrels among the ryots, who will immediately transfer these feelings on to the field, by way of closing the field channels or diverting their courses. Most of the field channels are not being maintained by the ryots by way of removing silt, clearing jungle and weeds and maintaining their sections, *etc.*, which is as important as that of initial cost of construction itself, to have the maximum benefit by reducing the transit losses. Hence it may be suggested that these field channels be excavated and maintained by the Irrigation Department. Lining of the field channels of a minimum capacity of one cusec of

water with soil-cement grout (with 5 per cent cement), will be an additional measure for preventing heavy losses. In the alternative, the field channels after once aligned and excavated by the beneficiaries should be treated as State property through legislation. This prevents major losses in field channels while bringing harmony between the ryots.

Pick-up weirs constructed wherever possible in the valley of irrigation, to collect the available seepage, which is estimated to be about 20 per cent of the irrigated area, will benefit the development of agriculture to a large extent at a minimum cost. A series of pick-up weirs have been constructed in the Visvesvaraya Canal area of Krishnarajasagar in Maddur *Taluk*, to augment the supply to increase the duty of water and this has been very successful.

It may not be out of place to suggest here the specific advantages of sprinkler irrigation in an irrigation tract. Surplus water applied to the land and reaching the sub-soil water-table can be utilised for developing extra area by sprinkler irrigation, which can conveniently be taken up when the land has an uneven topography needing expensive levelling. Sprinkler irrigation is being widely adopted in Canada and has proved a complete success. This type of irrigation in addition to its being matched to the crop requirement and water intake of the soil, reduces soil erosion and water logging, thus increasing the yield, liquid fertilisers and chemical acids can also be sprayed simultaneously without extra cost.

'Off and on' system of water supply for irrigation will be highly beneficial, both from the point of view of economic supply of water for an increased yield, and to have an extensive irrigation. Experiments conducted by the Mysore Engineering Research Station have shown that it is not necessary to supply water to the paddy crops for all the seven days in a week and that five days supply will be quite sufficient to get the same or increased yield, than that receiving water for all seven days in a week. The yield never gets diminished with the reduction of water supply by 30 to 35 per cent and that it is unnecessary to overflow the plots. Water supply can be managed to the entire area by allowing water for five days in a week, by dividing the entire area into several convenient blocks and arranging water supply by rotation, so that all the blocks get water supply for five days in a week. This actually reduces the loss of water considerably. Working tables, giving the full details of the supply available, yield expected during the season, and the area to be irrigated, *etc.*, should be maintained by the Irrigation Officer, who should notify the programme of irrigation, well in advance, through wide publicity through local newspapers and village officers so that the cultivators may keep themselves ready to take the best advantage of the supply made available. The water supply should be made in proper time as

belated utilisation gives rise to wastage of water. The programme of supply should be strictly adhered to, failing which it creates confusion in the minds of ryots, who will try to draw water in excess of the requirement of the crop, as they apprehend that they may not get the next supply in time, and ensuring their crop with sufficient supply to tide over the interval between the scheduled date of watering and the date on which the water is actually received on a subsequent date. In the alternative strict adherence to the programme of supply creates lot of confidence in the minds of ryots who will fully co-operate with the arrangements, thus reducing the water loss to a maximum extent.

### Role of Agricultural Department

Agricultural Department of the State is established to develop agriculture by giving full co-operation to the ryots, by way of supplying seeds, manures, latest agricultural implements, insecticides, pesticides, spraying equipment and other facilities in time to have an improved agricultural production. In addition to this department, the State is covered by N.E.S. and Community Development Schemes, to better the individual and collective welfare of the rural population on an aided peoples' contribution basis. In spite of all these facilities made available to the ryots, we are still to achieve good progress. Agriculture should receive the highest priority in the State's Programmes among other activities, such as communication, health and sanitation, housing and education, *etc.*, in order to see that India's food production is self-sufficient.

Any development of agriculture depends upon the socio-economic conditions of the agricultural population, their education standard, training, and the facilities made available to them, so that they can realise their responsibilities towards country's economy. The following primary needs of the ryots have to be satisfied before we can proceed towards implementation of any improvement over agriculture :—

- (1) Education and training to improve their enterprising ability;
- (2) Water rate and other taxes;
- (3) Protection of prices of food crops;
- (4) Crop insurance schemes;
- (5) Storage granneries;
- (6) Marketing and communication facilities;
- (7) Credit facilities on manures, seeds, implements, *etc.*;
- (8) Medical facilities; and
- (9) Co-operative farming.

A ryot has no proper knowledge of use of water for irrigation and hence it is found that lot of water is being wasted. Opening of demonstration farms at various places, showing to the ryots by wide publicity, the actual results of economical use of water for an increased yield will create confidence in their minds on improved agriculture. All facilities such as classification of their areas on the basis of soil, to have rotation of crops, levelling their lands, *etc.*, must be made available to them on the spot and if possible on their own land. They should be provided with the literatures on the latest research made in agricultural development and any financial help and technical aid required for such purposes such as levelling the ground, excavating drains in marshy areas, so that better results could be achieved.

Supply of manures, better seeds, improved implements, spraying facilities and any financial help should be made available to them through the Ryots' Co-operative Societies in the area, on loan basis at a reasonable interest, which can be recovered during the harvest, by simplifying the rules governing such facilities to intensify the extensive agricultural programmes. Improved implements, better seeds, manures, insecticides and pesticides, *etc.*, should be supplied to them, in kind, on credit basis, the cost of the same being recovered during next harvest. This encourages a ryot towards intensive agriculture. Crop insurance facilities made available to them, will assure them of their financial commitments on agriculture. Co-operative storage granneries or government offices must be established at various places, to give marketing facilities for the country's agricultural products, thus protecting the prices which stabilise the economic condition of the farmers. Such arrangements and all such facilities are made available to the farmers in foreign countries like the United States and Canada, where food production is very high.

India is a country where due to its social structure and land reforms, a farmer can only have a small holding and hence cannot afford to take up extensive farming by using machineries. This has lessened the incentive in him, who limits himself to the age old practices of agriculture which do not benefit either the farmer's financial position or the country's economy. Cooperative farming, on sound working system, is the only solution to help the agriculturists to have better financial stability without any further fragmentations of land. This also helps to have a sound system of rotation of crops, where the irrigation supplies can be well controlled. Latest practices of agriculture with improved machinery can be easily adopted in the cultivation of various crops on extensive agriculture.

### Role of Village Panchayat

Village *Panchayats* is a council formed to plan the village level activities for the development of village, providing the primary



activities such as communication, health and sanitation, water supply and education, etc. With the establishment of *Panchayat Raj*, the distribution of water supply for irrigation especially from the Government outlets of an irrigation tank of 202·34 ha. (500 acres) and below can be taken up by these *Panchayats*, as they would be in a better position to understand the local needs. The work of excavating and maintaining the field channels may also be entrusted to them, after marking the alignment of these channels on the village maps, to benefit the maximum area. Such channels after they were excavated and serviced, must be prevented from any closure or diversion by any ryot. *Warabandis* (*Varasavadi*) may be put up for the distribution of available supplies, between various ryots, indicating their turn and the time of water supply and the supply made as per this programme.

In the case of all other irrigation works of more than 202·34 ha. (500 acres), and the distributaries of irrigation channels, it is obligatory that both excavation and regulation of supply including the maintenance of these channels, should be entrusted to the Irrigation Department (P.W.D.) as the *Panchayats* cannot have a proper control over a vast area, commanded by these distributaries and irrigation tanks. Further, each distributary from an irrigation canal runs for several miles, covering the areas of different villages. The irrigation tanks of more than 202·34 ha. (500 acres), will be having an *atchkat* belonging to several villages and hence the control over such works by any one of the *Panchayats* is not a practicable suggestion.

The present system of water supply and field control in large irrigation works is entrusted to the Irrigation Department which is working very smoothly with the assistance of an Assistant Engineer, *Nalamanegars* (Channel Headman), Gauge readers, *Sowdies* (water supply man) who are attending to the proper distribution of water in the irrigation tract. Actually the water is being supplied directly on to the field, by these *Sowdies*, who are entrusted with the work of supplying water to an extent of 80·94-121·41 ha. (200-300 acres) each, with proper vigilance. The co-operation of ryots with the canal staff will further improve the field control, in reducing the losses and ensure sufficient quantity of water to them.

Formation of 'Irrigation Committees' for each irrigation work of more than 202·34 ha. (500 acres), consisting of the Irrigation Engineer of the Division, Deputy Commissioner or Assistant Commissioner, Agricultural Officer, Tehsildar of the area, and some of the local leaders, with the Assistant Engineer as its secretary, will be of much use, in improving the irrigation efficiency. This Committee has to decide the date of starting of irrigation area to be irrigated, crops to be sown and the other issues depending upon the supply available. Formation of such a Committee has proved a complete success in solving many problems of the ryots under Krishna Reservoir in Chhannapatna Taluk 64·37 km. (40 miles) from Bangalore in Mysore State.

### Rotation of Crops

It is an accepted fact that we should not grow the same kind of crop in the same field every season but should be rotated with other crops for the following reasons :—

- (1) To have a better utilisation of plant food in the soil by plants having different root system;
- (2) To avoid the weed growth, pest and other diseases, peculiar to one kind of crop;
- (3) To keep the soil healthy to get the maximum yield with minimum supply of water.

The change of crop pattern has to be determined by the Irrigation Department in consultation with the Agricultural and the Revenue Departments and after a final decision in the Irrigation Committee, to provide for an effective irrigation control.

Complete co-ordination among Irrigation Engineers, Agricultural and Revenue Officers, should be achieved through the National Extension Services and community development schemes, to have a close contact with the ryots, by periodical field trips on fixed programmes of agro-irrigational measures and field demonstrations to solve the problems of the ryots without delay.

### Levy of Betterment Contributions and Water Rates

Development of irrigation under a project, largely depends upon the levy of betterment contribution and water rate, due to the conversion of dry lands into wet. The levy of contribution and water rate should be fixed with a view to increase incentive of the ryots, without affecting the economy of irrigation supplies. Prior to 1957, in Mysore State betterment levy and water rate were being assessed by the Irrigation Department, depending upon the cost of the Project, and net area fit for irrigation. This being verified at the completion of the project and development of irrigation, the betterment contribution and water rate would be fixed to give a minimum revenue that may be fixed by the Government from time to time, on the amount spent by Government and intimated to the Revenue Department for collection.

After the introduction of the Betterment Levy Act 1957, in the State, assessment and collection from an irrigation Project is being fixed and collected by the Revenue Department. Normally the contribution and water rate would be fixed in such a way that 3 per cent revenue is realised on the Government's share of investment, in the case of major irrigation projects, 2 per cent in the case of minor irrigation schemes where the rainfall is more than 0·6 m. (24 in.) per year and 1 per cent in arid zones, where the rainfall is less than 0·6 m. (24 in.). The fixation of contribution ranges from Rs. 150 to Rs. 500 per acre while the water rate ranges from Rs. 8 to Rs. 15 per acre per year.

The system of both assessing and collecting these contributions and water rates by the Revenue Department gives rise to a lot of confusion in correctly assessing the exact area without being verified by the Irrigation Department. The ryots have a tendency to always dispute the figures furnished by the local village officers. Hence it is suggested that the Irrigation Department be vested with the work of assessing the lands with thorough verification of area of land, extent irrigated, crops grown, etc., duly fixing the amount of contribution and water rate for collection by the Revenue Department, which may again verify the figures and rise the demand for collection. This will avoid all confusion and complaints from the ryots, as this system would be under double verification.

✓ Generally ryots are not conscious of the ill-effects of their wasting water and its repercussions on the national wealth. One of the reasons for this is that water is supplied to him on an average basis of area of land irrigated for the entire crop period, which has led to wastage of water in field channels. This could be reduced to a large extent, if sale of water is made on volumetric basis, though it may involve a huge initial cost. This can at least be adopted in the case of large holdings as it is felt that in the case of small holdings it would be impracticable. It is estimated that at least 20 per cent of useful water can be saved by this method, which can conveniently be made use of for the extension of irrigation under the project.

#### **Irrigation Outlets and Controlling Arrangements**

Type of outlets and their controlling arrangements, contribute an effective check on wastage of water in channels. Generally distributaries of the channels will be provided with masonry barrels providing shutters with gear rod and gear-box for regulation of supply, while the sluice outlets will be provided with cast iron pipes. Controlling arrangements for the pipe outlets will be prohibitively costly if these are also provided with the shutters and gear rod arrangement and hence many of the smaller diameter pipe outlets go without any controlling arrangement, allowing lot of water to waste. Further, these shutters with gear rod and gear boxes can be easily meddled by the ryots, when they want to draw more water, either by breaking the gear box or by mishandling the screws.

Hence 'Horizontal plug device' of outlet control, may be adopted in the case of sluices where the depth of water in the main channel or distributary is 0.9 m. (3 ft.) and below. The device consists of a wooden plug of suitable diameter which can fit in the socket of the pipe. The plug can be moved horizontally and fixed in any required position, depending upon the discharge required in the pipe through a vertically movable iron rod with locking arrangement. The arrangement can be locally made at a very

low cost compared to the other type. It can be operated very easily by the channel *sowdy*, who operates it while standing in 0.9 m. (3 ft.) depth of water. The ryots cannot ordinarily handle these devices, as they have to get into the water in the channel during night time.

This type of horizontal plug system of controlling arrangements has been fixed by the author for the pipe sluices of Kanva Reservoir channels in Channapatna Taluk, where a large amount of loss of water could be reduced, and about 1/10 of the irrigation under the reservoir could be increased by extending the irrigation channels.

#### **Rehabilitation Programme**

It is not enough if an irrigation project is planned and implemented. Development of irrigation under the project is more important to see that the construction of project justifies the purpose for which it is planned. Non-utilisation of available water in time is also a national waste. There has been a lot of delay in actual utilisation of irrigation potential in most of the projects like Tungabhadra Project, Bhadra Reservoir, etc., which may be either due to the non-completion of many engineering works or due to lack of sufficient population in the area. It is estimated that out of 149.74 million ha. (370 million acres) of cultivated area only 16.19 million ha. (40 million acres) produce more than one crop, the rest produces only one crop for want of irrigation facilities. About 1.23 million ha. (3.7 million acres) go unutilised, owing to absence of field channels higher irrigation rates and lack of proper facilities for the ryots.

Rehabilitation programmes taken up in the project area, will be very much helpful in quick development of irrigation under a project. The Prairie Farm Rehabilitation Administration of Canada is assisting the farmers against draught and economic depression in the grain growing areas, in the provinces of Manitoba, Saskatchewan, and Alberta, by providing water supply, housing facilities, etc. so that the economy of the country can be stabilised. Such rehabilitation programmes should be taken up under the irrigation projects in India, by giving free land, free water and exemption of revenue to marginal farmers, housing, education, communication and other facilities. Cultivable land under an irrigation project, may be made available free of cost, and water may be supplied to them without any levy for an initial period of at least 5 years. This gives an incentive to the farmers to settle down in project areas and stabilise themselves which will intensify our food production without much time-lag, thus fully utilising the harnessed water economically.

A reasonable betterment levy and water cess may however be collected from the farmers after the complete development of irrigation.

## General

This paper is not to stress that our Government Department engaged in irrigation and agricultural development in the country, are not doing anything on that side. Instead, our Indian Engineers and Agriculturists are not sparing any of their efforts in adopting all possible measures to implement our irrigation projects and to develop agriculture at a topmost speed, so that India could be made a pioneer country in irrigation and agriculture. But what we are doing is only a part of what we should do, as we have to increase our agriculture, which has an arduous task to feed and clothe a growing population and produce the essential raw materials required for expanding industries.

Indian Engineers have developed a sense of responsibility to the nation and what they want is a widespread knowledge of technical know-how so that they can shoulder more responsibilities. Technical training in agricultural engineering for the irrigation engineers, to have a knowledge of agro-irrigation methods adopted in different countries, will be of immense use in bringing about an agricultural revolution in the country.

A separate cadre created for irrigation engineers as 'Indian Service of Irrigation Engineers' (I.S.I.E.), just like I.R.S.E. will go a long way in pooling up all the talents and experiences and evolving a most intelligent method of irrigation, which can be fully utilised for the development of irrigation exclusively.

Technical Meetings, Seminars and Researches on various problems such as irrigation and drainage practices which includes timing and methods of irrigation, farm irrigation and drainage, etc., have to be conducted, often to achieve higher results in irrigation for its complete development. By the experience of the author in the management of several irrigation works, it can be stressed here that a major portion of the problems of the ryots can be solved by the personal contacts of the irrigation engineers with them. This creates enormous confidence in their mind and they will cooperate with any programmes adopted by the department to effect economy in water use.

## Conclusion

The author has tried to give briefly the present practices of irrigation as applied to Mysore State, explaining as to how the irrigation works in the state are being managed under different agencies and detailing as to how, with a slight change of the existing system, the irrigation can be improved for better utilisation of water. Summarising the details, the following points are brought out to effect economic use of water.

(1) All irrigation works (major and minor), canals etc., should be entrusted for their maintenance to the Irrigation Department

(P.W.D.) levying an average acreage cess, under 'irrigation fund' to be operated by the Chief Engineers of Irrigation Department;

- (2) Local Assistant Engineers of Irrigation Department should be made the Irrigation Officers, instead of Revenue Sub-Division Officers;
- (3) Regulation of water for irrigation tanks of *atchkat* (area of cultivation commanded by the irrigation work) of 202.34 ha. (500 acres) and more, should be handled by the Irrigation Department, while the tanks of lesser acreage can be entrusted to local *Panchayats*;
- (4) Digging and maintenance of field channels under irrigation projects may be taken over to Irrigation Department, or when once they are marked on the village maps and excavated, they should be declared as Government channels by legislation. Maintenance of field channels of minor irrigation works may however vest with the local *Panchayats*.
- (5) Effective measures on lining of field channels by soil cement, 'off and on' system of supply of water, construction of pick-ups in the irrigated valley, sprinkler irrigation wherever possible, may be taken for the optimum utilisation of water by preventing wastages;
- (6) Training to ryots on agricultural methods, by establishing demonstration farms, should be given. Supply of manures, improved seeds and agricultural implements should be given on credit system, recoverable on easy instalments.
- (7) Storage granneries, or Government offices should be established to protect the prices of food crops. Crop insurance facilities should be given to create economic stability in the ryots;
- (8) Rehabilitation programmes assisting the ryots, by giving free land, water and exemption of revenue for marginal farmers, and housing facilities should be taken up to intensify our food production.
- (9) Co-operative farming should be encouraged on an enlarged scale, to have an increased yield with change of crop pattern;
- (10) Sale of water on volumetric basis should be adopted as far as possible. Suitable cheap and effective controlling arrangements for the outlets should be provided to reduce losses;
- (11) Training in the latest Agricultural Engineering practices in Irrigation adopted in foreign countries must be provided for our irrigation engineers;

- (12) A separate cadre of 'Indian Services of Irrigation Engineers' (I.S.I.E) may be created, so that their knowledge and experiences, assisted by the researches conducted on irrigation and drainage practices, may be pooled up for the development of irrigation exclusively.

The study of economic utilisation of water for irrigation, is an important factor in the field of irrigation and if by adopting several measures to minimise wastages, we could save at least 10 per cent of the losses of useful water, we can increase our irrigation by another 3·24 million hectares (8 million acres) and from the existing irrigation works, without any extra expenditure on storages, which adds a sizeable increase in India's food production.

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# MANAGEMENT OF IRRIGATION WATERS AND LAND

by

Barkat Ram\* and B. D. Bali\*\*

## Introduction

Irrigation water is a valuable commodity owned solely by the State. The users of irrigation supplies should, therefore, by canons of natural justice, pay only for the volume of water consumed by them.

When the Canal Irrigation System was originally introduced in the Punjab, there were no means of measuring the water supplies. Neither the module type of outlets were available nor were the irrigation supplies sufficiently reliable. Hence the water charges were levied on the basis of areas and crops matured. This system is considered to be out-of-date in the present times when the irrigation supplies are much more reliable and are given through modular outlets which provide reasonable basis for the measurement of water.

## Present System

Under the present system, irrigation engineer is responsible for supplying water up to the outlets beyond which the farmers carry the water themselves through their watercourses up to the fields according to the plan chalked out by the Irrigation Department. The water is supplied to each cultivator according to a pre-determined *warabandi* framed by the Irrigation Department. The complaints regarding *warabandi* and layout of watercourses are dealt with and redressed by the Irrigation Department.

As soon as the water enters the field the cultivator is free to utilise water in any manner he likes. The water charges are, however, levied crop-wise by the Irrigation Department on the basis of areas and crops matured.

## Defects in the Present System

The present system does not provide any incentive to the cultivators for the economical use of water. They take their turn in *warabandi* and go on applying water to their fields even if the crop requirements are nil. This results in wastage of water and tends to increase water-logging of culturable areas. A considerable volume of water is lost in seepage through water-courses for which neither the Irrigation Engineer nor the cultivator takes any responsibility.

This also tends to increase the water-logging. It has recently been reported by the Press† "The water-logged area in Punjab has increased by about 607029 ha. (15,00,000 acres) during the past seven years according to a Government Report. The annual estimated damage to crops as a result of water-logging is of the order of Rs. 34 crores". This is a tremendous recurring national loss. It is necessary, therefore, to adopt suitable measures to eradicate this trouble.

Table I shows that only about 26 per cent of water diverted from the river is utilised for crop growth and about 50 per cent goes to waste in seepage. The remaining 24 per cent is lost in evaporation and spillage.

TABLE I

Various losses for 100 cusec of water diverted from weirs into canals.

1. Main Canals and Branches	= 10 per cent of the supplies from rivers	= 10 cusec
		$90 \times 21.5$
2. Distributaries Minors	= 10-15 per cent of supplies diverted from (1) above	= 100
		$78.7 \times 20$
3. Field Water courses	= 20 per cent of deliveries at outlets	= 100
		= 15.8 cusec
4. Surface run-off and deep percolation	= 30-50 per cent of deliveries to field	$62.9 \times 40$
		100
		= 25.2 cusec
5. Evaporation	= 20-40 per cent of water stored in soil	$37.7 \times 30$
		100
		= 11.3 cusec
Balance for the crop growth		= 26.4 cusec

1 cusec = 0.02832 cumec.

The irrigator who takes initiative of spreading the water over a greater area in an attempt to make the economical use of water, has to pay relatively higher water charges—a penalty for his initiative and judicious use of water to increase the out-turn from his land and agricultural

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†The Tribune dated 25 May 1964.

} Hydel Design Directorate, Chandigarh.

production of the country as a whole. The careless irrigator on the other hand enjoys the advantage of paying less water charges as compared to volume of water utilised by him. This is obviously unfair.

The present system is also fraught with dangers of corruption at the level of petty officials who prepare and keep records of irrigation.

The irrigation supplies go to waste when the demand is slack due to rains, *etc.*, and there is no provision in the present system to divert the surplus supplies for storage to ponds for subsequent use by pumping or otherwise.

This system does not provide any incentive to the farmers to practise well or tube-well irrigation to supplement canal irrigation even where this is economically feasible.

The present system involves crop-wise assessment through a lengthy and tedious system for which the State has to incur a heavy expenditure every year.

A study of irrigation by tube-wells where the cultivators indirectly pay the water charges on volumetric basis shows that in this case they use water more economically than in the case of Canal Irrigation (Table II).

It is interesting to note from the details given in Table II that during the first 4 years, 1958-59 to 1961-62 when the water rate was charged on volumetric basis, the electric power consumption was 50 units to 0.405 ha. (an acre). However, during the year 1962-63 when the water rate was to be charged on acreage basis the electric consumption per acre went up to 68 units. In 1963-64, the electric power consumption per acre was still higher although the precise figures are not available.

These statistics in Table II clearly show that :

- (i) the volumetric charge induces the cultivator to make more economical use of water;
- (ii) the annual delta on irrigated area from tube-wells is only about 15.87 cm. (6.2 in.).
- (iii) the experiment of acreage assessment for the same area led to a good deal of wastage of water;
- (iv) the annual delta on the same irrigated area under the acreage system of assessment rose to 21.59 cm. (8.5 in.) showing an increase of 37 per cent.

This experiment clearly proves the superiority of volumetric system of assessment. This conclusion is further confirmed by the following statement made by Mr. Orson W. Israelson, Head of the Department of Irrigation and Drainage, Utah State College of Agriculture :

"The efficient use of water depends largely on the measurement of water. Increasing utilisation and value of available water and the growing tendency among irrigation companies to base annual water charges on the water used make an understanding of the principles and methods of water measurement necessary. Information concerning the relation of water soil and plant cannot be utilised in irrigation practice without measurement of water."

#### Proposals for Changeover to Volumetric System

A stage has now arrived in the process of our development when it is imperative to conserve every drop of water and utilise it most economically for the growth of agriculture and industry. It is, therefore, necessary to switch over to the

TABLE II

Year	Area Irrigated		Total (In acres) Col. 2+3	Total Units consumed	Units per acre Col. 5/4	Average units per cusec hour	Approximate cusec hours per acre Col. 6/7	Delta on Irrigated area (In ft.)
	Khariif (In acres)	Rabi (In acres)						
1	2	3	4	5	6	7	8	9
1958-59	85,768	88,752	1,74,520	87,05,901	49.88	8	6.23	0.52
1959-60	1,44,254	1,66,456	3,10,710	1,50,79,479	48.53	8	6.07	0.51
1960-61	1,64,242	2,41,815	4,06,057	2,07,43,111	51.08	8	6.38	0.54
1961-62	1,84,703	1,84,343	3,69,046	1,91,95,595	52.01	8	6.50	0.54
1962-63	1,83,893	1,73,785	3,57,678	2,41,75,624	67.59	8	8.47	0.71

1 acre=0.404686 ha. ; 1 cusec=0.02832 cumec

volumetric system of assessment and sooner we do it the better it is for the economy of the country.

The problem is how to supply the irrigation waters on a volumetric basis. The most apparent solution that suggests itself is the use of water meters like those installed in buildings. However there are practical difficulties as listed below which show that the use of water meters is not a feasible proposition.

- (i) Working head required to run the meters is generally not available in the field.
- (ii) The metering instruments being of delicate nature, are liable to be damaged frequently. They can also be tampered with and by-passed.
- (iii) Heavy cost of metering instruments.

For the sake of simplicity and economy, the answer to this problem has to be found within the frame work of the present set-up. Modular outlets have already been installed at the head of almost all the watercourses and the volume of water being delivered at these points is known. It is, therefore, proposed that the irrigators on each outlet may be charged as a co-operative body on the basis of the quantities of water delivered at the outlet.

Beyond this point, the management of water already rests with the irrigators except that it needs to be brought on a more rational basis. Accordingly, it is proposed that this management may be placed under the care of an organised body like a Village *Panchayat* or a village co-operative who should make a bulk purchase of water from the Irrigation Department at the outlet head for further distribution to the irrigators. The control of *warabandi* and recovery of water charges will rest with this organised body which will hereinafter be taken as synonymous with a *Panchayat* for the purposes of this paper.

As the quantity of water supply from the modular outlets is known, the water charges recoverable from each irrigator can be worked out on an hourly basis. Consequently, the cultivator will not allow the water to go waste if he knows that he has to pay the charges for all the volume of water consumed on his account. If his crop requirements are nil he will not take his turn. In such cases, the surplus water can be stored in the village pond for subsequent use by pumping or any other manner to be decided by the *Panchayat*.

This would be in accordance with the principle of endowing the *Panchayats* with power and authority necessary to enable them to function as a unit of Self-Government, as laid down in our Constitution.

According to our Constitution, the State is further committed to organise the agriculture in modern and scientific lines. The supply

of irrigation waters on volumetric basis to the *Panchayats* for utilisation on co-operative basis will be a constructive step in this direction.

An Advisory Committee of experts in irrigation engineering and agriculture can guide and assist the *Panchayats* in each District in the various aspects of management of irrigation waters so as to evolve suitable methods for increase in the agricultural production from land.

These Committees should have adequate liaison with the Irrigation, Research and Agriculture Departments and their co-ordination committees (as described later) so as to bring the new developments and modern techniques in farming within easy reach of *Panchayats* and cultivators. It will then be the responsibility of *Panchayats* to look after the practical aspects of land and water management as mentioned below :—

- (i) Levelling of land and layout of watercourses.
- (ii) Lining of watercourses.
- (iii) Adoption of measures necessary for eradication of water-logging and salinity.
- (iv) *Warabandi*.
- (v) Methods of application of water.
- (vi) Number and depths of waterings.
- (vii) Layout of fields and *kiaries*.
- (viii) Selection of seeds, fertilisers and agricultural implements.
- (ix) Resolving disputes of cultivators regarding management of irrigation waters and agricultural land.

#### Advantages of the Proposed System

- (i) The proposed system will induce the irrigators to use the irrigation waters in economical ways.
- (ii) It will popularise co-operative farming.
- (iii) This system will encourage the *Panchayats* to line their watercourses and save considerable seepage losses which can be utilised for extending canal irrigation to additional arid areas. It will thus be helpful to a great extent to eradicate the water-logging and salinity troubles.
- (iv) The proposed system will help the *Panchayats* to organise the agriculture on modern and scientific lines.
- (v) This system will encourage irrigation by wells and tube-wells where this is economically feasible to supplement canal irrigation. This combination

will provide more assured supplies and help increase the agricultural production of the country.

- (vi) The canal water supplies which are not required by the crops can be stored in ponds for fish culture and subsequent irrigation by pumping as required.
- (vii) This system will ensure closer co-ordination between the cultivators and the experts in irrigation and agriculture.

### Need for Further Research

Management of irrigation waters is only a means (and not an end in itself) to step up the agricultural production. Different crops, and in fact even different varieties of the same crop, have different response to irrigation waters. This explains the necessity of extensive studies and experiments to achieve the maximum output from the agricultural land.

Considerable research has been done in various countries to arrive at proper techniques for management of irrigation waters, utilising meteorological data and results of actual experiments on model farms. However, our knowledge about these techniques is not as far advanced as to give us maximum possible yield from agricultural land. It is necessary, therefore, that immediate steps are taken to initiate intensive research studies and ensure their application in the field for rapid increase in agricultural production. This is confirmed by the following report of Ford Foundation Team :

“Money is generally made available directly to the Irrigation Department for the construction of Irrigation Projects. On the other hand, no adequate funds are provided from the large funds spent on minor irrigation project for the necessary research, demonstration and technical assistance required to get maximum benefits from the project in terms of production.”

and their recommendation is :

“Research, experiments and demonstrations should be greatly expanded to deal with the proper combination of :

- (a) Water arrangements.
- (b) Fertilizers and green manures.
- (c) Good seeds.
- (d) Other cultural practices for high production”.

Some of the fields in which further research studies and experiments are necessary are enumerated below :

- (i) Importance of proper seeds.

- (ii) Effects of various types of fertilisers.
- (iii) Plant protection measures to prevent diseases and insect pests.
- (iv) Improvement and modernisation of the traditionally old agricultural implements.
- (v) Development of proper techniques for farming, application of water and conserving water—stored in the root zone regions. In Famosa, for instance, 3 to 4 crops are raised on the same land by adopting inter-planting which comprises planting of new crops in between lines of standing crops before they are harvested. This would change our age-old concept of harvesting only two crops in a year.
- (vi) Methods of conveyance of waters required for the crops and drainage of surplus waters through surface and sub-surface drains.
- (vii) Water requirements of crops for field and consumptive use.
- (viii) Crop pattern based on availability of water during the various months of the year.

### Co-ordination between Irrigation, Power, Agriculture and Research

The term irrigation, as it is understood at present, implies Irrigation Engineering pertaining to construction and maintenance of canals, storages and appurtenant works. However, the more important aspects of irrigation bearing its relationship with water requirements of crops, types of soils and climates are not generally associated with this term. These are being dealt with by the Department of Agriculture, but there is hardly any co-ordination between these departments.

Similarly, irrigation by tube-wells is closely connected with electric power requirements and it is felt that there should be a close co-ordination between the Irrigation and Power Departments. This will enable development of tube-well irrigation at minimum costs by maximum use of secondary power with the added advantage of minimising the water-logging trouble. Such co-ordination will be further helpful for overall development. Secondary power can be further utilised for tube-wells to augment the canal supplies and the corresponding savings in water at canal heads can be conserved in the reservoirs for increasing the firm power.

Experimental data which becomes available as a result of research in the field of irrigation and agriculture will become helpful only if there is proper liaison between the various departments of Irrigation, Power, Agriculture and Research. It is, therefore, proposed that a Co-ordination Committee may be set up with a



view to guiding the general policies regarding the measures to be adopted for increasing the agricultural production from land. This Committee may be comprised the heads of the various departments mentioned above or their authorised representatives who are experts in their own fields. This Committee will guide the general policies to be adopted in regard to the following aspects of management of irrigation waters :

- (i) Fixing crop patterns for particular areas and changing them occasionally on the basis of availability of water supplies from time to time for optimum utilisation of the irrigation waters.
- (ii) The system of rotation to be adopted for a particular water distribution system.
- (iii) The necessity and types of lining to be adopted for water carrying channels including watercourse.
- (iv) Water rates.
- (v) Types of seeds, fertilisers, implements and plant protection measures to be used for particular area.
- (vi) Methods of application of water and farming techniques.

Whereas the Co-ordination Committee will lay down the general policies, the actual implementation of such policies will rest with the *Panchayats* who will be guided and assisted by the advisory committees of experts as mentioned above.

### Summary

The present system of assessment of water charges on the basis of area and crops matured is rather wasteful. It is, therefore, proposed to replace it with the modern system based on volumetric measurement of water.

Irrigation supplies are already measured at the outlet head and can, therefore, be purchased in bulk by the village *Panchayats* who can further distribute the same to the farmer on an hourly basis.

Under the proposed system the responsibility of the irrigation engineer in regard to the management of irrigation water will end at the outlet head. Beyond this point, this responsibility will rest with the village *Panchayat*.

The village *Panchayats* will look after the practical aspects of the land and water management with the guidance and assistance of District Advisory Committee of experts in Irrigation and Agriculture. The overall policies would, however, be guided by a high level Co-ordination Committee comprising the Heads of the Departments of Irrigation, Power, Agriculture and Research.

It is hoped that the proposed system will be very helpful in increasing the agricultural production from irrigable areas.

# FIELD DISTRIBUTION OF IRRIGATION WATER IN THE D. V. C. AREA

by

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Supply of water for irrigation is one of the important aspects of the Damodar Valley Project. A portion of water stored in storage dams at Maithon, Panchet, Tilaiya and Konar is utilised for irrigation by diverting water to the Left Bank and the Right Bank Canal systems, originating from Durgapur Barrage Pool (Figure 1). The commanded area of D.V.C. irrigation system lies in the districts of Burdwan, Hooghly and Bankura in the State of West Bengal. As per test notes prepared by the I & W Department of the Government of West Bengal, the irrigated area in *Kharif* season which was 176751.87 ha. (4,36,763 acres) in 1958, increased to about 256975.61 ha. (6,35,000 acres) in 1963. It is expected that after completion of the Extension and Improvement Schemes and the watercourse Schemes, already taken in hand it will be possible to extend irrigation facilities to about 393759.48 ha. (9,73,000 acres).

Irrigation in the State of West Bengal is supplemental in nature and canal water supplies the deficit in rainfall. *Aman* paddy is the main crop of West Bengal during *Kharif*. Normal rainfall in the area is about 101.60 cm. (40 in.) which is concentrated during a few months in the rainy season. Hence during the *Kharif* season at times rainfall is in excess of actual need and there is also shortfall which requires to be met from canal water. The canals supply water from 1st of July. Table I shows rainfall in the Left Bank command area during a particular year for each 10-day period in irrigation season. This table also gives details of crop requirement and actual field requirement.

TABLE I

Period	Rainfall in command area in inches	Crop requirement in inches	Actual field requirement from canal water
1962 July 1-10	0.14	4	3.86
" 11-20	3.48	4	0.52
" 21-31	4.67	4	0.00
1962 Aug. 1-10	2.82	4	1.18
" 11-20	1.61	3.5	1.89
" 21-31	4.01	3.5	0.00
1962 Sept. 1-10	1.74	3.4	1.66
" 11-20	1.55	3.3	1.75
" 21-30	7.10	3.3	0.00
1962 Oct. 1-10	2.91	2.5	0.00
" 11-20	Nil	2.5	2.50
" 21-31	1.54	2.0	0.46
TOTAL	31.57	40.0	13.82

One in. = 2.54 cm. = 25.4 mm.

From Table I it will be clear that though there was some demand for irrigation during most of the period, rainfall was in excess of field requirement during July 21-31, August 21-31, September 21-30 and October 1-10. One important aspect in West Bengal Irrigation is that practically field channel system of irrigation does not exist and water from canal goes from field to field by inundation. The inundation system has the following inherent disadvantages :-

- (1) Over-irrigation of the upper lands.
- (2) Loss of manure of the upper land.
- (3) Wastage of water.
- (4) Lack of operation control.

D.V.C. Irrigation System, however, was designed for inundation system which was the prevailing system in the country and outlet sizes for discharge of 2.43 to 4.047 cumec (6 to 10 cusec) are not uncommon. Water from the outlet is supposed to inundate upper fields and gradually passes on to lower fields. Cultivators maintain required depth of water with the help of 'ail bundh' or boundaries along the periphery of their fields. They cut a portion of the 'ail bundh', allow water to pass on to the next field and thus maintain water-level in their own fields. In case of heavy rains the same process continues for draining the excess water by cutting the 'ail bundh'. Actual congestion starts in the lower fields if drainage system is not good.

As per decision of the Planning Commission, funds were allotted during the Third Five-Year Plan for taking up watercourse scheme in D.V.C. command area and to restrict block sizes to about 60.70 ha. (150 acres). The main idea being equitable distribution of irrigation water for optimum utilisation. During the construction of canals in the main project, it was thought that actual irrigation will be done by inundation system; present attempt for conversion to field channel system has posed a number of problems. Cultivators here are not used to field channel system. Though number of applications from farmers pour in the irrigation offices, these are restricted mainly to get the existing system extended to their area by constructing minors or small channels. Where an existing outlet though considerable capacity serves the area, there is practically no complaint and demand for getting watercourse dug either at Project's cost or by joint venture of the villagers is rare.

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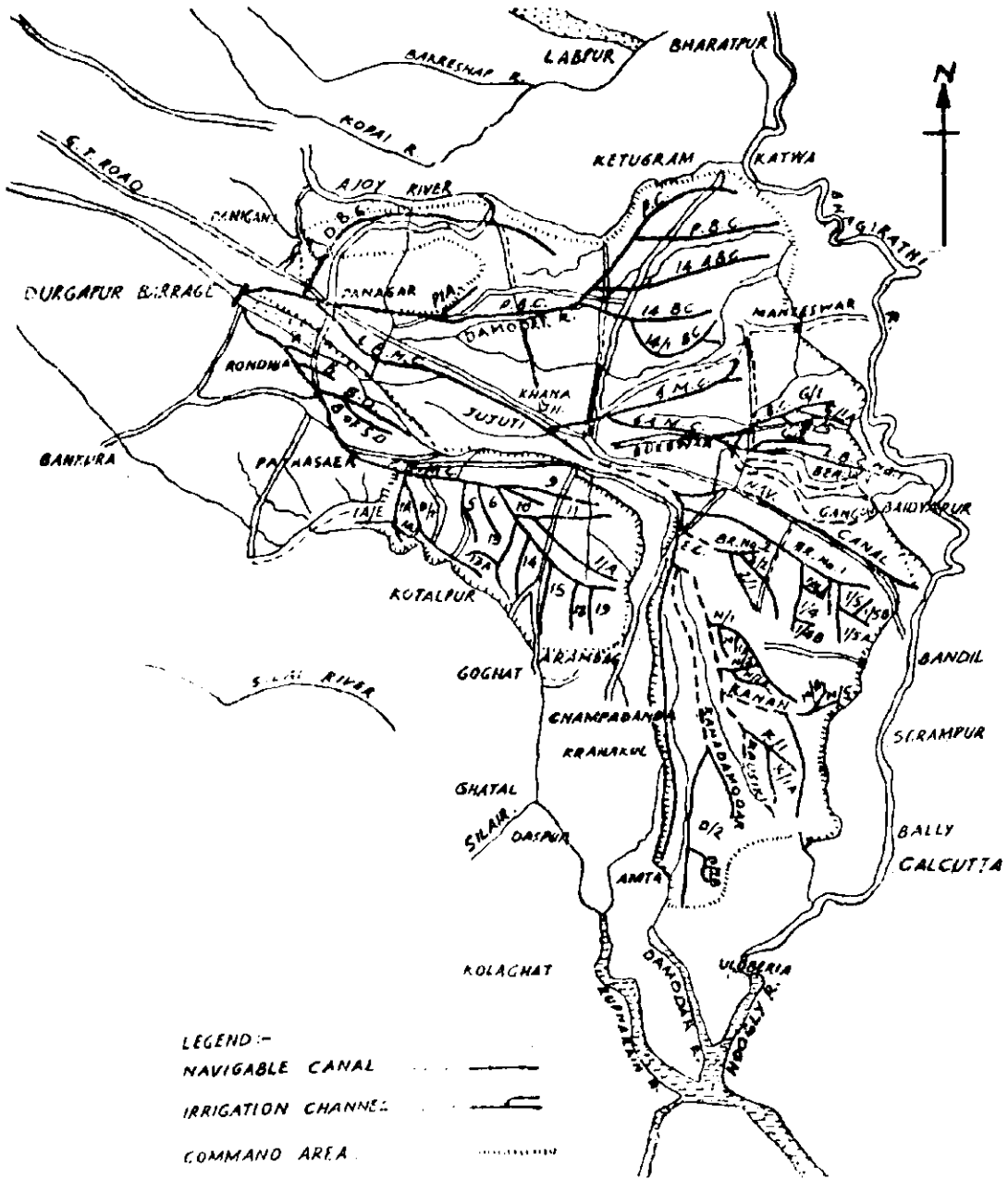


FIGURE 1 : Index Map of Canals.

To be more clear, it may be stated that the idea of taking up watercourse scheme and field channel construction did not originate from the consumers but from the Government, due to its eagerness for maximum utilisation of water. Another aspect which also should be borne in mind while dealing with the West Bengal irrigation for main *Aman* crop is that some amount of cultivation is possible in all normal years from rainfall alone and proper irrigation only increases the yield to some extent. Average increase due to irrigation facilities may be 0.048 to 0.06 tonne/ha. (4 to 5 mds./acre) during normal rainfall years and it may be increased appreciably with application of fertilisers. The point which I want to stress here is that demand for irrigation is not so acute like some of the Northern States of India, as cultivators are assured of some harvesting here even without irrigation. Moreover, irrigation system sometimes clashes with rainfall because of its localised occurrence during some unpredictable time during the cultivation season. It is common that during some weeks drainage is a problem even after stopping the canal water, as rain water is in excess of field requirements.

Again, due to non-uniformity of rainfall, it is difficult to operate distributaries and minors with full supply level throughout the whole reach to feed all watercourses. The canal reach where rainfall is low during the time full supply level is now maintained by partial closing of regulator gates. Very often it is seen that full designed discharge is not necessary for a long distributary and F.S.L. is maintained in different reaches by gate operation. Though irrigation experts discourage such procedure, yet this is found to be practical in the field due to nature of rainfall in the locality.

A comparison of rainfall between one station in D.V.C. area and the other in East Punjab has been done in Table II. For convenience, readings of rain-gauge Stations at Burdwan and Amritsar, have been tabled from July to September for the years 1962 and 1963. It is seen that in Burdwan there were rains in 47 per cent days compared to 13 per cent days in Amritsar during these months. Total average rainfall for the 4 months was 814 mm. in Burdwan compared to 253 mm. in Amritsar. This gives us a clear idea that the operation of irrigation canals in West Bengal is quite complicated.

Preliminaries for starting the watercourse schemes were taken up by D.V.C. only in 1962 by starting contour survey work for plotting close contours at 0.3 m. (1 ft.) intervals. With the progress of design of schemes, land acquisition, etc., were taken up. After careful consideration it was decided that instead of taking up work in the area which was receiving irrigation benefit (though by inundation system) work should first be concentrated to the areas where there were public grievances for shortage of

irrigation water. The shortage was mainly due to the fact that existing canal system was far off from many fields. Keeping in mind the main object of reduction of blocks to 60-70 ha. (150 acres) size, it was thought advisable that network of canal system should be extended in these areas by constructing additional minors and distributaries so that each outlet can command blocks of about 60-70 ha. (150 acres) size. Construction of field channels within the block will remain the responsibility of the farmers. In this way number of schemes have been prepared during the last two years for supplying easy irrigation water to the area where legitimate grievance for shortage of water exists. The actual difficulty for execution of these schemes is to take the canal from upper reaches which due to their proximity to the existing canals, get full benefit of canal water. Owners of land in the upper reaches raise vehement objection to take canal through their land whose value has considerably increased. In some cases court injunctions are issued obstructing excavation of channels. Requests for change of alignments are very common. It may be noted that at present the work is mainly limited to such constructions, where land is acquired by the D.V.C. after paying compensation and work is done at the cost of D.V.C. Question of donation of land from farmers for carrying out watercourses and voluntary construction of field channels by the villagers has not seriously been handled yet. As pointed out earlier, attempt has been made to concentrate work in the area where there is dearth of irrigation water so that when the system starts functioning in this area, it can work for small size blocks having small length of watercourses. The watercourse is considered as the channels between the outlet and the upper extremity of the command of the watercourse, i.e., the unproductive length of the carrier channel before it starts serving the command. This channel is considered as the responsibility of the project and is constructed by the project at its cost. From the point where the command of the watercourse starts, the responsibility of extending the channel lies with the beneficiaries. After completion of a scheme by D.V.C. area of irrigation by inundation system will get reduced as it will be restricted only to 60-70 ha. (150 acres). It is expected that field channels will be constructed expeditiously in these areas as farmers are expected to be more co-operative being deprived of irrigation water before taking up new schemes. In case of conventional watercourse construction and reduction of existing big blocks in the area where full irrigation benefit has been already received, chances of co-operation from villagers are remote. It is difficult to convince the villagers now that for supply of irrigation water, construction of watercourses and field channels will show some tangible benefit in their fields which will outweigh the value of land they have to spare. Moreover, in West Bengal, sizes of fields are rather small and consolidation of holdings has not been

taken up yet. This has posed problems in laying scientifically village channel alignments as fields are different in sizes and shapes. Some agreement is necessary as to minimum size which will be commanded by field channels.

A reference to the type of outlets may be of interest here. During the first few years of operation, temporary outlet pipes are placed which are gradually replaced by permanent non-module pipe outlets with gates. Figure 2 shows a typical outlet. There is nothing new in this outlet, on the other hand there may be impression that the D.V.C. is not utilising outlets of advanced types. Hasty conversion of outlets to module type is not desirable. Moreover, due to variation of rainfall, a gated outlet has got definite advantage. In the same distributary, outlets in lower reaches may be kept open whereas in upper reaches these may be kept closed. The trouble, of course, starts regarding maintaining the steel gates during non-irrigation period. Steel gates are often stolen away and some amount of protection is, however, given by storing the gates within the masonry structure and bolting the R.C. cover at the top as will be seen in Figure 3.

Due to reduction in sizes of blocks, some of the existing huge pipe outlets which now command a big area, are required to be converted to smaller size. It has been decided that instead of dismantling the existing outlets and replacing the pipe, the discharge through the existing bigger diameter pipes will be reduced by inserting collars. Field studies in this connection for deciding the collar sizes for different diameter pipes, have already been initiated.

*Rabi* irrigation in the D.V.C. area which is gradually increasing has also some distinct features. About 12140.58 ha. (30,000 acres) have been irrigated in the year 1963-64 against 6313.10 ha. (15,600 acres) during 1960. *Rabi* crops are potatoes, sugar-cane, vegetables, oil-seeds, pulses, wheat, etc., which are cultivated in districts of Burdwan and Hooghly. In the district of Bankura, no *Rabi* cultivation is yet done from D.V.C. canal system. The whole of Burdwan district except nine blocks falling in the industrial belt of Asansol where no irrigation is available, is included under the package programme of agricultural development. The present programme is to cover 0.405 lakh ha. (1 lakh acres) during 1963-64 under package programme, 1.01 lakh ha. (2.5 lakh acres) in 1964-65 thus increasing the area year by year to 2.63 lakh ha. (6.5 lakh acres) in the 5th year. It is expected that this programme will facilitate to considerable extent utilisation of canal water during *Rabi* irrigation season. *Rabi* irrigation usually starts from 1st of November each year. Lift irrigation system is in vogue as *Rabi* lands are comparatively higher. The usual practice is to lead canal water to a tank or in an old silted river bed, from where *donga*

is used in 2 or 3 stages to lift water to field level. During *Rabi* irrigation season, rainfall is almost nil and farmers are quite systematic in utilising water. Field channels are in many places constructed by the farmers. But cultivation is done in patches and not much continuity is observed in spite of availability of water. Growing of *Rabi* crop requires certain amount of ability on the part of farmer and, I am sure, that only by making water available *Rabi* cultivation can not miraculously increase. Finance and labour are two important factors for growing *Rabi* crop, apart from suitability of land. The cultivators should be able to spend some money on preparation of land, manure, seedlings and labour. It has been observed that in the district of Burdwan, labourers which come to work from nearby districts of Bankura and Purulia, go back after *kharif* harvesting. If *Rabi* cultivation can be taken up in mass scale instead of patches, as is done now, it may attract labourers to stay back and work during *Rabi* season. Co-operation between Engineering Department and Agriculture Department is essential for optimum utilisation of water particularly for *Rabi*. Suitable development programme for next few years is under preparation by the Agriculture Department on the basis of availability of water. The existing system of lift irrigation is, however, old. Only a few farmers have started use of pumps for taking water from canal to their *Rabi* fields. Attention is also being given to arrange for flow irrigation facilities to *Rabi* area.

From the description of *Kharif* and *Rabi* irrigation in D.V.C. area which has been furnished, it will be clear that irrigation system in West Bengal differs considerably with that of the Punjab and Uttar Pradesh. In *Kharif* season, irrigation in West Bengal is supplemental and engineers are to keep in mind concentration of rainfall during the season. Though Punjab irrigation system is excellent, it cannot be applicable to West Bengal in toto. Conversion of inundation system to field channel system is desirable. The D.V.C.'s programme for reducing block sizes by constructing additional minors and distributaries where technically feasible, seems to be a better way of handling the problem at the initial stage. Attention has been given to get the field channels constructed within the small sized blocks to be served by new minors. Here the distribution of responsibility between other department comes. As far as we can see, Engineering Department shall have to bear the responsibility in the capacity of technical advisers so far alignment, etc., of the field channels are concerned. If the main scheme up to outlet point has been constructed by irrigation engineers it is advisable to extend the technical service by the irrigation engineers within the block. It will be desirable that the Agriculture Department in this area should remain closely associated with the farmers not only for distribution of seeds and fertilisers but also for getting field channels constructed for proper utilisation of water within the block.

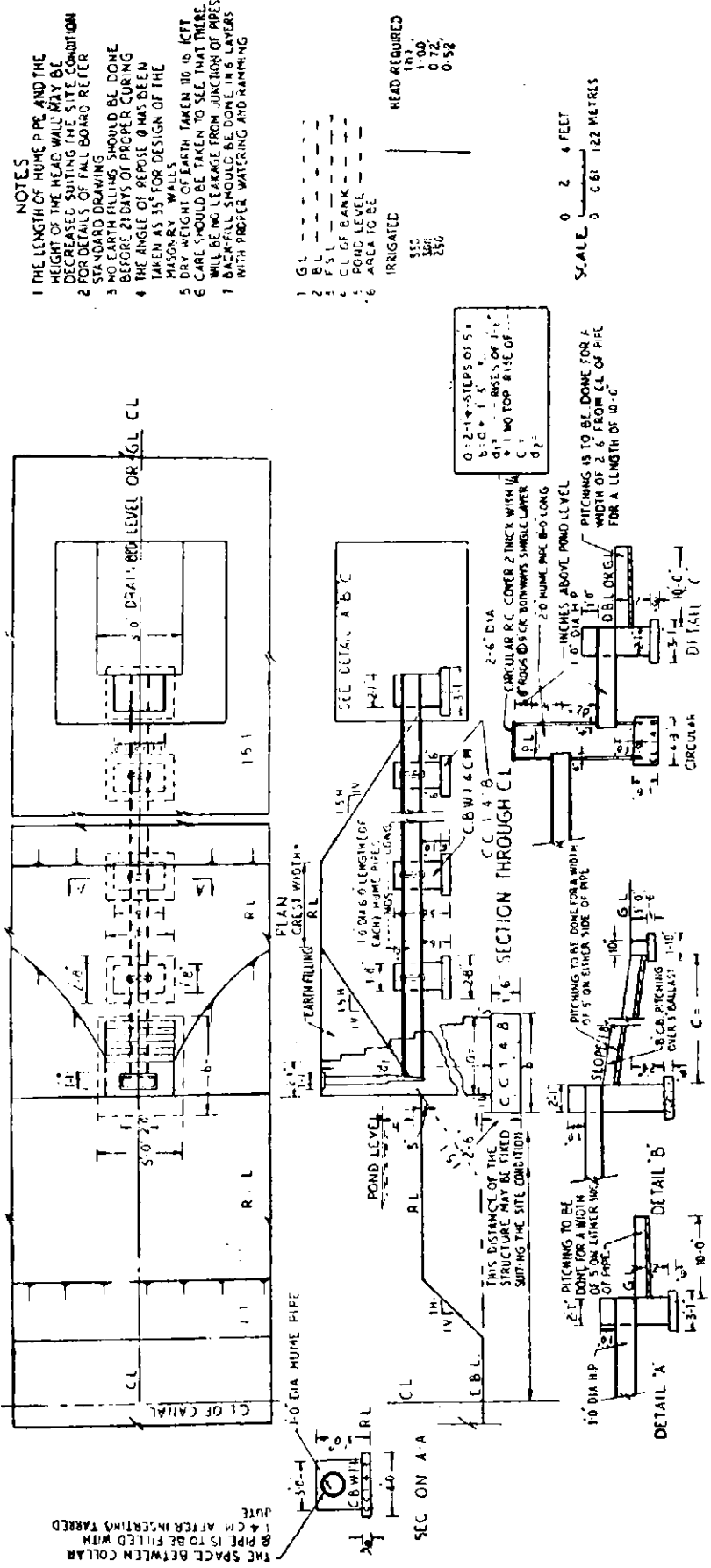


FIGURE 2 : Watercourse Scheme (bank).

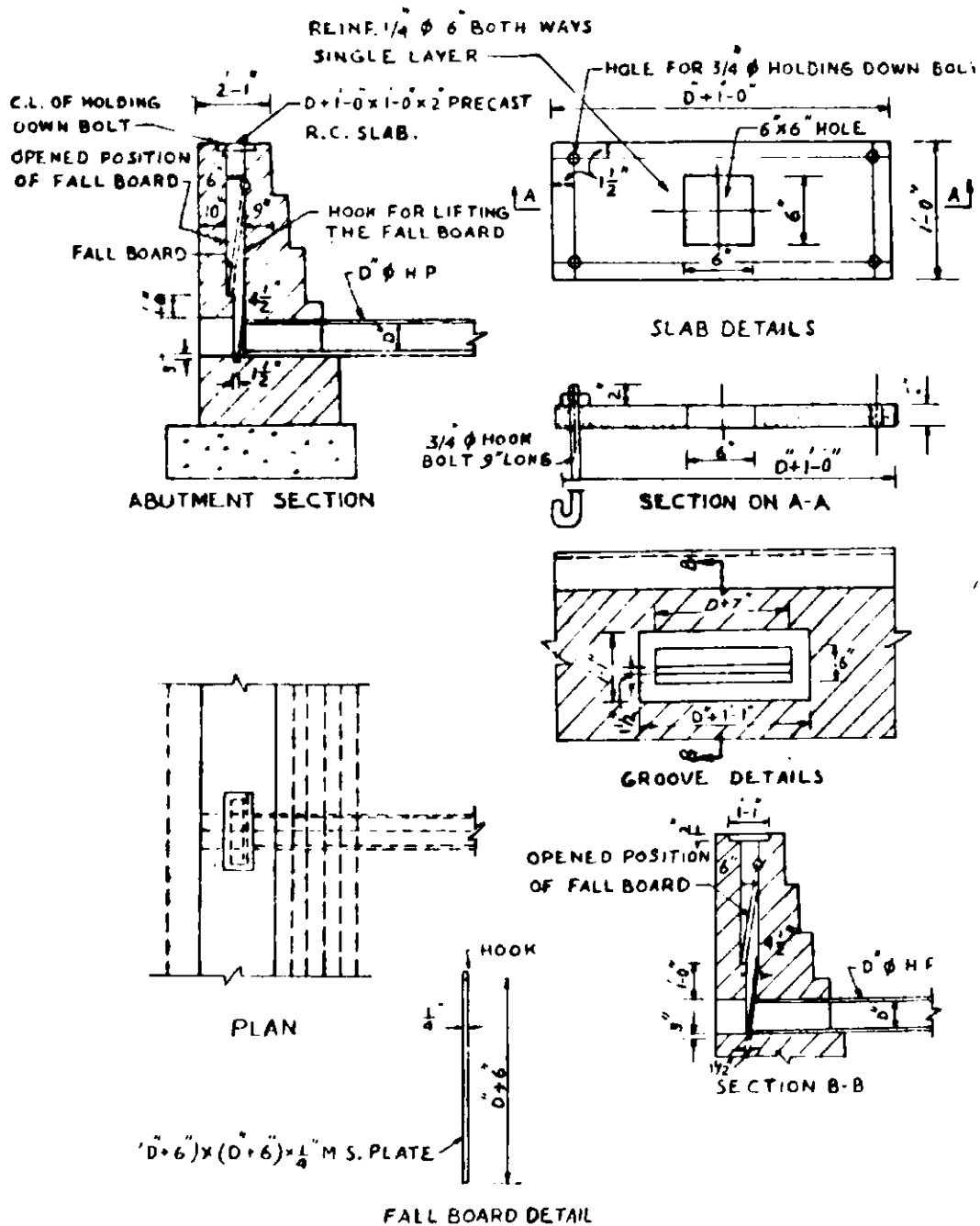


FIGURE 3 : Standard drawing of fall-board arrangement (up to 2 ft.  $\phi$  H. P.).





TABLE II—(Contd.)

Rainfall Data of Amritsar and Burdwan (in mm.).

Date	22	23	24	25	26	27	28	29	30	31	Total
<i>July, 1963</i>											
1. Amritsar . . .	68	1	0	0	0	0	0	0	0	0	98
2. Burdwan . . .	0	3.3	5.5	0.6	86.5	0	2.0	6.8	8.2	0	439.7
<i>August, 1963</i>											
1. Amritsar . . .	0	0	0	0	0	0	0	0	0	0	55
2. Burdwan . . .	33.2	0	0	0	0	2.8	3.5	0	0	0	98
<i>September, 1963</i>											
1. Amritsar . . .	0	0	0	0	0	9	0	0	0	0	69
2. Burdwan . . .	0	0	0	0	0	18.0	11.6	19.2	6.4	0	210.7
<i>October, 1963</i>											
1. Amritsar . . .	0	0	0	0	0	0	0	0	0	0	0
2. Burdwan . . .	0	6.4	17.2	12.2	0.5	1.0	0	0	0	0	79.0
<i>July, 1962</i>											
1. Amritsar . . .	0	0	0	0	0	0	0	0	0	0	41
2. Burdwan . . .	0	0	0.2	6.0	0.8	6.8	68.5	0.1	0.8	0	310.6
<i>August, 1962</i>											
1. Amritsar . . .	0	0	0	0	0	0	0	20	65	0	130
2. Burdwan . . .	0.2	2.8	0	8.0	0.6	0	0	0	0	0	199.9
<i>September, 1962</i>											
1. Amritsar . . .	0	0	0	0	0	11	0	0	0	0	114
2. Burdwan . . .	9.0	0	0	0	0	0	0	0	12.4	0	240.2
<i>October, 1962</i>											
1. Amritsar . . .	0	0	0	0	0	0	0	0	0	0	0
2. Burdwan . . .	0	0	0	0	4.8	2.0	4.2	6.0	12.0	0	51.0

Function of the Agriculture Department is such that for efficient discharge of their duty they require a close contact with the farmers. It is much easier for them to work within the block than the Engineering Department. It is expected that staff of Block Development officers and village *Panchayats* should join with the Agriculture Department. Agriculture Department should induce methods for proper utilisation of water. As for example, while distributing seeds, fertilisers, etc., they should give priority to the areas where field channels exist and where farmers act as per advice given to them for minimising wastage of water. Records should be maintained for performance of each block during irrigation season including production in the block. Distribution of seeds and fertilisers during next year should be done according to last year's performances. There is no doubt that a certain percentage of manures gets washed away during inundation irrigation and hence Agriculture Department should take interest to have the field channels constructed and utilise water only up to requirements.

In our opinion, if irrigation by field channels can prove better results in new areas, then only farmers of adjoining areas will volunteer to get them constructed in their fields.

In West Bengal, the Agriculture Department has also got the responsibility of changing the crop pattern. The programme is worked out

in consultation with the Irrigation Department. There has been gradual increase in the growth of additional crop. In the district of Burdwan, potato cultivation has increased from 6475.0 hectares (16,000 acres) in 1961 to about 12140.6 hectares (30,000 acres) in 1964, wheat cultivation from 3035.14 to 8093.7 hectares (7,500 to 20,000 acres). Similarly, sugar-cane cultivation has increased during the 4 years from 2023.5 to 8094 hectares (5,000 to 20,000 acres). Increase of food products in the district of Hooghly is also considerable. On experimental basis, *Boro* paddy cultivation during middle of January for harvesting during early May has already been taken up near Tarakeswar area in the fields which used to remain unutilised after *Kharif* cultivation.

It is true that there is much yet to be done in the field of agriculture for maximum utilisation of irrigation facilities. We are all interested to increase production in the country. Already co-ordination committee is functioning in the district level with the District Magistrate of the District, the Superintending Engineer, representative of Agriculture Department and others. The work is moving though the progress may be slow. The responsibility of running D.V.C. canals has been transferred to the Government of West Bengal from April 1, 1964. It is expected that with this transfer, better co-ordination between various departments for maximum utilisation of irrigation water will be possible.

# MANAGEMENT OF IRRIGATION WATERS—ROLE OF ENGINEERS VIS-A-VIS THEIR COUNTERPARTS IN OTHER DEPARTMENTS

by

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## SYNOPSIS

*The biggest problem confronting the country is achievement of self-sufficiency in foodgrains. The shortage as per the findings of the Agricultural Production Team sponsored by the Ford Foundation by the end of 1965-66 will be of the order of 28.45 million tonnes (28 million tons) requiring an import of foodgrains worth Rs. 1,120 crores, speak for the gravity of the problem. Tackling all ways and means of stepping up production of foodgrains is called for. It is thus imperative that water, the life of all plants, is fully utilised to the maximum. In this context defining the responsibility of various departments with respect to distribution of water in fields and its maximum utilisation is a must.*

### Distribution and Optimum Utilisation of Water

With entry of water into the watercourse the responsibility of the engineer should not end out but start as he is the man who planned and executed irrigation projects and canals after making observations of the availability of water in rivers and demands of water in fields in various periods of a year. In consistent with the availability and demand of water he worked out the water allowance and on its basis he worked out the size of outlet for a particular *chak*. Thus, there can be no person better than the engineer to look to the proper distribution of water as his position is analogous to a man who has designed and constructed a house, keeping in view the circumstances and the requirement of space therein, and there can be hardly a man abler than him to know its full utility. Thus it is the engineer who can and does look to the interests of both the irrigation and the irrigator. The development of irrigation which is outcome of joint efforts of generations of engineers is a matter of pride for him and he will do his level best to keep up the pace of development of his great heritage, the irrigation which fights the menace of scarcity and irregularity of rains which resulted in draughts and famines. He takes it as a privilege to step up the production of foodgrains by playing his important role well in seeing that each and every drop of water, which has been brought by great efforts of generation of engineers is fully utilised to the maximum. No third party—Agriculture Department or *Panchayat* having no responsibility and interest in the development of irrigation—should be entrusted with the distribution of water. Further, any such third party with no technical knowledge will be confronted with innumerable difficulties and problems, if asked to take over

distribution of water. Thus all the powers of sanction of outlets, watercourses, *warabandis* and time to time modification thereof and alteration in *chaks* and outlets should be vested in him.

To come to the proper utilisation of waters it depends upon various factors such as size of *chak*, commandability of area, proper alignment of watercourses. The experience has shown that downfall in irrigation is because of defective alignment of watercourses and deposition of silt in the watercourses. The watercourses if properly re-aligned, will definitely improve irrigation. Engineers should devote their full attention to the proper alignment of watercourses. Many a time there is lot of silt in the watercourse which is responsible for poor irrigation. It is humanly impossible for the irrigator to clear the silt himself. The only solution is that the watercourses be shifted to new sites during the consolidation operations. The silt should be got removed by the department at its own cost, in case the consolidation operations have been completed, otherwise the land for watercourses be taken from the common pool of the village. The other setback is that watercourses are not properly maintained by the cultivator and the engineer should be held responsible for seeing that the watercourses are properly maintained and in case they are not, he should be empowered to get it done himself and recover the cost from the irrigators as arrear of land revenue.

Big *chaks* have long watercourses with the result that there are huge losses of absorption and evaporation. The remedy of lining is a costly affair and is thus out of question for economic distribution of water. The best thing will be to limit the size of the *chak* to 121.41

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to 161.87 ha. (300 to 400 acres) and thus limit the length of watercourse thereby saving these avoidable losses of water.

The best possible commandability of area should be aimed at and the engineer should ensure the maximum command by modification of *chaks*, if so warranted.

The supply of water from a watercourse is regulated by a system of periodic turns after every 7 or 10 days commonly known as *warabandi*. The turn may be continuous or non-continuous depending upon the rules in force regarding counting of turn irrespective of presence or absence of water in the watercourse or counting of turn only on the presence of water in the watercourse.

As far as *Panchayat* is concerned it is impossible for it to frame *warabandi* and enforce it at site. Non-sanctioning of *chakbandis* comes in way of *warabandi* of the watercourse. So the *chakbandi* be carried out on priority basis so that *warabandis* be prepared to ensure equitable and proper utilisation of water.

So far as the rules and instructions regarding *warabandi* are concerned formerly the irrigation engineer was not empowered to move framing of *warabandi* or to interfere in the internal distribution of water. It was only on the complaints of some irrigators on the non-judicial stamp paper that the Divisional Canal Officer could frame *warabandi* which remained in force unless set aside by the Civil Court. It was experienced that such provision of appeal in Civil Court which court could only uphold or set aside the decision of the Divisional Canal Officer and not make a revised *warabandi* to be enforced at site, only resulted in unnecessary delay as the matter was referred back to D.C.O. who would either revise the *warabandi* or stick to his previous decision. Thus, there was a vicious circle of appeals and reappeals resulting in unnecessary delay.

Due to the consolidation operation in progress in the State the number of *warabandi* cases to be revised has considerably increased because of the consequent changes in ownership, etc. Keeping in view the multifarious duties of the engineer such as checking and supervision of booking of irrigation, looking after banks to guard against occurrence of breach or cut, looking after outlets, so that they are properly designed and are not tampered with and other administrative and construction responsibilities and in order to expedite the *warabandi* cases now the Deputy Collector has been recently in 1963 empowered after due amendment of Section 68 of the Canal Act to frame and announce *warabandis* even on his own motion and the authority to hear appeal has been vested in D.C.O. It is premature to judge the results of new enactment as to whether the *warabandi* cases are expeditiously dealt with or not but it is expected that the things will definitely improve.

The Punjab Village *Panchayat* Act, as it existed in 1921 conferred powers to a Village *Panchayat* to regulate the distribution of water from any watercourse which excludes the jurisdiction for this purpose of the D.C.O., the village in which there was a duly constituted *Panchayat* Act. Under the existing *Gram Panchayat* Act, now almost every village has its own constituted *Panchayat* which is conferred with wider powers to decide various types of cases. But passing on of *warabandi* cases to *Panchayat* is fraught with grave difficulties and consequences. The *Panchayat* having no technical knowledge will not be able to frame *warabandi* and to implement it. The *Panchayat* has no information regarding revenue and civil record and unless such information is forthcoming the provisions, if made in *Gram Panchayat* Act authorising it to regulate distribution of water, will be a dead legislation. To make such information available parallel staff consisting of Engineering, Revenue and Civil Establishments will have to be provided, thus increasing the cost of distribution.

Further, the party politics which is so vehemently prevalent in Village *Panchayat* will come in the way of ends of justice being met in case powers are transferred to Village *Panchayats* as members are again some of the irrigators. Thus it is worthwhile that the independent Engineer Officers should be empowered with the preparation of *warabandi* and its implementation at site. The powers of punishing for *warashikni*, i.e., breach of *warabandi* by levy of *Tawan* should also continue to be vested in the Engineer.

#### Land Levelling and Supply of Manures, etc.

✓ The necessity of land levelling for proper utilisation of water can be hardly over-emphasised. The irrigator does take pains to keep the land level to remove slight undulations in land so that the water reaches all the portion of a field and does proper irrigation thereof. But sometimes that is water available in the distributary but some *tibba* or higher isolated land is devoid of being taken in the *chak* because of lack of commandability. In such case if such small plateaus are levelled, the irrigation can be improved by getting more area under command. But levelling such lands is beyond the might of an individual irrigator as he is unable to incur huge expenditure on the levelling of lands and thus to further the cause of irrigation. In such cases it is desirable that the *Panchayat* who is responsible for improving the lot of the villages should come into play and get such jobs done through the common pool of village funds. These funds may be raised by collection of small amounts from all the villagers or may be contributed by the Government in the form of small percentage such as  $\frac{1}{2}$  or 1 per cent of the revenue of the village. Use may be made of these funds for the general benefit

of the villagers. Thus the Agriculture Department does not come in picture so far as land levelling and distribution of water in the fields is concerned.

### Digging of Watercourses

The current practice that after detailed inspection and levelling the alignment of watercourses is sanctioned by the Divisional Canal Officer. The levels and the alignment are marked at site by the Engineering subordinates.

As has already been mentioned above that the *Panchayats* have no direct responsibility and interest in furthering the course of irrigation. Thus they cannot be suitably held responsible for digging the watercourse. It has been experienced that wherever responsibility of digging watercourses was left to the *Panchayat* it has been the cause of complications detrimental to the interest of irrigation. The *Panchayat* having no technical know-how is bound to be a failure in deciding the most suitable alignment and thereafter laying it at site. If such responsibility is entrusted to *Panchayat* each *Panchayat* will have to employ its own technical staff and will have to acquire levelling and surveying instruments and thus the distribution of water shall cost higher. Thus it is inadvisable to make *Panchayats* responsible for preparing watercourse schemes etc., as it is a technical matter and it will create confusion and difficulties in rightly aligning the watercourses resulting in delay in the execution of watercourses schemes and thus hampering the cause of irrigation.

### Warabandis

Regarding the transfer of powers of framing and implementing *warabandis* to *Panchayat* it has already been stated that it is very difficult for the *Panchayats* to collect record from civil and canal departments which are basically required for framing of *warabandi* and to make such information available to the *Panchayat* parallel staff will have to be employed thus increasing the cost of distribution of water.

### Crop Pattern

The role of agriculture in the increase of agricultural production and to see that the water utilised to the maximum to give the maximum results cannot be ignored. On one hand where we ensure that the supply available is utilised to the maximum, on the other hand we have to see that the crops sown by the cultivators are suitable for that type of soil and that is where the Agriculture Department should step in to suggest suitable crop pattern to the cultivators for different zones depending upon the climatic conditions, availability of water and nature of soil. No doubt the irrigator does know something of the crop pattern based on

his ancestral experience, but the ever developing science of agriculture has much to say and suggest as to the crop pattern for a particular soil and the types of manure therefor. Thus, the raw experience of the cultivator reinforced with the positive contribution of the science of agriculture with its latest developments will go a long way to improve the agricultural production. To make such guidance available to the cultivator it is desirable that the representative of Agriculture Department should also attend the Canal Advisory Committee to co-ordinate with other departments.

The crop pattern may have to be changed periodically to suit the condition of sub-soil water-table weather and other factor affecting it. The role of agriculture department is mainly to advise the cultivator as to the use of manures, crop pattern and other ways and means to improve agricultural produce. But the general impression among the *Zamindars* is that much goods cannot be delivered by these improved methods and manures unless the supply of irrigation water is ensured to the *Zamindar*.

### Intensity of Irrigation and Means to Improve it

To improve the yield the intensity of irrigation be increased from 60 per cent to 100 per cent and efforts be made to increase it to 150 per cent. Further where sub-soil water-table is high shallow tube-wells be installed in districts like Gurdaspur, Amritsar, Jullundur, Hoshiarpur, Ferozepur, Kapurthala, Ludhiana, Sangrur, Patiala and Bhatinda. The shallow tube-wells be installed and maintained by the Government. They should be run in slack electricity demand period, i.e., from 10 P.M. to 4 A.M. and the cultivator be charged reduced rates of say half the normal rates for electricity. This will ensure proper irrigation to the fields, reduction of water-logging and also utilisation of the spare power available. By using the tube-wells in monsoon months and preserving the equivalent supplies at controlling reservoirs the power can be stepped up by the increase of head as a result of increase of reservoir level by storage of equivalent supplies. By using the secondary power for running of tube-wells we will make regular use of secondary power, i.e., we will firm up the secondary power which was hitherto not being used to any advantage.

### Inter-relation and Co-ordination of Authorities of Various Departments

The activities of the Agriculture Department should be inter-related with those of the Irrigation Officer in as much as the changing of crop pattern is concerned. The officer of Agriculture Department should after consulting the irrigation engineer about the availability of water for the tract and the condition of water logging should fix the crop pattern to ensure

maximum utilisation of water. The supply of manure and giving other suggestions for the improvement of agricultural produce will be the sole responsibility of officers of Agriculture Department. To ensure co-ordination as it has been suggested above that the officers of Agriculture Department should be member of Canal Advisory Committee consisting of representatives of *Zamindars*, Revenue Accounts of the District under the Chairmanship of the Executive Engineer (Irrigation). The engineer, as already stated above, is only man competent and anxious to look to maximum utilisation of water. He is doing his job well as it is matter of pride for him to see the outcome of efforts of generations of engineers bearing greater fruits in increasing food production.

### Assessment

The prevalent system of assessment of canal water is by area of crop actually matured and in case of tube-well water the basis for assessment is the number of units of electric energy consumed. Different crops are categorised into different classes with specified 'occupier's rate'. These rates have been fixed on the basis of water required for a crop, the price which the crop will fetch and the type of demand of water at the time of sowing and maturing of crop. Due provision exists for reduction in rates for certain crops if sown as green manures in a specified period, and also for remission in case of failure of crop or in case where the yield is less than 25 paise. Despite the fact that all these factors have been considered the assessment by area is disadvantageous both to irrigators and to the Government in the following respects :—

- (1) There is no inducement to the irrigator to use the canal water more economically, as they do in case of wells and tube-wells, by maintaining properly the water-course in good condition and also preparing the fields with well defined ridges.
- (2) During the period of keen demand of water supply excessive discharge is drawn by the irrigators in the head reaches by excessive silt clearance with consequent shortage in tail outlets of the distributary.
- (3) There are chances of non-assessment of some area by some fraudulent I.B.C., and thus the concealment of revenue. Despite the strictest control checking and rechecking there are a few chances of water being used by the cultivator without any payment thereof.
- (4) The full rates are chargeable from the irrigator irrespective of the number of waterings used by them.

Thus the assessment by volume of water would be ideal and also welcome by the irrigator. It will reduce the huge expenditure which is

being incurred for a large establishment on the elaborate system of registering the area irrigated and preparing demand slips and the *Khataunis*, i.e., demand statement.

I think sale of water by volume was experimentally introduced in the joint Punjab much before the partition on some distributaries and these experiments failed not for want of suitable meter or modules, but due to the problem of internal distribution and assessing the amount chargeable from the individual irrigator. But now with the introduction of *Panchayat* in almost every village, this problem is not that difficult. Of course the *warabandi* will be framed and enforced by the engineers, being the technical matter as stated above, but this simple and non-technical matter of keeping account of the time for which actual irrigation is made by individual irrigator can be of course entrusted to the *Panchayats*. Or to simplify the matter water in bulk be given to *Panchayat* who may distribute water among irrigators under the guidance of Irrigation Engineers who would frame *warabandi* and the *Panchayat* may realise the amount payable from them. This system will reduce appreciably the staff employed on the booking of irrigation and thus reduce the charges of distribution and assessment considerably to the benefit of irrigator. Water will be most economically utilised and greatest benefit will accrue from the increased production of foodgrains. Incidentally the Estimates Committee has also approved the sale of water by volume, unmindful of the expenditure to be incurred on remodelling the outlets and it is high time that it is implemented on some distributaries initially on experimental basis so as to replace area assessment gradually.

The rates to be charged per cusec hour of water may be worked out by taking the revenue of previous six years and dividing it by the number of total cusec hours, for a particular division for each harvest. The types of outlets and meters to be used to ensure fairly constant supply will be given below.

### Outlets and their Effect on Water Management

The commonly used outlets in Punjab are open flume, A.P.M. (Adjustable Proportionate Module) also called adjustable orifice semi-module and pipe outlet. From the view point of volumetric assessment a proportionate semi-module, independent of water-level in the water-course but distributing all the fluctuations proportionately to all outlets is the best. The A.P.M. fixed near the bed of the distributary has good silt conduction, low flexibility and can easily be adjusted to suit various changes occurring in the regime of channel. The A.P.M. ensures constant discharge for a fairly constant water-level in the distributary. Thus for volumetric assessment A.P.M. may be fixed and every day the gauge be read and recorded to this will form the basis of working out the water delivered

For keeping this record a gauge reader be employed for every 20 outlets and both S.O. and S.D.O. be made responsible for periodic checking of the 'b's'. The A.P.M. is most suitable outlet except for tail cluster where open flume will be fixed with a meter flumed in the water to work out the discharge of water passing through it.

#### **Rotation and its Effect on Water Management**

The system of rotation follow in the winter months when the supply in the river goes down appreciably. Long observations have been made for the supplies available in various months of a year before design and construction of canals. The water allowance, intensity of cropping, full supply factor, *etc.*, are determined on the basis of these observations. As a matter of fact these rotations do not come in way of the maturing of these crops unless there is an unusual draught. In rotation some distributaries are run for a period

of 10 days whereas other closed and so on. Further development of irrigation can be made by assuring more supply in winter months by the construction of reservoir to store water in summer months.

Thus with the sharing responsibilities of internal distribution of water by *Panchayats* according to the *warabandi* as framed by the engineers who will exercise the powers to enforce the *warabandi* and adoption of crop pattern and other means for improvement of food production as per guidance of Agriculture Department Officers, with the powers of ensuring silt clearance of watercourse with the engineers, the volumetric distribution of water as suggested above will go a long way in maximum and most economical utilisation of water. Maximum utilisation of water will give maximum food production and will lead country to self-sufficiency in foodgrains. Crores of rupees worth of foreign exchange will be saved to be used for import of equipment for industries and will build up a sound economy in India.

## AN ADMINISTRATIVE ASPECT IN MANAGEMENT OF IRRIGATION WATER

by

J. D. Sahi\*

Since the attainment of freedom, our country has made tremendous progress in the field of irrigation and power. It will be agreed that the development of a nation in Industrial, Educational, Social and other spheres is greatly helped if a self-sufficiency can be ensured in the production of food. Unfortunately, the position in this respect is still not fully satisfactory in that the development on agricultural side is to a great extent offset by continuing increase in population. Co-related efforts on all fronts, i.e., family planning, food production, improved agriculture, etc., have, therefore, to be persistently followed. It is hardly necessary to emphasize the importance and the advantages of irrigation development at such a time of pressing necessity which brings the problem to the fore-front. The methods of application of water as adopted by farmers in our country, especially when they are left to their own devices, are not generally economical. The cultivator has only one criterion for the efficiency of water management, viz., whether he gets ample supply of water whenever needed by him for his crops. On the other hand, the Irrigation Department have the responsibilities of economical use of water involving storage, conveyance and consumption of the same. It is natural that the efficiency in this respect, as ultimately attained, is more or less attributed to the skill of engineers. Irrigation engineers who are responsible for the conveying and distribution of water can, therefore, do much towards enforcing the most efficient application of water.

The agricultural aspects of irrigation are essentially concerned with the use of irrigation water on the farm. Naturally, therefore, there are more people who are directly concerned with the agricultural than the engineering aspects. In case, the total water available is not sufficient for all the land, the distribution has to be equitable and for that purpose, the outlet plays a very important part and its design is, therefore, of paramount importance to both the canal management and the end-users. Furthermore, the knowledge of soil and water relations is another factor which is valuable to all concerned with the application of irrigation practice. As such, a very perplexing responsibility confronts the irrigation engineers regarding the correct determination of water need and water supplies for irrigated lands. It cannot be denied

that even the estimates prepared with utmost scientific analysis not infrequently turn out to be either low or high. There is no denying the fact that irrigation engineers have made remarkable progress in their ability to cope with these things and other related irrigation problems but the opportunities for advancement are yet very great; as for the best results, he must work in close co-operation with the soil and plant scientists. In Punjab, great attention has been concentrated upon the distribution of water among individual cultivators which is in fact a very difficult problem. There is, however, a further scope for the individual irrigation engineer to utilize all his valuable time saved from routine duties to further improve and stabilize this important aspect.

The important aspect of determining the proper quantity of water to be applied to soil for agricultural purposes, to be as nearly uniform as possible, is related to the capacity of different soils, nature of crops and movement of water in the irrigated lands. It is axiomatic among persons best informed concerning agricultural aspects of irrigation that in order to make most use of water, the methods and practices employed must be based upon the conditions provided by the nature in the locality concerned. These natural conditions are largely the conditions of climate and soil. Clearly, the crops grown are selected to great extent according to the climatic conditions under which the farmers work.

It will be appreciated that so far the management of irrigation waters beyond the outlets, both with regard to maintenance of watercourses and distribution in the fields has been generally left to the discretion of cultivators. In some cases, however, *warabandi* is prepared by the Irrigation Department, when there is a dispute among the end-users and requests are made by the cultivators in this respect. It cannot be denied that there is a scope for improvement in this system. To make scientific distribution of available irrigation water, the following factors deserve consideration :—

- (i) Classification of soil.
- (ii) Crop pattern.
- (iii) Actual requirements and availability of water.

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- (iv) Use of fertilizers—type and extent for increasing crop output per acre which is very low at present in our country.
- (v) Enforcement of decisions with respect to (i), (ii), (iii) and (iv) above.

To obtain a scientific assessment of these items, it is imperative that a close co-operation is maintained between Irrigation, Agriculture, Panchayat and Development departments and the cultivators. A decision will also be required to the effect that the construction and maintenance of watercourses is made the joint responsibility of Irrigation Department and respective Panchayats; and also that the cost thereof shall be borne by the State or cultivators through Panchayats. In the former case, the enhancement of water rates shall have to be examined in co-operation with all concerned. In case the foregoing suggestions meet the favourable response, it will be essential to amend the Canal Act pertaining to these aspects by either a Legislature action or Special Government orders.

Most of the present irrigation engineers by virtue of their training are not in a position to implement the foregoing suggestions to the fullest extent. For this purpose a departure will have to be made from the existing system if really satisfactory results are to be attained. It is essential that the irrigation engineers posted on this important assignment are equipped fully with respect to the knowledge related to the aforesaid factors which can only be acquired by experience. Furthermore, they are also given status commensurate with the responsibilities so that they can efficiently guide the farmers in correctly deciding various problems connected with the irrigation. At present, the Irrigation Branch, as a complex unit, is responsible for the construction of River Valley Projects, headwork, barrages, canals, drainage works, maintenance of all these works and also subsequent water control and management. This position exists in Punjab and it is presumed that other States are no different in this respect. The time demands that this position is reviewed at an early date and the author submits the following suggestions in this respect.

The irrigation personnel, as employed at present, should be classified into the following two categories on permanent basis :—

- (i) Construction Engineers.
- (ii) Canal Engineers.

Out of these two categories, a third category of Designers and Planners in respective fields should emerge and form a Central Design and Planning Organization with two divisions for both the categories. It cannot be denied that specialization which is the order of the day, cannot be kept away from the Irrigation Branch any longer if really satisfactory results have to be further achieved. The present system of transferring officers from one job to another of entirely different nature has to stop if the role of irrigation engineers is to become efficient, constructive and responsible.

The category of canal engineers (irrigation engineers) should be imparted special departmental training in the science of soil and agriculture. This additional training in agricultural aspects and soil science would be immensely valuable and the engineers shall, with due experience, attain a more respectable public status and guide the Farmers, Administrators, Community Development Officers and Panchayats in a way that not only water management will become more efficient but the food production will also improve greatly. Our country is yet poor and still in a developing stage, where primitive methods of agriculture are still being followed at most of the places. The irrigation engineer, with a secondary training in agricultural engineering, can further play an important role in mechanization of agriculture. Placed as he is in a particular position, he will also contribute towards the grading of land *vis-a-vis* maximum utilization of distributed water. As at present, he will continue playing the important role of helping the farmer in the proper alignment of his watercourses in the field. The effectiveness of his control and guidance will immensely increase with his supplemented knowledge of agriculture and soil science. It is proposed that the irrigation engineers in this category should earn their own promotions in their line up to the highest rank and never deviate to other jobs unless they choose the other side of work in the early stage of their employment.

# SOME PROBLEMS IN THE MANAGEMENT OF IRRIGATION WATER—ROLE OF AGRICULTURE DEPARTMENT

by

Dr. D. G. Dakshindas\*

## Introduction

Although agricultural production is greatly increased through irrigation, the extent of irrigation potential and the area to which irrigation is available is very much small as compared to the total area under crops. In the State of Maharashtra area under irrigation forms only 6 per cent of the total cultivable area. In India itself also area irrigated is only 18 per cent. Even then irrigated areas, particularly those under perennial flow irrigation, create problems of various sorts if not managed properly. Two most important aspects have to be considered in case of irrigation water management. (1) Optimum utilisation of irrigation water for agricultural production and (2) Effects or after effects of irrigation on the soil. Out of this the second point is of utmost importance from long-term planning in national interest. In the State of Maharashtra irrigation has been one of the most important perennially irrigated crops which was taken up on an intensified scale after the opening of the Deccan Canals. Although block system was introduced for sugar-cane by the Irrigation Department to safeguard or to prevent damage to irrigated fields through over irrigation or continuous irrigation, it has been observed that in spite of these a very large area of about 25495.22 ha. (63,000 acres) was damaged due to water-logging in the commanded area under Deccan Canals.

## Necessity of Pre-irrigation Soil Survey

The damage to soils in irrigated areas may be due to improper management of irrigation water, i.e., over-irrigation or improper irrigation or might be due to unsuitable soils brought under irrigation or sub-soil water passing through layers laden with salts. Similarly, low lying heavy deep soils although excluded from sugar-cane blocks, but not separated from the irrigated areas on higher relief by drains, etc., are likely to be damaged due to underground movement of water and salts and their accumulation. One of the most important things to be done, therefore, before any irrigation project is put into operation, is to have a thorough pre-irrigation soil survey with the object of determining the nature of the soil in the commanded area and allocating areas, that are fit for irrigation as soon as water becomes available. The role of Agriculture

Department, therefore, becomes important in this regard once the details of a particular irrigation project have been finalised. This pre-irrigation soil survey will also help in proper layout of the fields after levelling, contour bunding, etc., as the case may be, into blocks suitable for irrigation and for determining the cropping pattern. It will be equally essential to have detailed information for finding out the suitability or otherwise of the soil as well as of the water for irrigation. Detailed analysis for various soil and water constituents is, therefore, essential.

During this survey the activities of the agricultural and irrigation departments could be co-ordinated so that the pre-irrigation soil survey will give sufficient information and data not only from the agriculture and land and water utilisation point of view but also give information on engineering aspects so that the nature of the soil through which irrigation water is to flow could be determined with the object of preventing or minimising of losses of water through distribution channels.

## Organisation for Determining and Executing Cropping Patterns

Once the suitability of the area for irrigation has been determined or the soils had been managed in a particular way for making them suitable for irrigation, the cropping pattern for the area in command of particular project should be determined. The Agriculture Department of course, will be mainly responsible for chalking out a crop pattern in a particular area but this could be done in consultation with representatives of the Engineering Department and with the local irrigators. It may be, therefore, advisable to have small irrigation committees in a unit area—may be of each distributary—for helping in drawing out the cropping pattern and then to see that the cropping pattern is followed properly once it is fixed up. This committee could also suggest local modifications in the cropping pattern depending upon the local conditions which could be modified in consultation with the representatives of Agriculture and Irrigation Departments so far as a particular locality is concerned. This committee consisting of the representatives of the irrigators and experts from the Agriculture and

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Irrigation Departments will also be then responsible for changing the cropping pattern in future if required, for maximum utilisation of the irrigated water and preventing of damage to the irrigated areas, or even the areas surrounding the irrigated blocks.

Various difficulties may crop up in managing irrigation of small scattered holdings belonging to various owners. It is, therefore, suggested that for effective and proper management, consolidation of holdings into compact blocks suitable for irrigation may be carried out.

The pre-irrigation soil survey and the fixing of cropping pattern should be taken up. Simultaneously, with the location of suitable surface and sub-soil drains to draw out surplus water so that water-table in the irrigated areas is kept sufficiently low and saline or alkaline water-logged conditions do not follow introduction of irrigation.

**Proper and Economic use of Irrigation Water**

Once the suitability of a particular area and soils fit for cultivation and irrigation has been determined and once the cropping pattern has also been fixed for maximum utilisation of the available water, it is then equally necessary to see that irrigation water available in the canals and distributaries is utilised properly and economically. One of the causes of improper use of irrigation water is losses of various types. It goes without saying that channels, sub-channels, distributaries, etc., should be properly lined to prevent losses occurring therein but it is equally important that even in the subsequent field channels through which water flows, the losses are reduced to the minimum. For this purpose Irrigation Department should be equally responsible. The losses occurring during transport of water once it leaves the distributaries has been one of the points for controversy for the irrigators. For example, the irrigation required for sugarcane in factory areas having their own factory farms where irrigation is assessed on volumetric basis. The irrigators demand much more water than what is fixed by the Irrigation Department, as much more losses are claimed than are taken for the sake of calculation. The amount of water which is lost through losses from the distributaries, sub-distributaries channels and sub-channels and losses in night irrigation could be saved and utilised for a larger areas or for larger number of crops.

The maintenance of smaller field channels of less than 0.028 cumec (one cusec) and the distribution and management of irrigation

water may rest with the local irrigation *Panchayat*, while distribution channels above 0.028 cumec (one cusec) capacity may be managed and maintained by the Irrigation Department.

**Keeping Watercourses and Drains free from Weedy Growth**

Growth of weeds in the water channels in the fields is another problem which might be affecting the proper utilisation of water because of hindrance in proper flow and maintenance of given discharge. Elimination of weedy growth through mechanical means or through selective weedicides should form an important item of maintenance of water channels. This could be the responsibility of Agriculture Department and if necessary certain levy may be fixed on the irrigators for keeping irrigation channels clean, through the Agriculture Department. Such steps should be taken equally effectively in case of drains as well.

**Utilisation of Irrigation Water during Rainy Season for Reclamation of Saline Soils and improving Saline Well Water**

Another problem coming up in water management is its utilisation during rainy season when irrigation water is not generally required or is not utilised. The Agriculture Department after starting research work on trial-cum-demonstration farms could evolve suitable recommendations for giving irrigation to rain-fed crops during monsoon, so that the supplementary irrigation could help in increasing agricultural output. However, this will mostly depend upon the nature of rainy season in that particular area, or upon distribution of rainfall. A few irrigation during periods of drought or at crucial stages of crop growth may help in better crop production. In certain years irrigation may not at all be necessary. The surplus water in irrigation projects could perhaps be also utilised with advantage in other ways, at least in certain areas. There are pockets where the soils have become highly salty or where even wells have got high contents of soluble salts so that they have become unsuitable for irrigation. These soils flooded frequently during rainy season and the extra water taken out through suitable drains so that the salt contents of the saline soils are flashed out. Similarly, the well water in such localities could be pumped out and fresh water allowed to accumulate. It may be possible to improve the water of these wells through this process because the recuperation of such wells is mostly through underground movement of water coming from irrigated areas.

**A COMBINED PAPER ON  
THE ROLE OF AGRICULTURE DEPARTMENT REGARDING LAND  
LEVELLING, SUPPLY OF MANURES, ETC., AND HOW FAR  
AND IN WHAT MANNER THE RESPONSIBILITY FOR FIELD  
UTILISATION CAN BE LAID ON THEM**

and

**THE RELATIVE RESPONSIBILITY OF THE VARIOUS UNITS  
RESPONSIBLE FOR THESE ACTIVITIES AND HOW THEY  
CAN BE INTER-RELATED AND CO-ORDINATED**

by

**V. G. Vaidya\***

Best results by way of stepping up agricultural production would be obtained if the limited resources available of technical personnel, agricultural requisites such as fertilizers, pesticides, etc., improved implements and credit facilities are concentrated in the irrigated or assured rainfall areas. Paddy pilot projects each of 8093·72 ha. (20,000 acres) were, therefore, started by the Agriculture Department in Maharashtra State in the year 1957 and in view of the encouraging results obtained by way of additional increase of about 9·4 B.Md. of paddy per acre, the scheme was extended to all crops located in irrigated and assured rainfall areas of Maharashtra State. Each Intensive Cultivation Block of 8093·72 ha. (20,000 acres) is manned by one Agricultural Officer and 10 Agricultural Assistants, each in charge of 809·37 ha. (2,000 acres) cultivated by about 500 agricultural families. The same type of staff has been given in the command area of some irrigation projects with the only difference that the area of operation was reduced to 4046·86 to 6070·29 ha. (10,000 to 15,000 acres), named as 'Irrigation Unit'. While these steps no doubt helped in minimising the shortfall in utilisation of irrigation water as well as stepping up agricultural production, the progress of work has also indicated that while irrigation made available by the Irrigation Department and technical advice, supplies, short-term credit given liberally by the Agriculture and Co-operative Departments, that is not enough to give maximum results in minimum possible time. It has now become necessary to take a more comprehensive view of the problem of irrigation utilisation including land development, agro-industrial growth in the command area, and have a coordinated approach by various concerned departments if the time-lag between creation of irrigation potential and its utilisation is to be reduced to the minimum of say 5 to 6 years.

The Maharashtra State Government therefore, appointed a Study Group to consider the problem of non-utilisation of irrigation potential

in all its aspects and prepare a prototype integrated plan for Gangapur and Ghod Weir projects. The report clearly brought out the need for integrated operations programme drawn up area-wise and made several recommendations for executing the same. Government of Maharashtra approved the report and sanctioned in February, 1964, the establishment of (a) survey units for locating areas where levelling and bunding will have to be taken up under the project area, (b) soil conservation units and bulldozing units to carry out levelling and land development work, (c) irrigation units to render technical advice, carry out demonstrations, make available requisite supplies and credit, and (d) trial-cum-demonstration farms to conduct experiments and collect data on irrigated farming.

76 major and medium irrigation projects with ultimate irrigation benefit of 8·802 lakh ha. (21·75 lakh acres) have been sanctioned in Maharashtra State during 1st, 2nd and 3rd Five-Year Plans. While some of these are under construction others have been nearly completed and irrigation water has become available. At present only 45 per cent of the irrigation potential is being utilised. It is, therefore, necessary to take active steps for rapid utilisation of irrigation potential created from time to time by the Irrigation Department.

At present the period of development of irrigation is reckoned as 10 years from starting of irrigation. Maharashtra State Irrigation Commission recommended that it should be shortened to 8 years from starting of construction work or 5 years from starting of irrigation. The task of development of irrigation within this period is no doubt difficult but the Commission felt that it was not impossible of achievement. Maximum irrigation utilisation can be achieved if the work is carried out in the following three States:

- (1) Preparation of Irrigation Utilisation and Agricultural Development Project Report

\*Additional Director of Agriculture, Maharashtra State, Poona.

- (2) Steps preparatory to irrigation utilisation.
- (3) Steps for actual utilisation of irrigation when it becomes available and execution of the programme by concerned departments.

### I. Scheme for Preparation of Irrigation Utilisation and Agricultural Development Project Report

As soon as the Project Report is sanctioned, an Irrigation Utilisation and Agricultural Development Project Report should be prepared within one year. It should cover the following items:—

- (1) General description of the command area of the project including topography, rainfall, soil type, soil depth, cultivators and cultivation standards, etc. Maps of the command area and map of the taluka or district in which the command area is located.
- (2) A broad estimate of the area which may need levelling, the area which can be levelled with the help of (a) human labour and bullock power (*kenies*) and (b) bulldozers, along with a rough estimate of expenditure involved.
- (3) A broad estimate of the length of field channels required to be constructed, percentage of field channels that may have to be constructed at Government cost and approximate expenditure involved.
- (4) A broad estimate of long-term finance requirement for levelling and land development work.
- (5) The cropping pattern proposed for the command area and how it differs from the general cropping pattern of the taluka and district.
- (6) Possibilities of new crops that could be introduced in the area.
- (7) Total area under command, villages that will be benefited, number of cultivators who would receive irrigation in every village, cultivator-wise and survey number-wise area that will be irrigated.
- (8) Suggestions about changes in the cropping pattern in specific villages of the command area due to factors such as soil type, soil depth, salinity, bad drainage, marketing facilities, etc.
- (9) Estimated requirements of improved seeds fertilizers, pesticides, improved implements, plant protection equipment, green manuring seeds, etc., on the basis of the approved cropping pattern.
- (10) Annual medium and short-term loan requirements for a period of say five years.
- (11) Requirement of technical advisory staff for establishing Irrigation Units.
- (12) Need for establishing a trial-cum-demonstration farm if there is none. Can the purpose be served by conducting experiments on a small area of Agricultural Research Station, Seed Multiplication Farm or Agricultural School Farm, located within or in the vicinity of the project.
- (13) Agricultural Demonstration Centres and Free Fertiliser Demonstrations. The need and number of such demonstrations prior to the irrigation water becoming available may be indicated, keeping in view the introduction of new crops and irrigated farming.
- (14) Existing number of godowns in the command area and additional requirements.
- (15) Existing marketing facilities and suggestions, if any, for establishing a co-operative marketing society with adequate facility for warehousing in the area.
- (16) Processing factories like cotton ginning, pressing and weaving, oil crushing, sugar factory, fruit preservation industry, etc., with adequate justification.
- (17) Transport and communication facilities, suggestions for improvement, if necessary.
- (18) Possibility of dairy development, poultry development and fishery development.
- (19) Electric power for developing lift irrigation, village electrification and ancillary development such as tourism, etc.

The Chief Executive Officer, Zilla Parishad will collect relevant information on all the items mentioned above with the help of extension staff as well as staff of other departments in the district. This information will then be scrutinised and compiled into Irrigation Utilisation and Agricultural Development Project Report by the Irrigation Projects Officer in the Department of Agriculture under the guidance of the Additional Director of Agriculture. This officer will keep in close touch with the officers of Irrigation and other departments. The report will then be followed as guide by all the departments concerned.

### II. Steps Preparatory to Irrigation Utilisation

After the Irrigation Utilisation and Agricultural Development Project Report is prepared, the next 2 to 3 years before irrigation water

actually becomes available will be utilised in taking following steps preparatory to irrigation utilisation :

(1) *Establishment of Trial-cum-demonstration Farms*

These should be established by the Agriculture Department for conducting experiments and collecting data on irrigated farming.

(2) *Survey of Command Areas by Survey Units*

(3) *Levelling and Land Development Work by Soil Conservation and Terracing Sub-divisions and Bulldozer units*

(4) *Digging Water courses by Cultivators*

Items 2 to 4 will be carried out in the Agriculture Department by the staff of the survey units, soil conservation and bulldozer units. They will construct the watercourses in those areas which will be levelled by Agriculture Department while in the remaining areas which are either level or which the cultivators have levelled at their own cost, the Block Development Officers should get the watercourses dug by cultivators. The Irrigation Department and Agriculture Department will render technical guidance wherever necessary.

(5) *Making Long-term Loans Available through Land Mortgaged Banks*

Land development will require long-term loans, an estimate of which should be prepared by the Agriculture Department but the loans should be sanctioned by Land Mortgage Banks and the Co-operative Department should see that required amount of loans is made available.

(6) *Construction of Co-operative Godowns*

It is necessary to have one co-operative godown within a bullock cart distance from the cultivator's place not only to store the agricultural requisites and supplies but also to collect his produce for co-operative marketing. The Co-operative Department should be made responsible to construct necessary number of godowns in the area.

(7) *Improvement of Roads in the Command Area*

It does not always happen that national and State highways and district roads run through the command area. It will be necessary to construct service roads to facilitate transport of produce especially of perishable nature within shortest possible time. The length of roads required may be mentioned in the Project Report but the Buildings and Communications Department should see to their construction.

(8) *Location of Processing Factories*

While major part of the command area will be growing cereals and pulses, quite a substantial area will be put under sugar-cane, fruits, vegetables,

fodder crops, etc. In order that the cultivator gets proper price for his produce, the produce should be processed by co-operative processing factories such as rice mill, dall mill, oil mill, sugar factory, cotton gins and presses set-up at key centres. The exact number and type of processing units may be mentioned in the Project Report but the Cooperative and Industries Departments will have to play major role in organizing industrial cooperatives for the purpose.

### III. Steps for actual Utilisation of Irrigation Potential.

*Establishment of Irrigation Units for rendering Technical Advice, giving Demonstrations, etc.*

Extension staff consisting of one Agricultural Supervisor and 10 Agricultural Assistants may be appointed for 4046.86 to 6070.29 ha. (10,000 to 15,000 acres) as 'Irrigation Unit' by the Agriculture Department. The staff will work for a period of three years by which time most of the irrigation potential under the project will be utilised and then transferred to some other project leaving the follow on work to the normal extension agency. This staff will work under the control of *Zilla Parishads* and not only open a demonstration centre in each village of the command area, give technical advice and carry out free fertiliser demonstrations, but also see that necessary agricultural requisites are stocked by the cooperative societies and are made available to cultivators along with necessary crop loan. While the Agriculture Department will indicate the quantity of manures, fertilisers, improved seed, pesticides, etc., to be stocked in a given area, it will be the responsibility of the Co-operative Department to see that the co-operative societies stock and distribute the same to cultivators on the advice of the Irrigation Unit staff and also make available short-term credit required for the purpose. That department will also organise co-operative marketing societies and link credit with marketing as well as help in establishing co-operative processing units.

Though the responsibility of each department has been mentioned above, it should be the overall responsibility of the Agriculture Department for utilisation of irrigation potential. In order that the Agriculture Department discharges its functions properly and brings about effective co-ordination, there should be a post of Additional Director of Agriculture in the Agriculture Department to look after irrigation utilisation. He will have a very close liaison with the Irrigation Department right from the stage of approving the cropping pattern of any project to be sanctioned and thereafter till full utilisation is achieved. The problems by way of water rates, cropping patterns, block system, irrigation intervals, etc., should be discussed by him with the Irrigation Department officials and agreed proposals should be sent to Government for approval and sanction. The proper co-ordination between various other departments can further be effected by constitu-

ting a Project Co-ordination Committee for every district, of which the Additional Development Commissioner will be the Chairman, District Agricultural Officer Member-Secretary, the Additional Director of Agriculture who is responsible for irrigation utilisation and all concerned staff of Agriculture, Irrigation, Buildings and Commu-

nications, Co-operation and Revenue Departments and the *Zilla Parishads* should be its members. The Committee should meet at least once in three months and take stock of work done, discuss difficulties and problems that arise, suggest remedies and propose the work to be done in the following months.

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## A NOTE ON THE ROLE OF AGRICULTURE AND IRRIGATION DEPARTMENTS IN THE MANAGEMENT OF IRRIGATION WATER FOR CROPS

by

R. R. Panje\*

The purpose of irrigation is to increase production of crops. The facts that the irrigation water has to be efficiently used on the one hand and that irrigation has to subserve the requirements of the crop on the other, need no discussion. However, the installations of irrigation and the day-to-day working of the water supply arrangements can only be according to a given economic lay-out and working plan and once laid out and constructed, the facility is inflexible and does not permit of frequent modification to subserve the changing needs of crop production. As the same time, difficulties arise in regard to the availability of water for the best requirement of crops. This is because usually in most areas crops are grown by cultivators on an individual basis and not in permanent crop blocks or according to an overall cropping pattern suitable to the irrigation facility. It is, therefore, a question how far the irrigation service can be adapted to meet the needs of the crops and to what extent a cropping pattern can be drawn up and executed so as to make the maximum and economic use of the available irrigation facility.

In this subject, several questions arise. To what extent are the irrigation engineers responsible for the field distribution of water? What is the role of Agricultural Department in ensuring optimum field utilisation of water? Which organisation can be given the task of laying out channels for the distribution of water? What modifications can be made in the distribution system so that a more efficient use of water can be ensured?

The responsibility of Canal Engineers for the water released by them obviously ends at the outlet head, and they cannot normally be expected to bear any responsibility for the field distribution of water except in areas under the command of State tube-wells. But they are inevitably concerned with the maximum utilisation of the water released by them; the management of water at the outlet head has, therefore, to be done by them with the fullest possible co-ordination with the management beyond the head. Inter-departmental co-ordination has been attempted to the best extent possible in the past and continues to be done, but it has not helped to make irrigation sufficiently flexible and adapted to meet the

needs of crops. It would appear that the only possible way of bringing this co-ordination about is to combine the two departments, Agriculture and Irrigation, in a single administrative unit and to provide local consultative committees consisting of the staff of the two wings and growers' representatives.

The Agriculture Department is most closely concerned in crop planning, supply of fertilisers and other aids to agricultural production designed for obtaining the maximum use of the available irrigation water. However, it is to be noted that the Department itself is not utilising the water, but the agriculturists over whom the department has no administrative control. It is, therefore, difficult to lay on the Department of Agriculture more responsibilities than for the general agricultural policy and the provision of aids.

But at the same time there are many ways of ensuring more efficient utilisation of irrigation water. As far as owners of crops are concerned, efficient utilisation can be done by fixing rates for water on volumetric basis. As far as Government Departments are concerned, long range policies of consolidation of holdings, formation of crop blocks, setting up of intensive cultivation areas, etc., are primarily in their hands, and these should be not only vigorously pursued by those departments, but also implemented with due regard to the optimum utilisation of water. Similarly, the issue of suitable seeds, the timely provision of fertilisers, etc., has to be ensured by the Department.

The responsibilities of local bodies like *Panchayats* vary from place to place, but it appears to be in order to entrust to them the digging and alignment of watercourses, levelling of land, fixing of *warabandis* and settlement of disputes regarding the distribution of water. It is true that in many areas, their present performance is not quite satisfactory. Also there are areas where these functions are carried out by official authorities.

It may, however, appear preferable to entrust the execution of these measures to an authority with a wider jurisdiction than the *Panchayats*,

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because the work in any one area has to be co-ordinated with that in adjoining areas and has to be executed in an overall and well co-ordinated fashion rather than separately or exclusively in the interest of each individual village.

The cropping programme in an individual holding depends largely on the individual owner of the holding, and is usually dictated only by the current commercial or economic situation and the personal requirements or preferences of the grower. Changes in the cropping pattern or the planning of crops does rest with the Department of Agriculture, but the scope for implementation is limited by the preferences exercised by individual agriculturists. Nevertheless changes in crop pattern are planned by the Department some times; these become necessary in the interest of production needs of the country or region, exigencies of situation such as need for export, defence, rehabilitation, *etc.*, or in the light of economic conditions such as current prices, margins of profits, *etc.* It is these considerations rather than the maximum utilisation of irrigation water that operate in actual practice as principal criteria in crop planning. Irrigation has necessarily to subserve the requirements of crop production planned on economic or specific local con-

siderations, and has, therefore, to be managed accordingly. All the same, since the production of crops has necessarily to depend on the availability of irrigation water, such plans as are drawn up cannot by any means ignore the irrigation factor, and they do take due account of the water availability in the area and the conditions of its distribution. Here again it is a case of co-ordination.

In most areas, systems of rotation are not rigorously fixed, and to some extent the crops in rotation depend upon the annual rainfall and local demand. Considerable economies in the use of irrigation water can be effected if rotations are changed where necessary and cultural practices improved. The establishment of an industry or an urban colony in the locality, the introduction of a new crop in the area, and changes in the price structure have their impacts on the rotations and the pattern of irrigation, which will necessarily affect development of irrigation. But more often, it is not the introduction of the crop or a change in the system of rotation that affects the development of irrigation in an area, but the other way about, namely, the development of irrigation in an area leads to changes in crop pattern and productivity.

## SUGGESTIONS ON EFFICIENT MANAGEMENT OF IRRIGATION WATERS\*

*Some authors have made useful suggestions for the efficient management of irrigation waters. All the suggestions have been collected and condensed into one paper. Briefly the suggestions are given below.*

1/ SHRI J. WALTER, SUPERINTENDING ENGINEER,  
DESIGNS AND RESEARCH, MADRAS

### (i) Co-ordination Amongst Different Departments and Agencies

It is generally accepted that the responsibility for the proper management of water from the reservoir up to the outlet head in the canal or distributary, vests with the engineers but economical use of irrigation water beyond the outlet is generally neglected since the responsibility in this sphere primarily falls on the cultivators, who rarely understand economy in the use of water. The basic information required for proper water utilization is widely scattered amongst different agencies like irrigation engineers, Agronomist and Geologists, etc. Necessity of co-ordination between them needs no emphasis. Frequent group discussions will accomplish much in the matter of optimum utilization of water.

### (ii) Soil Survey

Water requirement of crops differs from region to region depending upon the nature of the soil, rainfall and temperature, etc. For rational utilisation of water classification of the soil is essential. Based on the results of such studies, the crop pattern, crop rotation, fertilizers to be used, method of irrigation, type of agricultural practice best suited, etc., have to be fixed by the Agronomist for that area.

### (iii) Maintenance of Watercourses

Maintenance of watercourse conveying water from the outlets to the fields is generally neglected by the ryots and their maintenance essentially needs to be improved. Separate watercourses can be constructed for serving the high and low level lands to avoid internal quarrels and neglectful distribution. The ryots must be allowed to excavate the field channels only according to the alignment approved by the irrigation engineers. In the long watercourses the lower ryots should be given separate sources of supply as far as possible. Lining of watercourses offers an important scope for effecting great economy. Cheap type of lining will have to be evolved and adopted.

Weed growth reduces the carrying capacity of a channel and causes overflowing. Already some chemicals have been tried in Madras State and found to be successful. Depending upon the type of weed, selection of the chemical has to be made.

In the old days ryots use to contribute physical labour and keep the field channels in good condition. This was called *Khudimuramat* work. For various reasons this is not working now. With the establishment of *Panchyat Raj* in the State Government is contemplating to revive *Khudimuramat* work in an effective way.

2. SHRI J. P. MITTAL, ADDITIONAL CHIEF ENGINEER,  
IRRIGATION DEPARTMENT, U.P.

### (i) The Responsibility of Engineers and Panchayats in the Construction and Maintenance of Watercourses, fixing Warabandis and Settlement of Disputes regarding Distribution of Water

In U.P. determining the best alignment of a watercourse and marking it on the village map is the responsibility of the Irrigation Branch. Construction of the watercourses is the responsibility of *Gaon Sabhas* in case the beneficiaries fail to construct themselves. In case *Gaon Sabhas* also fail the Executive Engineer is empowered to get the watercourses constructed at the cost of the beneficiaries. Maintenance of the watercourses is supposed to be done by the beneficiaries and the *Gaon Sabhas*. The *Gaon Sabhas* with their existing resources may not be able to show substantial progress for various reasons and the bulk of this work may ultimately have to be done by the Irrigation Engineers themselves.

Distribution of supply is done by the cultivators themselves and in case it is requested by the cultivators a *warabandi* is prepared under the Canal Act.

As an experimental measure the responsibility for distribution of water on some tube-wells has been placed on *Keshetra Krishi Anam Utpadan Samities*, where they have agreed to do so through a resolution. Results of this experiment will be watched with interest.

### (ii) The role of Agriculture Department regarding Change of Crop Pattern, Land Levelling, Supply of Manure, etc., and how far and in what manner the responsibility for Field Utilisation can be laid on them.

Land levelling is supposed to be done by the cultivators themselves at their own expense but in the new project areas this should be done by the Agriculture Department as a bulk of this work

\*Paper prepared by Shri Joginder Nath, General Reporter.

has necessarily to be carried out with mechanical equipment and is generally beyond the capacity of cultivators. Cost of this work can be recovered from the beneficiaries in suitable instalments. Arrangement for the supply of seeds, implements and manure should be made by the State Agriculture Department. The Agriculture Department with the assistance of the Block Agencies should be solely responsible for changing the crop pattern for the best utilisation of irrigation water.

(iii) *The Relative Responsibility of the Various Units Responsible for these Activities and how they can be Inter-related and Co-ordinated*

In U.P. co-ordination at district, divisional and State levels is being done by the various committees set up for the purpose at these levels. The responsibility for co-ordination and increase in agricultural production in the State has been placed on the Commissioner of Agricultural Production and Rural Development recently appointed at the State level.

(iv) *Method of Assessment, Authority Responsible for Assessment and effect of such Assessment on the Total Water Management*

In U.P. assessment is made on the basis of area actually irrigated irrespective of the number of waterings. On tube-wells assessment is made on volumetric basis. Assessment is made by the Irrigation Department while collection of irrigation charges is made by the Revenue Department. In the case of tube-wells a proposal is under the consideration of the Government to introduce a two part tariff of rates. In this system a fixed charge will be levied on the entire area under the command of the tube-well and in addition a lower than at present charge will be levied on the areas which are actually irrigated.

(v) *Types of Outlets Mainly used in the Area and how they affect the Utilisation.*

Outlets used on the U.P. Canals are generally iron pipes or hume pipes.

### 3. DR. A. S. CHEEMA, DIRECTOR OF AGRICULTURE, PUNJAB

(i) *The Responsibility of Engineers and Panchayats in the Construction and Maintenance of Watercourses, fixing Warabandis and Settlement of Disputes regarding Distribution of Water*

Experience has shown that for want of sufficient field channels it has not been possible to utilise the full irrigation potential in the past. This has been mainly due to the fact that the beneficiaries were unable to construct their watercourses. It is suggested that all the field channels envisaged in the command of a canal project must be completed at Government cost and this should be a legitimate charge on the project.

In regard to the distribution of water it is proposed that one small distributary should be given to a committee comprising an officer

of the Irrigation Branch and two farmer members to give proper guidance to the cultivators in the field distribution of water. In this manner it may be possible to eliminate many of the troubles or quarrels amongst the irrigators.

(ii) *The role of Agriculture Department regarding Land Levelling, Supply of Seeds and Manures, etc., and how far and in what manner the Responsibility for field Utilisation can be laid on them*

It is agreed that land levelling is an essential part of irrigation development and this work should be entrusted to the Soil Conservation Wing of the Agriculture Department. Responsibility for the supply of seeds, manures and fertilizers must be fully borne by the Agriculture Department.

(iii) *The Responsibility of Panchayats in digging up of Watercourses, fixing of Warabandis and settling of disputes regarding Distribution of Water—Their present Performance and future set-up*

It would not appear to be correct to entrust the full responsibility to the Panchoyats. The duties must be carried out by the Government in consultation and co-operation with the Panchoyats.

(iv) *Who should be responsible for Changing the Crop Pattern Occasionally in order to get Maximum Utilisation of Irrigation Water*

Usually cultivators are clever enough to understand their own benefit and change the crop pattern whenever they find that the change would give them better return. However, Agriculture Department should be entrusted with the responsibility of changing crop pattern for maximum utilisation of irrigation water.

(v) *The Relative Responsibility of the various Units Responsible for these Activities and how they can be Inter-related and Co-ordinated*

Officers of different departments concerned with the utilisation of irrigation water including the farmers must meet occasionally and solve the difficulties and bottlenecks, etc., well ahead of the irrigation season. It would be a good procedure if Advisory Committees are formed.

(vi) *Construction of Main and Field Drains*

Provision must always be made in the project estimate for the construction of main as well as field drains. Absence of this has resulted in throwing out large areas out of cultivation. Main drains should be constructed by the Irrigation Branch and the construction of field drains should be left to the Agriculture Department. In either case the cost should be met with by Government.

4. SHRI ARDAMAN SINGH, SUPERINTENDING ENGINEER, PLANT DESIGNS, BEAS-SUTLEJ LINK, PUNJAB.

(i) *The Role of Engineering and Agriculture Departments*

Utilisation of water has three major aspects, viz., engineering, agriculture and administrative. The engineering aspect is mainly confined to ensuring adequate supply at the outlet head. The agricultural aspect is with regard to the suitability of crop pattern and determination of the quantum of water necessary for each crop. The administrative aspect is with regard to day-to-day management such as resolving of disputes and assessment of revenue.

In the presentday working, besides their legitimate engineering duties the engineers are burdened with the work of revenue assessment and resolving the disputes under the Canal Act. These functions take so much of the engineer's time that the engineering functions get neglected. By reorganising the set-up on functional basis, water management can be made more efficient. The engineer's attention should be confined to the engineering aspect and water management.

(ii) *The Role of Panchayats*

In the developing democracy of ours, *Panchayats* have an important position. It is logical that they should be partners in progress and should take suitable part in water management. Many of the disputes which are at present being resolved by the canal department should go to the *Panchayats*. They should also be made responsible for assessment of revenue. It is true that the *Panchayats* by themselves may not be in a position to take up this responsibility, but they need to be associated in this duty in some form or the other. Initially, Civil Revenue Department which has overlapping jurisdiction with the Canal Revenue Wing can be made mainly responsible for assessment and gradually the *Panchayat* can be made to take increasing share in this responsibility.

5. SHRI K. K. PRAMANIK, SUPERINTENDING ENGINEER, MURAKSHI CANAL CIRCLE

(i) *The Responsibility of Engineers and Panchayats in the Construction and Maintenance of Watercourse, fixing Warabandis and Settlement of Disputes Regarding Distribution of Water*

The system at present in vogue in Murakshi Reservoir Project is that water released from an outlet flows from field to field for irrigation. There are at present practically no field channels, which are actually essential for proper distribution of water. The main crop grown in this area is paddy and people are reluctant to lose any land which may come under the field channels. Lands are mostly undulating and there are both longitudinal and cross slopes. Unless water is led in the proper direction all the fields in an outlet block cannot be properly irrigated. To solve this difficulty it is suggested that field channels

must be excavated in all the outlet blocks. Alignment for the watercourses should be prepared by the engineering staff. For the proper distribution of water there should be a headman for each outlet block who should be elected by the cultivators. In case there are any disputes they should be settled by the *Panchayats*. In case of failure on the part of the *Panchayats* to settle the disputes the matter should be referred to S.D.O., Irrigation.

(ii) *The Responsibility of Panchayats in Digging Up of Watercourses, fixing of Warabandis and Settling of Disputes Regarding Distribution of Water—Their present Performance and Future Set-up*

Water courses are defined as channels starting from an outlet and ending at the start of a block of area which is to be served by that outlet. At present such watercourses are being constructed and maintained at Government cost but they are proposed to be handed over to the beneficiaries for maintenance.

Field channels are channels excavated within a block of area for proper distribution of water which is brought up to the head of the block in a watercourse. The field channels are excavated and maintained by the beneficiaries.

The alignment plan of a watercourse as prepared by the engineering staff should be sent to the *Panchayats* for getting it dug through the beneficiaries. *Panchayats* should be responsible for getting the field channels excavated and maintained.

Disputes in the distribution of water through outlets are at present being settled by the engineering staff but actually these duties should be entrusted to the *Panchayats*.

Generally *warabandis* are not adopted on this project but in case they do become necessary sometimes the *Panchayats* should be able to frame them.

6. DR. R. V. TAMHANE, ADVISER ON SOIL CONSERVATION, MINISTRY OF FOOD AND AGRICULTURE, NEW DELHI.

AND

DR. N. D. REGE, DEPUTY ADVISER ON CONSERVATION, MINISTRY OF FOOD AND AGRICULTURE, NEW DELHI.

(i) *The Main Problem of Irrigated Agriculture*

In India, Irrigation has been adopted as an acknowledged agricultural practice and was in vogue even before the Christian era. Major projects have started coming up in the last 100 years or so. This has brought in its wake many problems. As is well known the major problems which crop up in irrigated agriculture are :

- (a) Constructing and maintaining extensive irrigation systems.
- (b) Prevention of water-logging, salt accumulation, soil erosion through proper control of irrigation practices.

If irrigated agriculture is to be a success, serious attention has to be given to these problems. In India, vast areas are getting badly water-logged. Indiscriminate use of soil and water has to be stopped as it is not possible to get more and more additional area under cultivation. It has, therefore, become very important for all those concerned with agriculture to see that irrigated agriculture is planned and managed properly. In this context a few other points need consideration. These are :

- (i) Topography of the land. This should be such that there is not much disturbance through exposure of sub-soil.
- (ii) The soil should either be free from salt as far as possible or should be amenable to reclamation economically.
- (iii) The soil profile should have good permeability so that drainage can be effectively done.
- (iv) The soil must be able to have good quality of irrigation water in adequate quantity.
- (v) The soil must be able to store sufficient amount of water, have satisfactory aeration and allow unrestricted root penetration.

It is also necessary to consider the quality of water and its effect on soil before bringing the land under irrigation.

#### (ii) Planning Irrigation

The following steps are involved in planning for irrigation :

- (a) Study of soil through soil survey.
- (b) Land levelling.

This is necessary for two reasons, *i.e.*, to make the best use of irrigation water through uniform distribution and to avoid soil erosion.

Care has to be taken to see that the top soil is not much disturbed and very little disturbance is caused in the sub-soil. If too much sub-soil is disturbed or brought up it may lead to additional expenditure, for bringing about improvement of the exposed material. If during the process of levelling too much of sub-soil gets exposed then a suitable amount of green matter has to be added to build up the structure which has been destroyed during the process of levelling. In addition to this other nutrients have to be supplemented in order to rectify the nutrient deficiencies.

#### (iii) Water Distribution System

It is of utmost importance that water is utilised to its full advantage without undue losses. The distribution system should be laid out after first formulating the crop pattern and adequate provision should be made for drainage. This would avoid excessive irrigation and also prevent development of salinity.

#### i) Selecting the Irrigation System

In selecting the irrigation system the following points have to be taken into consideration :

- (a) Soil characteristics.
- (b) Water requirement of crops.
- (c) Growth characteristics with particular reference to the root system of crops.
- (d) Size of irrigation stream and quality of water.
- (e) Weather conditions.
- (f) Method of application.

The efficiency of a good irrigation system will depend upon :—

- (a) Distribution of water evenly on the field.
- (b) The availability of water needed to meet the crop demands.
- (c) Division of water in the required quantity to different fields.
- (d) Disposal of waste water.
- (e) Avoidance of misuse of water.

The general methods are use of surface, sub-surface and sprinkler irrigation system. In India the first two are already in vogue but considerable improvement is necessary in these. The sprinkler system of irrigation is not possible at this stage as there is no technical service available easily for the farmer to deal with the sprinkler.

In view of the fact that irrigation in India is going to be on the increase and also because a large area has already gone out of cultivation due to improper irrigation, it is imperative that a research-cum-educational approach is made to deal with this national problem.

7. L. SREENIWAS, AGRONOMIST, DEPARTMENT OF AGRICULTURE, MAHARASHTRA STATE, POONA.

#### (i) Evolving a Proper Crop Pattern

Crop pattern in the commanded area should be chalked out by a committee consisting of the Agriculture Development Officer, an officer of the Irrigation Department of the rank of Executive Engineer and cultivators' representative of the irrigated area. This committee should fix up the rotation of irrigation and the cropping pattern which should be flexible taking into consideration the type of soil and availability of water.

#### (ii) Land Levelling

A pre-requisite for irrigation is that the land should have a gentle slope and should be levelled up suitably. In Maharashtra the Department of Agriculture proposes to give loan to the farmer to the extent of Rs. 370.5 per ha. (Rs. 150 per acre) for land levelling.

In regard to the development of irrigation agriculture, the Agriculture Department should be fully responsible for the introduction of new crops and lay out of fields for irrigation as required by the various crops.

With the introduction of irrigation water in areas where dry farming practices were followed the nature of crops to be grown, the method of land management, fertilizers to be used, quantity of irrigation water required and interval, etc. will differ and require research to be conducted in different regions. In order to achieve this objective trial-cum-demonstration farms in the irrigation project area have been started in Maharashtra State.

It would also be worthwhile to start short courses in 'Irrigation Agriculture' to the farmers in the project area at the trial-cum-demonstration

farms to make them not only irrigation minded but also practical in the economical use of water.

8. SHRI S. N. GUPTA, DIRECTOR, U. P. IRRIGATION RESEARCH INSTITUTE, ROORKEE AND SHRI A. P. BHATTACHARYA, RESEARCH OFFICER, BASIC RESEARCH DIVISION, IRRIGATION RESEARCH INSTITUTE, ROORKEE.

This report contains the result of experiments carried out in 1963 at the Government Agriculture Farm at Dhanauri, for determination of the most economical requirements of water for growing rice. Experiments were based on the principle of submergence and submergence with drainage. This approach of continued submergence and submergence with drainage is aimed mainly for controlling weeds, which is supposed to be the main factor for reducing crop yield whereas drainage is considered to be beneficial for plant aeration.

## DISCUSSIONS

SHRI M. R. CHOPRA, President, Central Board of Irrigation and Power conducted the proceedings.

The general report of the papers received on the subject from various authors was read out by Shri Joginder Nath, General Reporter and it was suggested that discussion may be restricted to :

- (i) The organisational set-up for efficient management of water beyond the outlet, and
- (ii) Whether volumetric supply would be a feasible proposition.

BALESHWAR NATH, initiating the discussion expressed that some of our engineering works stand among the best in the world and in some respects reflect last word in technological development. Yet, in the field of management of irrigation supplies our record in India is almost the poorest. Apparently, there is not sufficient co-ordination and dovetailing of the activities of Irrigation and Agriculture Departments which was essential for an efficient field management of irrigation supplies and which alone can give us more food and fibre from irrigated agriculture. He stated that 80 per cent recorded utilisation with 50 per cent efficiency was no better than 50 per cent recorded utilisation with 100 per cent efficiency. Therefore, efficiency of field water management was of paramount importance.

He further stated that this efficiency in field water management cannot be attained if there are number of agencies in the same field pulling in different directions. There were at present about half a dozen agencies like *Panchayati Raj*, Community Development, Agriculture Extension, Irrigation Department, Co-operation and Revenue Authorities, each pulling the cultivator in its respective direction. As a result, the cultivator sometimes felt confused. It was, therefore, necessary to have a uniform control, which he thought could be best in the form of Irrigation Extension Service under the control of Irrigation Department, wherever irrigated agriculture existed.

With regard to line on which discussion should take place he opined that certain lines of action have already been indicated in the Third Five-Year Plan and they might themselves provide issues on which discussion could be focalised. Suggestions emerging out of the discussion needing any modifications in the provisions

of the Third Five-Year Plan could then be formulated in the shape of recommendations of the Symposium and forwarded for further action to the authorities concerned.

JAIN (J. K.) Stated that apart from the two major issues, *viz.*, organisational set-up and the proposal for changing over to the volumetric system of assessment, recommended by the General Reporter to be covered under the discussion, there were two other important factors, namely, (a) intensity of irrigation, and (b) availability and rostering of supplies in the irrigation channels which also need to be included in a discussion on water management. He pointed out that intensities of irrigation as adopted on the canal systems varied very widely from region to region and there was need for a more scientific approach in this direction. The modern thinking in the developed countries was that more intensive irrigation was better suited for maximising agricultural production and making optimum use of available water and land resources. More intensive irrigation, however, might lead to hazards like water-logging, *etc.*, and therefore it would be necessary to pay particular attention to the drainage of the irrigated tract.

He further said that on some of the diversion canal systems in the North, there was occasional shortage of water and the channels were operated in a roster of 1:4 or 1:5 in the cold and hot weathers, with the result that some of the crops did not get timely supplies of water. The supplemental use of ground water and from open wells and tube-wells in the commanded areas of such canal systems could be helpful.

He stressed that the above points may also be taken into consideration at the Symposium.

ANAND (D. B.) stated that there has been a talk of intensive *versus* extensive use of water. As far as the requirements of land were concerned, he felt that where the existence of salinity in the soil so demanded, extra quantity of water would need to be given. Where, however, the soils were good, water should be used economically so as to mainly meet the evapo-transpiration losses of the crop.

With regard to water management, he said that in the present set-up of administrative machinery in the country, several departments were playing complementary roles satisfactorily; he felt that this basic set-up should be recognised

and modifications would be sufficient in order to achieve satisfactory results in irrigated agriculture. It was, however, necessary that the functions of the two main departments concerned with the subject namely irrigation and agriculture should be clear. In his opinion, the irrigation department was responsible for the engineering and, therefore, for bringing the water up to the outlets from where water is let into the water-courses and the field channels. Once the water has been let into the watercourses, there are two functions: (1) conveyance of water to the fields and (2) the growing of crops from the water. These two functions, he said, could not be separated entirely and co-ordination between the two departments would be helpful. The quantity of water to be released would depend on the cropping patterns and would be determined in consultation with the Agricultural Department. He felt that the distribution of water to the farmers should be the responsibility of the irrigation department. This would mean control on management of water which is usually obtained by fixing a roster system. The engineer should also take steps to control mismanagement, misuse and wastage of water. On the other hand, the use of water for crop production would come under the purview of the Agricultural Department. This would involve advice to the farmers regarding cropping patterns and agricultural practices, the supply of seeds and fertilisers, the levelling of land and other similar items.

There has been a talk of intensive irrigation with the aim of maximum production per acre. In his opinion, the aim should be the optimum production from the available quantity of water rather than the maximum production per acre. This, he said, is because of the fact that we have a large rural population which is sustained by agriculture, and therefore, the available water supplies have to be spread to benefit the largest numbers. In this context, he felt that so long as the available quantity of water produces the optimum results, there is no special merit in obtaining the maximum per acre production as this would only mean more benefit to a fewer number of holders.

He thought that the fixing of water requirements for optimum production was not quite so simple a matter. It was here, in his opinion, that the Agricultural Department should play a vital role. They should, for example, carry out experiments with varying dosages of water and fertilisers on different types of soils—climate complexes, and draw out some kind of conclusions which would indicate the optimum production from fixed quantities of water. They could then fix the various inputs, *viz.*, water, seeds, fertilisers, *etc.*, needed for such optimum output of crops in different parts of the country. This, in his opinion, would be a worthwhile achievement which would lead to maximum production from available resources while at the same time serving the maximum number of farmers.

He felt that it was not perhaps necessary to have a special department for irrigated agriculture. In his opinion, the departmental set-up existing at present could meet the situation with some structural changes. One suggestion that he would make was that a high ranking officer (perhaps an additional director) should be either seconded to or specifically earmarked for work in irrigation project areas. Such an officer should be supported by the necessary agricultural staff and should be responsible for carrying out the experiments to find out crop patterns and other requirements for optimum production from the available quantities of irrigation waters. Such an officer could also expeditiously set up research and demonstration farms and could popularise suitable cropping patterns and agricultural operations by demonstration plots, *etc.* This, in his opinion, was one of the very important measures required for speeding up utilisation of irrigation facilities towards increased agricultural production.

The question of volumetric supply has been raised from time to time. He was doubtful whether people really understood the exact meaning of this word. If volumetric supply meant the sale of water by actual volumes this would be impossible in this country because the returns from various crops were not proportionate to the volume of water used. It should also be remembered that the irrigator has not always got the freedom of growing whatever crops he wanted for various reasons, the most important being the insufficiency of water for cash crops which he would naturally like to grow. It is also to be remembered that the water rates at present fixed on acreage basis depend on the bearability of the crop and not on the volume of water required. This, in the present context of economy, is unavoidable. A distinction has, therefore, to be made in the technical requirements of water for various crops and in the matter of water rates to be charged. While, therefore, it is essential that the water requirements of crops should be fully met according to technical needs, it is also to be expected that the water rates would depend on market conditions and the bearability of the crops. In his opinion, therefore, the two should not be related which would not be the case if the supplies were to be made on volumetric basis and charges were based on actual volumes of water used. He, therefore, felt that water rates should continue to be based on the types of crops. He, however, emphasised the need for restricting the quantities of water to scientific requirements for each crop. For this purpose, he felt that measured quantities of water should be given and, therefore, the word "measured quantities" should replace "volumetric supply". The measurement of quantities can be made by various means like flumes, semi-modules, *etc.*, at present in use.

DR. ARJAN SINGH stated that already departments of agriculture were supplying improved seeds, implements, fertilizers, plant protection



equipment, etc., and demonstrating the use of suitable cultural practices to cultivators. He drew particular attention to the new agency, *viz.*, National Extension Service, which is now responsible for the development work in rural areas and stated that all departments concerned with the development of Agriculture, including the Agriculture Department, were now functioning through this agency. He, therefore, felt that for the management of the canal water also this agency should be utilized. He, further, remarked that there was practically no co-ordination at the field level between the officials of the Irrigation and Agriculture Departments, though such a problem did not arise at the State level. The agricultural farms, set up in the irrigated areas, were devoting most of their attention to the agronomic experiments, such as varietal trials, doses of manures, seed rate, spacing, etc., and they were doing very little in respect of the planned use of irrigation water. The programme of work at these farms, therefore, requires to be modified. The main objective of these farms is to evolve suitable cropping patterns for the areas brought under irrigation and draw up schedules of agronomic practices for these crops. This should, therefore, receive greater attention than hitherto and as a follow-up measure demonstration of the recommendations made by these farms are also required to be carried out in the farmers' fields on an extensive scale.

SATWANT SINGH as a practising farmer, suggested a Land Colonising Board for all the project areas having the representatives from various departments such as Agricultural Scientists, Canal Engineers, Revenue Officer, Practising farmer and similar disciplines who should simultaneously survey how best the created potential could be utilised in 5 to 10 years. The necessity of reviewing the water rate tariffs to encourage soil restorative legumes in the localities of low fertility was mentioned. Similarly, he indicated the integrated operation of available pumping and rainfall water with the canal supply that could be made in the existing systems for extending irrigation in the arid zones. He also suggested a combined tariff in such situations.

Laying stress on special purpose tenancies for creating a bank of superior animal plant germ plasma he suggested the development of processing industry with suitable marketing facilities and also to bring down the difference between procurement price and the selling price which would create an incentive to the farmer for adopting improved production methods. He was of the opinion that a close study at the irrigator's level by the agricultural officer, canal engineer, etc., was very essential and as a result policies for each unit being developed, as no uniform pattern of policy would work in the country as a whole. He was not in favour of the suggestion of one department working under

the other, suggested a closer study for ensuring better co-ordination between soil surveys, agronomic experiments of crop patterns, etc., and progressive farming practice. So far as the control of water from outlet to field channels is concerned, he suggested one technical control. For proper development, he advocated consolidation of holdings conforming to the soil contours with no betterment levy in the first five years to create an incentive.

GULHATI (N. D.) drew attention to certain inaccuracies that had crept in the General Report. He was neither of the view that the construction and maintenance of watercourses must necessarily be carried out by the engineering staff nor that the distribution of water, beyond the outlet, must be the responsibility of engineers. All he had stated in his paper was that the Irrigation Department must extend its services beyond the outlet. This did not imply that engineers must take over the entire work. It was also not correct that "it is possible to achieve good results only if there is unified control of one department". Unified control was no doubt the simplest method; but there were other ways also, perhaps more difficult, of achieving the end result. Lastly, he was not of the view that the agricultural and soil survey wings of Agricultural Departments should be built into the proposed Departments of Irrigated Agriculture. All he meant was that, in so far as irrigated agriculture was concerned, the Irrigation Department must have these wings. Irrigation Departments could not function properly if they did not have agronomic experts working for them to give all the necessary advice.

Continuing, he said that the purpose of this Symposium was how to get the maximum agricultural production from 0.028 cusec (one cusec) of water developed, at the canal head of the reservoir, not for say 10 or 20 years but on a permanent basis.

A number of improvements were needed above and below the outlet. There would be some benefit from each but the point he wanted to stress was that, by an integrated approach, by dealing with all individual elements of production in an integrated manner, one can get proportionately much more benefit than by attacking one element at a time, each by a different individual, by different departments. Large sums of money had been spent on canals, dams and other irrigation works. The problem was how to get the maximum agricultural production from every cusec of water which had been developed at considerable cost. It was not enough to say that 80 per cent of the project area had actually been irrigated. The real question was "Have we attained the maximum possible production"? Or was it only one-half or one-third or one-quarter or two-thirds. This aspect had not received sufficient attention in India, even statistics for the purpose did not exist.

Somehow, the thinking in this country was tied with the existing pattern of administration. He suggested that for a scientific approach the problem should first be examined purely from the functional point of view. What was the best pattern of administration, of governmental management that could be evolved from a purely scientific point of view? After that one should try to fit the answer into the existing departments, with such modifications as may be necessary because of functional requirements.

He suggested that, as a first step, one should recognise that un-irrigated agriculture and irrigated agriculture were two very different things. By and large, un-irrigated areas have a *status quo*, built over the centuries, and all that had been done over the last many years was to replace natural vegetation by crops or trees. Improvements could be and had been made but there were natural limitations. On the other hand, irrigated agriculture did not have such limitations. But several other factors enter the picture; these had been set out in his paper. If it was recognised that irrigated agriculture had several special problems and was in some respects much more important than un-irrigated agriculture, the question would arise what to do with small pockets here and there. In big blocks of irrigated agriculture, the problem is relatively simple as irrigated agriculture has to be integrated with whatever can be done in the area from rainfall. This is tied in with the land management policy. Where large blocks of un-irrigated area exist in between small local units of irrigated agriculture, the area would have to be treated an un-irrigated block but technical know-how must be provided to deal with small pockets of irrigated agriculture. But there were pretty large blocks in the country which were either wholly irrigated or largely un-irrigated.

Having decided that irrigated agriculture has to be approached in an integrated manner, the next thing to consider is that in many parts of the country irrigation engineer stop abruptly at the outlet. Beyond the outlet he has no function to perform. In some provinces, in Punjab, parts of Rajasthan, Maharashtra and Madhya Pradesh, the irrigation engineer has several functions to perform beyond the outlet. In the Punjab, for example, all the watercourses are designed by him, even the disputes among cultivators are dealt with by the Irrigation Officer. In Maharashtra, even the cropping pattern and the area to be put under any crop are determined by Irrigation Officer. But in many parts of India, the irrigation engineer stops at the outlet, even though many activities beyond the outlet involve engineering and technical know-how just as up to the outlet. Land forming is one, the laying out of watercourses is another, even the distribution of water among cultivators has several engineering elements in it. So the next point, he said, was that the Irrigation Department should have some responsibility beyond the outlet.

Now what shape that responsibility should take was a matter of detail. So long as watercourses, land forming, cropping pattern and soil studies *etc.*, were controlled by the proposed Department of Irrigated Agriculture, it was immaterial who executes the work.

Continuing he said that irrigated agriculture was an industry owned by farmers who were ill-equipped both with the technical know-how and with finance. So, something must be done to bring them together and to provide them with the technical know-how and requisite finance. Some associations of farmers, whether by villages or by distributaries, were necessary and through these associations they must be provided with the technical know-how on the agronomic side and on the irrigation side, how much water to give, at what time to give, what depth, what soil amelioration measures should be taken up and when, *etc.*

The next thing to consider was the administrative structure. There were two ways :

- (a) unitary control; functionally there was no question that this would be the best as could be seen from several Soviet examples ; and
- (b) there should be as few departments as possible and a very high degree of co-ordination, all the way down from Delhi into the remotest irrigated field in the country.

In conclusion, Mr. Gulhati repeated the four points he would like to be considered :

- (1) Recognition of the fact that irrigated agriculture requires a high degree of technical skill, the kind not required in un-irrigated agriculture.
- (2) Irrigation engineers must extend their activities, in some manner, beyond the outlet and look after not only the watercourses and land forming but also the soil itself, salinity, water-logging, drainage, *etc.* The terms, irrigation, drainage and land reclamation or land amelioration are really three inter-related processes and, for permanent irrigated agriculture, one must consider all three as parts of one integrated problem.
- (3) Put the farmers in position, co-operatively, to get the technical know-how, to get the finance and, for these purposes to form societies of their own in which they are the managers.
- (4) There must either be unitary control over all elements of irrigated agriculture or a high degree of co-ordination with as few departments as possible.

NAG (B. S.) drew attention to the constant complaints from the Agricultural Department that proper and timely supplies were not being made

available by the Irrigation Authorities for ensuring optimum production. This, he said, pointed to the need of looking into the working of irrigation projects with a view to improving their operation and also for making any supplemental arrangements to augment the supplies. There were two categories of irrigation schemes, namely storage reservoirs and the run-off the river schemes. The storage reservoirs afforded good control over releases and regulation of supplies but in the latter case supplies had to be utilised as available in the river. In this context he suggested augmentation of the supply by tapping the underground sources in order to ensure adequate and timely supplies to secure maximum production.

PROF. HRABOVSKY (J. P.) felt that it was more appropriate to name the present discussion as management of farmers instead of management of waters, since it was they who ultimately utilized the supplies and it depended on their decisions how economically this utilisation was made.

To draw the attention of the group to the possible differences in the organisations required for better utilisation of waters in different situations he posed the following questions :

“Are we going to discuss organisations which would help farmers in the speedy and full utilisation of irrigation waters in newly established irrigation areas, *i.e.*, organisations to speed up the adoption of newly available water, or

Are we going to discuss organisations which would help farmers to better utilize the available water resources already in use ?”

These two objectives require different kinds of action and organisations.

For this “management of farmers” for bringing forth a better water utilization, he saw three available alternatives :

- (1) To force farmers by orders,
- (2) To advise farmers, and
- (3) To induce farmers by offering them incentives.

For the first alternative he saw little use except in some extreme situations. The second alternative comes mainly within the purview of the Agricultural Extension Organisation. It is the third alternative where the pricing and the volumetric sale of irrigation water could create incentives for a much improved use of the water.

To demonstrate the strong incentive for careful water use which could be created by volumetric sales, he said that if appeared that those Indian farmers who lifted water by bullock

power, were very well informed on the optimum quantity of water to use, and were very careful in utilizing their limited supplies.

To facilitate volumetric sales of water he felt that some form of bulk sales could be established by the use of *Panchayats* and the agricultural extension services who then would be responsible for suitable and equitable internal arrangements for distributions among members. In his opinion both volumetric sales and suitably adjusted rates would create a large step forward to the optimal utilization of irrigation water beyond channel outlets.

NARASIMHA RAO (G. A.) referred to the multiple agencies prevalent in Andhra Pradesh and also the curious responsibility on the engineers to see that water was supplied properly and crop maturity assured though they were not primarily responsible for the distribution and management beyond the outlet. The engineer had no authority on the farmers in the management, as whenever disputes arose the farmer had to go to the Revenue Department in the present system. This being an anomalous position for the engineer, he said, that after a good deal of argument a different system has been taken up as an experiment in a new project under completion. In this new system the entire organisation would be under the Irrigation Department with Chief Engineer as the head and a Deputy Director of Agriculture, five Agriculture Officers and Agronomists with suitable demonstration farms, *etc.*, attached to him. This amounted to more or less a unitary type of control.

At the same time he drew attention to the new set-up, *viz.*, *Panchayat Samities*, to whom the Government has been thinking of vesting all the power to collect revenue, to maintain minor and medium irrigation projects including construction except insofar as the major projects were concerned. In this context, he wanted to know how a unitary control would function while the current thinking was being extended to transfer the activities of even the major irrigation projects—maintenance and development to the *Panchayats* after some time. Therefore, he suggested that the role of *Panchayats* be considered while framing recommendations on the management side.

GUHA (P.R.) was of the opinion that management of irrigation water beyond the outlet should be the responsibility of Extension Service consisting of agriculture and irrigation officers under the unified control of the Chief Administrator of the Project. This management should not be the responsibility of the Project Chief Engineer or his staff.

In this connection, he mentioned that the definition of watercourse, as framed by the Planning Commission, *viz.*, “A watercourse may be defined as a channel built at Government

expenses to convey water from the outlet to 40·47-ha. (100-acre) block or as may be prescribed by the State Authorities", is not quite clear and convincing. Under the Irrigation Act, a Government channel cannot be allowed to be cut or damaged. If any body cuts or damages a Government channel he is liable to be prosecuted. A watercourse as defined by the Planning Commission has to be cut every year for irrigation purposes. Hence, until the Irrigation Act is modified, the above definition of watercourse cannot be valid. Besides, it will create confusion if some part of watercourses is built at Project expenses and the remaining is built by the beneficiaries either by themselves or through *Panchayats*. An analogy may be drawn to the distribution system of electricity, where the Supply Company or the State Electricity Board supplies the power up to the meter and thereafter the distribution is done through internal wiring system by the owner of the house. Similarly, water from Government channel can be supplied up to the outlet point (which is equivalent to the meter point), after which the watercourse has to be built by beneficiary.

Regarding water rate, he said that in Bihar it is charged on the basis of maturity of crop and not on volumetric basis. He was of opinion that volumetric basis of assessment under the present canal irrigation system was not feasible though the present method of collection of water rate required a radical change in most of the States. He cited the example of Switzerland wherein incentive to the farmer is provided, through co-operatives, in the form of issue of agricultural implements on hire, improved seed and manure, free technical advice and warehousing facility, wherefrom he can get 80 to 90 per cent of price of the farm produce, when the crop is harvested. The co-operative sells the farm produce much later, when the prices go up and pays the farmer the balance of the price after deducting the storage charge, *etc.* By this method, the farmer is protected from the village *Bania* or middle man and is not compelled to accept the lowest price prevalent when the crop is harvested. Such help through co-operatives give the farmers lot of incentive to increase farm production and he does not mind paying the water rate and betterment levy. He, therefore, suggested that such incentives could be given through unified management of the whole irrigated area by the Administrator of the Project under whom Directorates of Agriculture, Co-operative, *etc.*, would be created.

GHATURVEDI (R. S.) quoting a number of old projects in U.P., like Yamuna and Ganga Canal systems where increased utilisation was coming forth even after development for over a century, stressed the need for conforming to the standards actually obtainable in the field while framing the estimates for new projects. A suitable organisational set-up for stepping

up production, would naturally depend on the targets fixed. In the natural course a period of 10 to 15 years of development was always necessary. However, in view of the emergency, we are trying to compress this period to only two to three years. No doubt the pace of development depends upon several other complex socio-economic factors like commodity prices, administrative efficiency, marketing conditions, *etc.* One thing should, however, be abundantly clear, *viz.*, the commands of all the outlets on the old systems were today possessing much more mileage of better maintained guls than thirty or fifty years earlier and more mileage continues to be added.

Oviously, therefore, special efforts from the engineers for carrying water to every nook and corner within the command are immediately required. Nor can this responsibility be transferred to any other agency.

In this connection he cited a suggestion recently made, while discussing the plan of the Roorkee University, to start agricultural engineering courses. These agricultural engineers may not be experts either in engineering or agronomy but would be most helpful in the development of irrigated agriculture. In the U.S.A., this type of agricultural engineer has been chiefly responsible for the phenomenal development. Subordinates with agriculture engineering qualifications would perhaps be better able to take care of outlets, distribution, agricultural practices, *etc.* Experiment can be made by having *Zilledars* with agriculture engineering qualifications.

As on tube-wells which accomplish 121·41 to 161·87 ha. (300 to 400 acres) by a cusec and a half only, he felt that it should be possible to develop such an acreage by proper control of canal irrigation also if suitable irrigation facilities, as on tube-wells, are made available. The experience of tube-well irrigation also justifies the immediate rejection of smaller outlets, very common in U.P., as it might also result in better economy of water application and administration if the outlets are 0·042 to 0·057 cumec ( $1\frac{1}{2}$  to 2 cusec) discharge only. All this, he said, could be achieved only with the complete change in the pattern of irrigation administration. Helplessly depending on the vagaries of cultivators, *Panchayats*, and even Agriculture Department, *etc.*, must be completely eliminated so long as food shortage existed.

He felt that the Irrigation Department should be wholly responsible to convey the last drop of water to the last root zone and treat every outlet like a headwork. The role of Agriculture Department may be more usefully confined to the most important task of educating the cultivators for better agricultural methods and practice besides providing better seeds and manures, proper irrigation methods as also education in co-operative efforts along with the *Panchayats*, *etc.*

DR. UPPAL (H. L.) pointed out that the criterion of getting maximum production from a given quantity of water say 0.028 cumec (one cusec) did not appear to be correct. It should be "0.028 cumec (one cusec) of water giving maximum production without affecting any deterioration in the soil". What actually happens is that maximum production out of 0.028 cumec (one cusec) is obtained in the first few years by spreading water over large areas. But in course of time, low intensity of irrigation causes salinization of the soil and later on leads to infertility. This has happened in practically all canal irrigated tracts where irrigation has been done with this object of maximum production. Huge areas once very fertile have been turned saline or alkali. Therefore, it is not essential that the utilization of water is taken for maximum production. It should be the overall picture and not for the first few years only.

DR. MYLVAGANAM (T.) informed that in Ceylon a similar practice existed and water at the head outlet was given by the engineering staff, but the distribution of water was done by the revenue staff. He felt that the farmer used more water than needed in the present system. Recounting his experience in actual charge of such a distribution, he informed that he had controlled the required water supply with the help of the revenue authorities and cultivators, thus assuring a good crop and sowing water for another 1214.058 ha. (3,000 acres). As such, he felt that by carefully working out the quantities of water to be released, the farmer could be made to utilise the supplies to maximum advantage.

He was of the opinion that the agricultural officers would not be of help in this respect as their activity mostly pertained to the use of fertilizers, etc. In another project in Ceylon, he said that the waters were expected to irrigate 5665.60 ha. (14,000 acres) but by actually utilising the supply available from drainages, they were able to extend irrigation to another 1416.40 ha. (3,500 acres).

DHANAK (G. G.) stated that although the water distribution can best be managed by Irrigation Engineer, he has his own limitations. It is necessary for us to appreciate how far we can go. The engineer should indeed go down to the outlet and provide water at the head of an outlet with a capacity of 0.028 to 0.042 cumec (1 to 1½ cusec); but thereafter the *Panchayat* and the developmental organisation should play their roles. He cited examples that in olden days the control and development of irrigation, particularly on Minor Irrigation system called *Phod* round about Nasik, was managed and organised by the Village Headman. This sort of initiative must come from people as far as the cropping pattern and the best use of water is concerned.

He felt that a block of 40.47 to 60.70 ha. (100 to 150 acres) should be left to the management of the village *Panchayat* concerned. The Irrigation Department's responsibility should end with the supply of water to such a block. In his opinion the overall control for useful application of water and increased agricultural production should be taken over by the Development Commissioners through *Panchayat* organisation.

In regard to volumetric supply, he was of the opinion that there are two different facets in the papers and the discussions held so far. One is the sale of water to the consumer on volumetric quantity, and the other is the supply of water to the sanctioned crop on the volumetric control; the charges being still on the area basis. On the Deccan Canals, he stated, large-scale sugar-cane growers like sugar factories are being given water by volumetric sale, and as far as possible the total water consumption is restricted to a pre-agreed acre-inches. Thereafter the internal arrangement is left to the sugar-cane growers themselves. They can either apply a very high dose of water, get a heavy tonnage of sugar-cane per acre and restrict the total cultivation of sugar-cane to a smaller area from the given quota of water or they may as well have a low water application, a lower yield and a larger area under sugar-cane from the same water quota. He felt that this latitude should be left to the people as they know their economics better.

Another system, he pointed out is prevalent to the North of Nasik where all the available water of particular Bandhara is supplied for a defined period to the farmer, and he is left to do whatever he likes within that much water; he can either do light crop like *jawar* in larger areas or heavier crop like sugar-cane in smaller areas.

He informed that a very close liaison is necessary between the Irrigation Department and the Agriculture Department. In this direction Gujarat has taken the step to appoint an agronomist to look after the development of agriculture in irrigated areas. The Irrigation Department has also got a Soil Scientist who advises the Department on classification of soils, concentration of crops, drainage, water-logging, etc. He stated that this assistance from the agricultural staff and soil scientist is very necessary to the irrigation engineer for the management and development of areas on large irrigation schemes.

INAMDAR (S. G.) said that water is supplied at the outlet at considerable cost, and it was farmer's responsibility to further utilise it for maximum output. The farmer was not interested in the economic use of water, as long as the system of assessment, on the basis of matured crop prevailed. At present, the practice has been one of persuasion, but a better method

would be to develop some sort of incentives to induce the farmer, to use the State water more economically, during the irrigation of different crops. He agreed that the control up to the outlet only, should be of the Irrigation Department and beyond that village *Panchayat* controlled through the Development Commissioner or Revenue Authorities.

NEEMA (S. L.) suggested that the Irrigation Department should control all such activities even beyond the outlet which required engineering techniques, such as land development, watercourses, etc.

ABRAHAM (J. G.) supporting the views of Shri G. A. Narasimha Rao, reiterated that though the engineer's responsibility was only up to the outlet, yet the engineers were questioned whenever a crop failure occurred which indirectly reflected on the supervision of water distribution by the engineers. The case of a new Irrigation Project, Parambikulam Aliyar Project in Madras State, where he is in-charge, was cited, and in this Project, 20 per cent of the designed ayacut was allotted for paddy or wet crops and the rest 80 per cent for dry crops. He stated that in October 1962, Aliyar Reservoir, first of a series of seven reservoirs contemplated in the Project, was opened for an ayacut of 3035.14 ha. (7,500 acres), but after six months, it was seen that only about 607.03 ha. (1,500 acres) of land had utilised the water.

After examining the reasons for the slow progress of development, it was considered that lack of co-ordination between the Engineering, Agriculture and Revenue Departments may have contributed to this slow development. This was investigated by one of the senior Members of the Board of Revenue in Madras State, who had discussions with the Chief Engineer, and it was recommended that the Special Deputy Collector for localisation in the Project and the Special District Agricultural Officer should work under the Chief Engineer of the Project to effect better co-ordination and ensure speedier utilisation.

Later, a World Bank Expert Team visited the Project on the initiative taken by the Government of India, and this problem was discussed with the experts, who seemed to be of the view that a soil scientist should work in close collaboration with the engineers for the proper development.

The Government of Madras subsequently discussed the matter in a conference and have now passed orders appointing a Project Co-ordination Board with the Member, Board of Revenue as Chairman, the Chief Engineer as a Member, a senior I. A. S. Officer as Member-Secretary of the Board, with the Chief Engineer (Irrigation) and the Director of Agriculture as Members. They have also appointed a Project Utilisation Team with the Special Officer

as Leader of the Team, and a Special Deputy Director of Agriculture and an Executive Engineer as Members of the Team. The functions of the Board are to co-ordinate the activities of the various departments and the Project Utilisation Team is to ensure speedy development. The work of this team will be reviewed after a year.

He, however, felt that to ensure speedy and effective utilisation, a soil scientist should be closely associated with the Engineering Department and development programme should be under the unitary control of the Chief Engineer of the Project.

KHURSALE (N. V.) suggested that the irrigated agriculture should be treated scientifically and separately from the un-irrigated agriculture as indicated by Shri Gulhati. He advocated an exclusively independent wing for irrigated agriculture within the Department of Agriculture instead of a separate unit. This he compared with the existing pattern of having minor irrigation wing and the medium and major irrigation wings separately under the same department of irrigation with individual Chief Engineers heading the wings that is prevalent in most of the States. This wing of irrigated agriculture could be headed by an Additional Director of Agriculture in the Agricultural Department as was done in the Maharashtra State. The purpose of irrigation being agricultural production, and irrigation being only a means and not the end the organisational set-up should be considered in clear terms for the objective in view. He was not in agreement with the unitary control under the irrigation department. For improved production from irrigated agriculture, he suggested action on the following lines :

- (a) Providing irrigation facilities;
- (b) Supply of fertilisers;
- (c) Levelling and land formation;
- (d) Supplying improved seeds ;
- (e) Supply of insecticides and pesticides;
- (f) Administration of best agricultural practices ;
- (g) Agronomic advise to irrigators;
- (h) Credit facilities to the irrigators;
- (i) Storage places for agricultural produce;
- (j) Marketing facilities for agricultural products and providing communications in the irrigated area.

Out of the above he stated that about six items were within the purview of the Agriculture Department, three within the Co-operative Department and two within the purview of Engineering Department and therefore it was reasonable that the overall responsibility of irrigation management beyond outlet should be of Agriculture Department and others should

play their part by closely co-operating with it. The principle of one department rendering its specialised service to several departments was an accepted fact in the administration of Government, and this, he said, has worked well in the past and should work well in future.

He suggested that the Irrigation Department should sanction the water supply to the irrigators, and assess the irrigation cess and water rates for recovery through Revenue Department. The co-operation between the various departments concerned with production was sound and satisfactory as far as it pertained to levels higher than the districts. At the district level, *Zilla Parishad* and *Taluka Samities* already existed which co-ordinated the activities of the Irrigation, Agriculture and Co-operative Departments and therefore the responsibility for the full utilisation for optimum agricultural production should be of the *Zilla Parishad* and *Taluka Samiti* headed by the Chief Executive Officer and the Block Development Officer.

In regard to volumetric supply, he informed that it was working satisfactorily in Maharashtra State to a limited extent, in that, the large consolidated farms either of individuals or of joint stock companies were being supplied on the volumetric basis. A further step proposed was to supply water to all the irrigators in the zone of co-operative sugar factories through the factories on volumetric basis. He said that a proposal was also there to give measured supply to all the irrigators under each distributary through the irrigator's co-operatives which would be formed specifically for this purpose. It was, therefore, felt that a gradual changeover from area basis to volumetric basis was quite workable and would be advisable as the only means of minimizing wastage. Concluding, he suggested that where irrigation was practised for several mixed crops (as in Maharashtra) the option should be with the irrigator and the aim of "Irrigation Management" should be best agricultural production suitable for the area and not necessarily the maximum food production.

JATINDRA SINGH said that upto now, in the Punjab the Irrigation Department was distributing the requisite water to the individual consumers beyond the outlet and this arrangement was working satisfactorily. However, in view of the criticism levelled by public in not getting the proper service, the Chief Engineers of the State decided in a committee to bring down the limit of responsibility of the engineers up to the outlet, beyond which it has been suggested to the Government that other Departments, like, Co-operative or Agriculture, etc., might take over and do the distribution. To this, the Government has not communicated any decision so far. He personally felt that for stepping up the food production, Irrigation

Department should continue to be responsible for the distribution of waters to the individual shareholders and the unitary control of Irrigation Department maintained undisturbed

SIDHU (G. S.) narrated that out of desperation and pinpricks from the administrative machinery, the control of water beyond the outlet by the Irrigation Department was suggested to be taken away by any other department. He stated that in the beginning, the development officers wanted a few aspects of drainage management to be handed over to them in spite of resistance from the engineers that such a proposal would not function but in the end it was proposed by the Chief Engineers to hand over these functions to the Development Officers and this recommendation was communicated to Government. But after this was communicated the officers of Development Department went back and refused to take over the management of even these few aspects.

Food production being a subject of national importance, required careful handling. He proposed a unitary control of management under the irrigation department and the other advisory departments like Agriculture, etc., might co-operate as at present management could be classified as : (i) a form of Control Board consisting of Irrigation, Agriculture and other departments. In this type, however, he had not much faith, (ii) A unitary control system, under the Agriculture Department but they had some shortcomings due to their advisory nature. Considering all facts he felt that the management of the whole irrigation should be with the Irrigation Department as any co-operative venture also would lead to delays in the production in the present context though such a venture after a long lapse of time might start functioning adequately.

MADAN LAL WAHI stated that the Punjab has been practising extensive irrigation with the Irrigation Department having the control over the construction and maintenance of field channels and watercourses. However, he was of the view that the management beyond the outlet should be by the people in accordance with the socialistic pattern of society. Considering a block of 20234.30 to 24281.16 ha. (50,000 to 60,000 acres) served by a channel of 2.832 cumec (100 cusec) he said that it could be looked after by a representative Board of 3 to 5, one of them being the chairman for ensuring efficient management. He proposed that this Board should be assisted by 3 ex-officio members namely, (1) Irrigation Engineer of the area to act as Chairman of the Board, (2) Revenue Officer of the area to act as Secretary of the Board and (3) an Agriculture Officer to act as Advisor on all problems connected with agricultural production such as manures, crop planning, reclamation, etc.

## MANAGEMENT OF IRRIGATION WATERS

YADAVA MOHAN said that when thinking about management, one has to think simultaneously of the aims to be achieved by management. It was stated earlier that maximum production per cusec might be a suitable basis as an aim. This was no doubt correct to the extent it goes. Many other considerations, however, have to be taken into account. The socio-economic pattern in the country dictates extensive type of irrigation. For instance, if irrigation could be extended to 50 per cent larger area with two-thirds volume of water per unit area without losing total production, this alternative may have to be adopted for extending benefits to a large number of people. In fact, in view of the large areas available on certain projects and the large population of unemployed people, one may have to extend this principle further and if more people could be benefited by losing say 5 per cent in total production, this may have to be faced in certain localities. A policy in this regard needed consideration and formulation at the highest levels.

In arriving at the best production or extension of benefits in accordance with said policy, water requirements as well as requirements for fertilizers, etc., would have to be carefully studied. These would be different in different soil conditions. There is thus obvious necessity of a large number of experimental agricultural farms, which could indicate the best applications in different soils and climatic conditions. These activities would obviously fall under the field of the Agriculture Department, which should have exclusive responsibility of soil surveys indicating best crop patterns, appropriate doses of water, etc.

After this he entered into the question of application of the results derived at the experimental farms to the fields. He said that one of the derivations would certainly be the volume of water to be applied to unit area. This could only be achieved if application of water is on volumetric basis. This, he suggested, is undoubtedly a difficult problem, but since in the course of time the volumetric supply has to be and is bound to be adopted, a beginning should be made in this direction on certain selected channels in each State so that methods may be developed for overcoming practical difficulties.

He added that constructional responsibility for field channels and watercourses vested with the Department of Irrigation and should continue to remain as such. But the maintenance and management thereof could be done either by the Irrigation Department or by the Agriculture Department or by the *Panchayats*. He had no doubt that this could be done by the irrigation engineers better than by other agencies. But the question has to be viewed in long range from the point of view of building up social institutions. From this point of view he advocated that the maintenance and management

of watercourses should be the responsibility of the *Panchayats*. Although shortcomings will have to be faced for some time, he expected that this would be the best agency for management in the long run.

MITTAL (J. P.) also suggested that the system of extensive irrigation had the advantage that it would benefit the maximum number of cultivators. In respect of water management beyond Government outlets, which consisted of the conveyance system and distribution beyond the outlet, he felt that the Agricultural Department was the best agency to guide the end use with the help of the extension staff co-operatives, the *Panchayats*, etc. He stressed that with the advent of *Panchayats* it was better to transfer the responsibility of proper enforcement of *Warabandi* to them though in the beginning one might experience a lot of difficulty. He went to the extent of suggesting the entire transfer of the construction and maintenance of field channels to the local people except insofar as the alignment, cross drainages, etc., which should remain the responsibility of the Irrigation Department.

In U.P., he said, that the distribution of water was gradually being transferred to the Agricultural Production Committee wherever the *Panchayats* had passed a resolution for taking up the responsibility of distribution of water by themselves. However, the fact remained that the success of such an experiment was still uncertain. No doubt, there would be wastage to a certain extent. It was to be considered whether at the present juncture it was advisable to try this experiment. In regard to proper maintenance of watercourses and avoidance of wastage, he informed that the irrigation engineers were still required to supervise the overall performance.

Advocating the volumetric distribution, he suggested that simpler methods should be found and implemented.

GUPTA (P. N.) attributed the cause for the lop-sided agricultural production to many agencies handling the question of management of irrigation waters. In that light he suggested a unitary control system even to the extent of creating an Irrigation Extension Service. He emphasised on the quality of water along with the soil type which played a great role in the agricultural production. He pointed out that in Germany a chart is displayed in every locality defining the suitability of water to soil type and crop. His experience of the work of the co-ordination committees was that it was not to the expectations. He advocated a sole efficient management by the Irrigation Department.

Vij (G. K.) raised the point as to how far the Irrigation Department should function beyond the outlet. In case maximum out-turn per cusec had to be obtained, what was the best arrangement to achieve the same? This he



classified under the three headings (i) by persuasion, (ii) by co-ordination and (iii) by execution through a unitary authority. He laid emphasis on the role of human activity, in all these aspects. From this angle, he felt persuasion being advisory means the results could not be guaranteed and also it would take a longer time. Secondly, in co-operation more people come in and an agreement among them would be difficult to frame and implement policies. Therefore, the best way, he felt, was the unitary control and as to the structure of it, it could be any department who would be able to deliver the goods. Further, the Government also required a single authority which should be made answerable in such situations. Thus, he said, in the ultimate working, it would be the responsibility of the people who have created the water potential to manage till production, and assure the best utilisation, and this again indicated the desirability of unitary control by the Irrigation Department.

RIPUDAMAN SINGH felt that the suggestions which had come out so far might be an idealistic approach and welcome but from practical considerations were not feasible. Beyond the outlet there were certain functions which could efficiently be performed by only different agencies. Though the alignment of watercourses, field channels and such other engineering aspects could be looked after by the Irrigation Department in case unitary control was exercised by the Irrigation Department, they would not be able to have the field channels constructed and maintained by the beneficiaries. There are other functions like distribution of fertilisers, improved seeds, etc., where other agencies would be better suited. With these limitations of the Irrigation Department, therefore, he felt that it would be advisable to have the various functions carried out by the respective agencies able to deliver the goods.

The need for certain crops suiting to the economic needs of the country was there, and therefore, the water rates were usually fixed on the requirements for maturing those crops even if it meant to some extent subsidising them for certain areas and crops. Apart from other considerations this aspect, he felt, had to be carefully considered before enforcing the volumetric basis which led to complications. As such, either the volumetric basis had to be adopted with a very complicated system of assessment or the present system of water rates be continued.

DR. ARJAN SINGH observed that proper utilisation of water in the field was an extension problem which, in the present set-up, could only be attended to by the National Extension Service—an agency created for this purpose throughout the country. Unless some changes in its functions and organisation are brought about it may be difficult to bring about unitary form of control

in respect of canal water management and utilisation, by one department, though this seems to be ideal to achieve the desired results. In the field of agriculture, it has been seen that the V. L. W., who is a multi-purpose worker, has not been able to pay adequate attention to its development. It is for this reason that, on the recommendations of a high-powered committee, some changes in regard to the control of the staff of the Department of Agriculture in blocks are being brought about. The general idea is to have single line control right from the top to the lowest level. Some of the States have already implemented the recommendations of this Committee. This may, however, be not possible in the case of each department. As immediate measure, therefore, he felt that it will be useful to have, at the block level, a special committee composed of the officers of the Irrigation and Agriculture Departments and a few representatives of the farmers and *Panchayat Samities* to look after the management of irrigation water by utilising the services of local institutions and extension staff.

GILL (R. S.) suggested that best management would differ with the type of area under consideration which would be divided into three parts :

- (i) Areas already under irrigation where potential has been created but where optimum development had not taken place.
- (ii) Areas where water potential was being created and part development had taken place.
- (iii) Irrigation system under construction.

He said that one uniform formula for all the three categories would not be proper solution. Therefore, the best agency to solve such a problem was the Agricultural Committee which should be primarily responsible for increasing the agricultural production. In the present context of *Panchayat* Era he suggested that this agency has to be made to take up the responsibility beyond the outlet with the co-ordinated help of irrigation engineers, agricultural experts, soil scientists, etc., who would form an advisory body under the unitary control of one technical expert. Thus the *Panchayats* will have to deal with one man only and get all the necessary technical and official help.

Further, he felt that volumetric basis of tariff was the best which would avoid all malpractices and though some difficulties would be there for fixing such tariffs and this could be overcome by proper study of the available records.

SHARMA (S. D.) gave the example of California for the best irrigation system especially in the management and distribution of water by the counties even up to 2·832 cusec (100 cusec). The counties were responsible for the

collection of water charges also and the Government was not interfering with their activities. One point of significance in California was that the irrigators were sufficiently educated and could manage the distribution efficiently.

In India at present, he stated, there were five tiers namely; the Central Government, the State, the District Level (*Adhyak*), Block *Pramukh* and finally the *Gaon Sabha* and in case these worked efficiently, each one in the higher category would take care of the activities of the lower. He was of the opinion that at present the *Panchayats* should not be burdened with full responsibility as it will be too risky an experiment and, therefore, should be assisted suitably by some form of technical committee. In this way he thought that the *Panchayats* could be geared up to take care of the full responsibility in the management below the outlet in course of time. The farmer, though illiterate, was shrewd enough to choose the proper crop pattern suiting to his economy and therefore he felt that it was better to adopt intensive system of cultivation and covering the extra area left over as such by minor schemes.

CHATTERJI (B. N.) stated that for minimising wastage, the outlet should be remodelled at the earliest opportunity. The experience of the Sone Canal System had indicated such a trend after the stabilisation of utilisation. He was strongly of the opinion that watercourses management would be difficult by Irrigation Department.

BARKAT RAM observed that the present system of water distribution and assessment of water charges on the basis of areas of crop matured was wasteful and should be replaced with the modern system based on volumetric measurements of water. He added that under the present system, the irrigation engineer delivers the water at the outlet and the farmer takes it over at the field. A considerable volume of water is lost in seepage through watercourses for which neither the irrigation engineer nor the farmer takes any responsibility.

The main difficulty in following the volumetric system was metering of irrigation supplies. This could be overcome with the use of modular outlets. Such outlets are already installed at the heads of almost all outlet heads in Punjab and the volumes of water being delivered at these points are known. It was, therefore, proposed that the *Panchayats* could make a bulk purchase of irrigation supplies at the outlet heads for further distribution to the farmers on hourly basis.

Under the proposed system, the responsibility of the irrigation engineer in regard to the management of irrigation waters would end at the outlet head. Beyond this point, the responsibility would rest with the Village *Panchayats*. The *Panchayats* will look after the practical aspects of the land

and water management with the guidance and assistance of District Advisory Committees of experts in irrigation and agriculture. Since there was a large number of *Panchayats* already created, a single advisory committee would not be adequate for the purpose.

Regarding the measures to be adopted for increasing the agricultural production from land it was proposed that the overall general policies would be guided by a High Level Co-ordination Committee comprising the heads of departments of Irrigation, Power, Agriculture, Research and Cooperative Societies.

The proposed system of management of irrigation waters and land would be in accordance with the principles of endowing *Panchayats* with power and authority necessary to enable them to function as units of Self-Government as laid down in our Constitution. The adoption of any other system which attempts at nationalizing the agricultural industry by the departmental interference would be a step in the backward direction.

The system of unitary control can certainly be devised by placing all the management of irrigation waters and land beyond the outlet head under the administrative control of one department namely the 'Development Department' which is responsible for the administration of *Panchayats*.

JAIN (J. K.) pointed out that as mentioned by an earlier speaker, it was incorrect to say that though a number of irrigation schemes had been constructed during the Plan period, yet the food production had not gone up. He mentioned that while after the advent of plans, the irrigation had gone up in the country by about 25 per cent, the food production had increased by more than 50 per cent.

In regard to the organisational set-up for various phases of water management Shri Jain felt that the construction of watercourses should be the responsibility of the Irrigation Department as the fixing of outlet sites and alignment of field channels was a work very much interconnected with the design and layout of the main irrigation channels. He was, however, of the opinion that after the watercourses, it was important to have a unitary control over all the phases of water management. These phases of water management would include land forming, use of improved implements for preparing lands according to scientific irrigation methods adopted to the cropping pattern, evolving and extending improved cropping pattern and agricultural practices, arranging supply of fertilizers, improved seeds and research and extension of information about the optimum doses of irrigation in relation to the fertilisers. Shri Jain was of the opinion that a well-organised extension service under the Agriculture Department would be in a better position to handle these phases of the water use.

DR. RANBIR SINGH felt that after fixing a suitable minimum limit for the Government outlet, the responsibility for management of irrigation water beyond this point should rest with the farmer. Since conveyance of water beyond such points will require to be suitably planned and designed and guidance will also be required for the preparation of land to be irrigated, the farmers would require technical help. This work will have to be provided by the extension agency of the Soil Conservation Wing of the Agriculture Department. He also informed that in Rajasthan this programme has been started in the Rajasthan Canal Project area and Chambal commanded area.

Since farmer had an important role to play in managing water it was considered necessary to hold a number of training camps to introduce the various items of the programme to farmers.

He also stressed the importance of considering drainage measures along with measures for better utilisation of irrigation water. These two issues were closely linked and deserved to be considered together. Some irrigated areas badly needed drainage.

Further he informed that in 1961 a Seminar on Irrigation and Drainage was held by the I.C.A.R., and a number of useful recommendations were made (Annexure I). Adequate notice of the same should be taken while making any further recommendations.

#### ANNEXURE I

##### Note on Agricultural Irrigation and Drainage

Irrigation water potential has been developed as a result of a number of major, medium and minor irrigation projects. In order to make the best use of the supplies available it is necessary to have a proper agency for advising the farmers about land preparation, location and layout of irrigation channels; lining of channels, where necessary, suitable irrigation method, application of water, other improved agricultural practices, e.g., use of better seeds, fertilizers, cropping patterns, etc., and finally removal of any excess water through a system of field drains. This work involves close co-operation between Irrigation, Soil Conservation Wing and the Agriculture Extension Wing of Agriculture Department, the respective responsibilities being as under:

Irrigation Department	Agriculture Department	
	Soil Conservation Wing	Agriculture Extension Wing
Water storage and supply up to Government outlets and construction and maintenance of main drainage works.	Land preparation, location and layout of irrigation channels, lining, irrigation methods and field drainage.	Crops and cropping patterns, seeds, fertilisers, implements, plant protection measures.

HARBANS SINGH informed that at present the agency at the village level was *Zilledar* and *Patwari* and while making bulk supplies to *Panchayats* these two agencies also could be given to them to help them in their proper distribution, management and assessment. In addition, the irrigation engineers and others were required to continue their help to the *Panchayats*. While making bulk supplies an encouragement should be developed for using the wells and other pumping devices so that the irrigation facilities could be extended to other regions. Regarding the land, he was of the opinion that all the beneficiaries should be brought under co-operatives at least for irrigation purposes to remove the imbalances that exist today due to improper economic levels and distribution of waters. He suggested that the political boundaries of the villages should not be considered and the distributaries should be considered as a unit for proper control and management.

NAG (B. S.) concluding the discussions, invited attention to the various views expressed by the speakers. He suggested that notes on the discussions might be circulated to all as early as possible for eliciting their considered opinions. He further suggested the formation of a small committee consisting of some experienced irrigation engineers and agricultural specialists, etc., who should examine the matter taking into consideration the views expressed by the speakers and make definite recommendations which could be forwarded to Government for consideration.

Insofar as working of the Irrigation Department is concerned everything except drainage works are being done. Construction and maintenance of main drains is to be their responsibility.

Soil Conservation Wing is already executing most of the items of the programme and the only item of work which needs to be assigned to it, is the construction and maintenance of field drainage ditches. This work is urgently needed in irrigation projects like the Chambal, Meja, Gudha, etc.

Agriculture Extension Wing is responsible for the items proposed for them.

Field co-ordinating of the type suggested above for drainage is to be ensured in one project in Talera, *Panchayat Samiti* where 485.6 ha (1,200 acres) of land has become water-logged. The Irrigation Department has prepared a plan for the main drainage works and to this a plan for the field drains has to be added to make it a perfect plan.

It is strongly recommended that the arrangements proposed above may be adequately considered. The arrangements suggested above, if agreed to, will give a lead to many States in handling the issue which is assuming first importance in the present situation when increase in agricultural production has become the country's first goal.

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