



Bombay Public Works Department
Technical Paper No. 16

Note on Irrigation on the
Block System in the Deccan
Canal Tracts

by

C. C. Inglis, I.S.E.,
Executive Engineer, Special Irrigation Division

[Price—Annas 5 or 6d.]

BOMBAY
PRINTED AT THE GOVERNMENT CENTRAL PRESS
1927

Obtainable from the Superintendent of Government Printing and Stationery,
Bombay; from the High Commissioner for India, 42 Grosvenor Gardens,
S. W. 1, London; or through any recognized Bookseller

Last of Bombay Public Works Department Technical Papers

Paper No	Subj	Year of publication	Number of copies in stock (July 27)
1	Reinforced Concrete Flooring in the Hostel for the High School at Satara (Bombay Presidency) by W L G. Trench, B A I, A M I C E Executive Engineer, and T S Mirchandani, B Sc (Edin), Assistant Engineer	1913	Out of stock
2	Famine Relief Road Works carried out in the Banda District, United Provinces in the famine of 1913 14, by D R H Browne, A K C Executive Engineer	1915	"
3	Note on the Lower Ganges Bridge Works at Sara Bengal by D R H Browne A K C, Executive Engineer	1915	"
4	Report on experiments on Concrete Flooring carried out at Poona (Bombay Presidency) by Conductor T H Naughton Sub-Engineer	1917	"
5	Reinforced Concrete work in the Bombay Presidency by J C Gammon B Sc A C G I, Late Assistant Engineer Bombay P. W D	1917	"
6	Reinforced Concrete Roof Construction for use with ceiling tiles by J M Macky A M I C E, Executive Engineer	1917	"
7	Report on the Felling of the Masonry Chimney at Dapur (Bombay Presidency), by H W Oddie Taylor A C G I, B Sc, Executive Engineer	1920	"
8	Note on the Tests carried out with Reinforced Concrete Brick Walling Loaded as a Beam by Khan Saheb J D Dubash, Assistant Engineer	1920	"
9	Note on the Manufacture of Hydraulic Lime in the Nasik and Ahmednagar Districts of the Bombay Presidency—1920, by Rao Saheb V K Chapekar, Temporary Engineer	1921	"
10	Glossary of Irrigation Terms applicable to the Deccan Canals	1921	"
11	Report on the Malir River Boring Investigations for the Karachi Water Supply, by H O B Shoubridge, M Inst C E, Chief Engineer for Irrigation	1923	"
12	A Note on the Design Application and Construction of Masonry Semi Modules as used on the Jamrao Canal, by W Kirkpatrick, Executive Engineer (2nd Edition)	0 12 6	41
13	Soil and subsoil surveys in the Deccan Canal areas, by C C Inglis Executive Engineer and V K Gokhale, Deputy Soil Physicist	0 6 0	4

Paper No.	Subject	Price	Year of publication	Number of copies in stock (July 27)
14	A Short Note on the Improvement of Damaged Lands in the Canal Irrigated Tracts of the Bombay Deccan, by C C Ingls, Executive Engineer	Rs a p 0 4 6	1927	76
15	Notes on Standing Wave Flumes and Flume Meter Falls by C C Ingls, Executive Engineer, Special Irrigation Division		In Press	

Copies obtainable from the Superintendent, Government Printing and Stationery, Bombay

NOTE ON IRRIGATION ON THE BLOCK SYSTEM IN THE DECCAN CANAL TRACTS

BY

C C INGLIS, I S E , EXECUTIVE ENGINEER, SPECIAL
IRRIGATION DIVISION

1 Sir M Visvesvaraya, who was the originator of the Block System, wrote a note dated 15th April 1903 entitled

“IRRIGATION ON THE BLOCK SYSTEM”

“A description of the System with proposals for applying the same to the Nira Canal and two Minor Tanks in the Poona District”

2 In this note he pointed out that

“Wherever, outside Bombay, there was any large extension of irrigation in recent years, it was due to the demand for artificial irrigation for food grain and other crops. Such crops in the Deccan were ordinarily grown on rainfall and except in years of scarcity, did not require irrigation to bring them to maturity.” As a consequence “the areas fluctuated with the character of seasons and the market prices of crops”

“There is a fairly steady demand for irrigation for a few selected classes of crops in the Bombay Presidency, but such crops, of which sugarcane is the most important, require capital, manure and enterprise for their successful cultivation. They cannot be grown over any large continuous areas like wheat or rice, or in the same land year after year, that is, without resting the land, or some kind of crop rotation. The local peculiarities of soil and climate render a general extension of irrigation to cereals or other staple crops of the country impossible except in seasons of drought. It follows, therefore, that the cultivation of sugarcane and other high class crops should be encouraged in the Deccan by a system of rules and management specially adapted for their development”

3 In paragraph 5 of the note the proposed system was described

“The object of the system is to distribute the benefits of an irrigation work over a large number of villages and to concentrate the irrigation in each village within blocks of specified limits and in selected soils and situations. The total area of the blocks in each village should be large enough to enable every one who is able to grow an irrigated crop to have a share, but not too large to constitute a surfeit, or cultivators to neglect the advantages of water-supply in good seasons”

“Only one-third of the area in each block is to have sugarcane or other perennial crops at a time and in the remaining two-thirds either

vegetable or monsoon or rabi crop may be grown up to the end of February. After February, water will be given for only one-third of the area, that is, for the area on which a perennial crop, is grown. There will thus be a sort of triennial crop rotation in each block."

"At present, water-rates are charged on the crops actually matured. On the Mutha Canal, the rate varies from Rs 40 for sugarcane, Rs 8 for eight months crops, Rs 2-8-0 for rabi to Rs 1-8-0 for monsoon dry crops. For the areas included in the blocks it is proposed to charge a fixed rate per acre irrespective of the crop grown, subject to the general limitation that only one-third of the area will receive water throughout the year. This rate it is proposed to fix at between Rs 8 and Rs 15 per acre according to circumstances. In Khandesh under similar circumstances, a consolidated rate of Rs 16 per acre is charged on some of the old irrigation works at present."

"Water applications will be sanctioned once in six years."

4 In paragraph 9 Sir M. Visvesvaraya described the many great difficulties which arose under the old (pre-block) system of Irrigation —

"9 At present the distribution of area to be watered from season to season among all the villages under command of a canal, especially when there is a 1 increase in the demand and a simultaneously short supply, is one of great difficulty. The capacity of the canal staff is taxed to the utmost in order to ensure a fair distribution and mature as large an area as possible. The area irrigated varies considerably from year to year. The increased demand occurs usually when the rainfall is deficient. In a year of pressure like that, there is much difficulty in distributing the water-supply between sugarcane and rabi crops on some canals. What proportion of the water should be set apart for sugarcane and what for rabi and other cold weather crops? Suppose a proportion is fixed by a rule of thumb method, how are such areas to be distributed by villages and how again between the individual cultivators of each village?"

"Some villages have small areas under irrigation while others may be over-irrigated. Capitalists monopolise the water-supply for large areas. The poorer cultivators cannot obtain capital and have no chance in a year of plague or famine. Regulation on some system is necessary to prevent these inequalities."

"Again, on some occasions, people wait for rain till the last moment for rabi or monsoon crops and should the rain fail there will be a great rush for canal water. Tens of thousands of acres of rabi crops require water at the same time and all in 12 or 15 days. On such occasions the demand is most intense and an equitable distribution of the areas becomes well-nigh impossible. If, added to this, the water-supply is not sufficient, some of the people have to be refused water, and, if people are dissatisfied, it is beyond the capacity of the canal officer to prevent complaints on such occasions."

' Estimates of areas which can be watered are prepared at the commencement of the fair weather, but they have to be modified afterwards for various reasons. In November last, for instance, I estimated that 17,000 acres could be watered in the third section of the Nira Canal. Shortly after, orders were issued and preparations made, there was a heavy fall of rain (about 6 inches) in December and as a result the demand for water fell to about 3,000 acres only " -

" Another common difficulty is, when the cultivators spend large sums on manure and prepare lands for sugarcane and then submit their applications. Some ignorant or perverse cultivators do this before making sure that water supply is available. Exceptions have had to be made to help poor cultivators but the concessions have frequently led to a repetition of the irregularity "

" Then again, after the areas are allotted, it is found that the poor cultivators do not plant sugarcane to the extent sanction is given for want of capital and other reasons. In such cases the canal officer has no authority to charge a water rate and finds that there is a saving of water which it is too late for him to utilize elsewhere. The poorer cultivators are often unable to obtain advances from capitalists in order to prepare land for sugarcane plantation "

Again in paragraph 14

" 14 Successful irrigation requires organisation, co-operation and capital. Cultivators lose confidence when water is given in one year and refused, or liable to be refused, in the next. Under present conditions, there is no means of preventing this. The works are constructed at a great expense. Government cannot compel owners of lands under command of a canal to use the water when available, and the cultivators may not be able to obtain water when they want it. This uncertainty and want of touch between demand and supply have retarded the development of Irrigation "

5 The Block System was derived from the " thal " (" *phad* ") System, which had been followed for generations on some of the bandharas of Jask and Khandesh

This system was described by Mr Beale in a report when Superintending Engineer on Special Duty, as under —

" The ' thal ' or area commanded by a ' *bandhara* ' and channel is usually divided into four nearly equal parts or ' *phads*, ' the whole of which is annually brought under irrigation. Each ' *phad* ' is divided into an equal number of shares of fields according to number of owners. In any one year the whole of one ' *phad* ' is devoted to rice, another to sugarcane, the third to wheat, gram peas, etc., and the fourth to bajri or kharif, jawari, etc. In the next year the same crops are grown, but on different ' *phads*, ' namely in the following order — Sugarcane, wheat, bajri, rice, and in the next two years the crops move round in the same rotation until the fifth year, when they regain their original position. This rotation continues without interruption, the only periods of fallow being the intervals between the crops. This

system is termed quadrennial rotation. In triennial rotation, the Bajri is omitted "

Sir M. Visvesvaraya—like many others—looked on the ' *phad* ' system, as the ideal system of irrigation and in paragraph 18 wrote regarding it

" The distribution of water is all done by the irrigators themselves and there are no expenses for management, as distinguished from works or repairs. There are no important variations in area and revenue, save in years of exceptional scarcity. Remissions of water rates are apparently not granted even in such years "

" The maintenance expenses bear only a small percentage to the revenue "

" All these favourable results are due to the responsibility being undivided, to fixity of tenure or perpetual contract for the use and payment for water and to the fact that it is to the cultivator's advantage to study the strictest economy in the use of the water "

He then went on to say

" The recommendation follows from the above, namely that the revenue management of irrigation under first class works should be developed on the lines of the other works so that they may be more useful and remunerative than they are at present "

6 I will deal with the ' *phad* ' system later (in Part II). All that it is necessary to say at this stage is that it was not proposed to divide the blocks into ' *phads* , ' because it was realized that such a drastic distribution of holdings would be impossible, but it was anticipated that exchanges of land could be arranged between those with land outside the selected blocks who wanted to grow cane in the blocks and those with lands inside the blocks who did not want to grow cane.

Working on this assumption it was considered that composite blocks of 60 to 300 acres could be formed and that water could be distributed to those large areas by measurement, the cultivators being allowed to do the internal distribution themselves.

It was also thought that crop measurements would be unnecessary, and it was anticipated that the area irrigated annually would remain constant (see paragraph 8) of the note, which reads

" Under the Block System it is proposed to sanction applications for 6 years. Demand statement may be prepared once in the same period and the annual or crop measurements dispensed with "

7 In actual practice, however, it was found that the men with land inside block would not exchange their land with men outside, partly because the cultivators had a natural ingrained attachment to their ancestral acres, and partly because it was realized that land in a block was potentially far more valuable than land outside a block. As a consequence, the cane areas were not concentrated into large blocks and practically the only alteration that took place was that cane areas were standardised by demarcation, but they remained scattered widely over large areas wherever there was a demand for them.

8 The advantages which occurred from the introduction of Blocks were, however, very great, because when the areas were standardised it was possible for the canal staff to distribute water much more economically, and the cultivators, having an assurance of water for a period of years, found it worth while to carry out improvements to their land

9 Owing, however, to the cane areas being scattered in numerous small plots surrounded by large areas of seasonal crops, it was not possible to deliver water to the blocks and leave the distribution to the cultivators (even had it been possible to meter the supplies, which was not a practicable possibility then, nor even now, 20 years after the note was written) Furthermore cane being a 13 months crop, water had to be given for overlapping cane—that is to say, water had to be given to newly planted cane before the old cane was removed (*Vide* Government Resolution No W I—1468, dated 22nd May 1908)

It was also found that at times plantation was delayed till April and even May—owing to a shortage of labour or shortage of funds, and when this occurred the crop could not be cut until after the monsoon of the following year, *i e*, after 18 months

10 For the above and other reasons it was found impossible to give a constant supply—even where the cane areas were concentrated—and as no suitable measuring device was available, distribution of water by measurement was found to be impracticable

11 Crop measurement work was slightly reduced, but owing to most of the cultivators having 2 or more plots of varying size—in any part of which they might grow cane—the cane areas had to be measured as hitherto

12 The belief that the extension of water logging and salt efflorescence would be checked by the cane being concentrated in suitable land was found to be incorrect, because as already pointed out, little or no selection of land was carried out and very little change occurred in the position of the cane fields The only improvement in this respect was that owing to the water being used more economically, less water found its way into the subsoil

13 It may be said, therefore, that though the introduction of the Block System was a very great advance—in that it standardised the areas which cane could be grown and increased efficiency—yet it fell far short of what had been originally hoped for it

14 The failure of the Block System to arrest the spread of salt efflorescence was brought to notice, before the Block Revision of the Nira Left Bank Canal, was due in 1912, by Bulletin No 39 of 1910 of the Agricultural Department entitled “The salt lands of the Nira Valley ”

The 4th conclusion of Dr Mann in that Bulletin read —

“Apart from the areas actually become barren (some 5,000 acres) almost the whole of the land now under canal irrigation is more or less salt, but not yet sufficiently so to injure crops ”

This statement, coupled with complaints from owners of damaged lands, brought the question prominently to notice

Dr Mann had rightly stated in his first conclusion that

“ The development of salt land on the Nira Canal area is due solely to the existence of the canal ”

“ The same phenomenon will always be liable to occur where a canal is placed in a District with deep black soil where provision is not made to prevent the undue rise of the ground water level, in other words for drainage ”

Sir George Curtis, the Commissioner, Central Division at that time, went much further and imputed the damage to the Block System

15 A conference was, therefore, held* at the Commissioner's Office on December 23rd, 1910, regarding the future working of the block system of irrigation at which 3 members of the Revenue, Irrigation and Agricultural Departments and the Commissioner were present

*Vide Government Resolution No WI—1012 dated 19th May 1911

Dr Mann proposed that

“ a survey should be made by a committee consisting of an Assistant Collector, an Agricultural expert and an Executive Engineer, of land suitable for perennial irrigation, taking the area under the present block system as the basis of enquiry but giving authority to the Committee to carry out the survey to go outside the block area where necessary The land would be divided into classes ”

1 Land eminently suited to perennial irrigation by reason of its situation, the texture and depth of the soil and the facilities for irrigation

2 Land believed to be suitable for perennial irrigation provided that reasonable drainage is undertaken

3 Land obviously unsuitable for perennial irrigation

It was also proposed to spend 5½ lakhs of rupees on land drainage and Rs. 2 lakhs on clearing nalas

“ The conference was unanimous that the distribution of water within blocks should continue to be controlled by Government officials and that it is impracticable to leave it to the people ”

The proposals were approved by Government

16 Sir George Curtis' contention that salt efflorescence and waterlogging was mainly due to the blocks was not accepted and was in fact shown to be incorrect, but his contention that

“ the main defects in the system are that it does not give a special incentive to economy in the use of water, does not encourage well irrigation, and does not sufficiently help to prevent waterlogging or salt efflorescence, ” was admitted, and in an endeavour to meet this criticism the then Chief Engineer, Mr A. Hill proposed (*vide* paragraphs

4 and 7 of Government Resolution No WI—1012, dated 19th May 1911) —

“ (1) to issue definite volumes of water to each block, the volumes to be fixed by the Director of Agriculture in consultation with the Superintending Engineer ,

(2) to dispense with the measurement of crops , and

(3) to remove all restrictions on extensions of perennial irrigation within blocks by the use of well water or otherwise ”

The holders of land in blocks were offered the choice of paying Rs 16 per acre, if they elected to take water according to the original block rules or Rs 20 per acre if they elected to come under the Chief Engineer for Irrigation's method set forth in (1) to (3) above

Mr Hill's method was a return to Sir M Visvesvaraya's original idea, or rather ideal, but though the offer appeared to be tempting not a single cultivator elected to come under the new method, because they realised—as everyone with first hand experience of Deccan Irrigation knows—that it is impossible “ to issue definite volumes of water varied to suit the seasons, to each block (which implies to each holding in each block) ”

The Blocks, therefore, continued for a second period of six years with but small variation and no alteration in the rules, but the methods of distribution steadily improved, due to the introduction of the telegraph line, construction of masonry outlets, the measurement and standardisation of discharges at the heads of distributaries, the fixing of rotations by share lists, and the introduction of the “ Band Rules ”

17 The “ Band Rules ” were evolved by Mr T S Pipe, in 1913 when he was Inspecting Assistant Engineer on the Nira Canal, the main principle being that waste would be greatly reduced by

(1) the construction of a large outer “ band ” to prevent excess water wasting on to adjoining lands and damaging them ,

(2) the division of the area into small plots with a field channel leading to each, so that the water would be under control

Subsidiary advantages which resulted from the “ band ” rules were

(i) facilities for inspection, which enabled the cultivators to get through their cane, and Inspecting officers to check irregularities ,

(ii) terracing along the “ band ” lines ,

(iii) approximate standardisation of areas, so that the cultivators and the canal staff knew the approximate area being irrigated each day

The improvement directly traceable to the “ band ” rules were very great indeed, and the comparatively dry state of the canal tract after their introduction combined with the improved “ duty ” for water used, afford definite proof of this fact

18 Although no immediate change was made in the Block Rules, several points bearing on the question were investigated —

The enquiry into reclamation of salt lands and drainage carried by the Agricultural Department, recorded in Bulletin 39 of 1910 of the Department of Agriculture, Bombay ("The salt lands of the Nira Valley") has already been mentioned in paragraph 14, and in paragraph 3* of the Government Resolution No W I—1012 of 19th May 1911 are set forth the main results obtained on Distributary No 29 of the Nira Left Bank Canal in "a) experiment to ascertain the results obtainable where a fixed discharge of water is given for a limited time and the cultivators are allowed to extend the area "

That experiment indicated that where there is careful supervision, a very much larger area can be irrigated per cusec than is usual in the canal tracts

The 12 hour "duty" (i.e., the area of sugarcane irrigated per cusec per 12 hours) varied from 3.22 in the beginning of January to 3.60 in mid-April, as against duties of 2.5 to 3.0 under normal conditions

A third investigation was carried out to ascertain the effect of pumping water from wells on the water level and salinity. This investigation started in 1910*. A copy of a report I wrote on the question when Acting Executive Engineer for Irrigation, Poona District (No 8402 of 29th August 1914) is attached as Appendix II. The first wells selected were in Hol village near Vadgaon-Nimbalkar, in the Nira Left Bank Canal area

Prior to this experiment—Dr Mann was "very strongly of opinion that water which is not fit for irrigation if continually pumped out would tend to improve, and much well water now too salt to use might, and I believe, would tend to become fit for irrigation if regularly used" but on 3rd February he wrote in this connection —

"It may at once be said that the results were disappointing, in no case was there any appreciable fall in the depth of the sub-soil water. In most cases, the water was fresh from the beginning and did not change in character during the operation of the pump"

A further experiment—pumping water from a well in Survey No 48 of Baramati—was carried out over a period of two years (1911-13) in accordance with the orders of Government*. In this case a deep trench 1700 feet long, 15 feet deep at the well, was excavated across the valley to increase the effectiveness of pumping. There was, however, no improvement whatever in the salt content of the water, and the water rose to its normal level within three days of stoppage of pumping (see appendix II)

Another investigation carried out by me in the village of Hol "to ascertain how far wells could be utilized for irrigating cane in blocks" showed that out of a total of 21 wells only 5 could be used for irrigating

blocks and only one was used—due to a large variety of reasons. It can be stated definitely that the oft-repeated cry that we should allow wells to be used in blocks is based on unsound premises and would inevitably lead to dishonesty.

This series of experiments showed that well irrigation can have but little effect on waterlogging and none on the salinity of the water and there are only two practical methods suitable for keeping the sub-soil water down to a safe level, *i.e.*, by drainage or by restricting irrigation water.

19 In Government Resolution No W I —1012 of 19th May 1911 it was laid down that

“ 10 The drainage operations which should be undertaken should include

(1) the clearing and, when necessary, deepening of the main drainage channels, chiefly *nalas*, the cost of which is estimated roughly at two lakhs, the interest on the outlay to be recovered by revenue to be derived from irrigation under pick-up-weirs,

(2) Land Drainage by methods analogous to those recommended in ‘ salt lands of the Nira Valley. The treatment to be carried out at the expense of Government at least in the first instance, with the consent of the holder ’ In obtaining the holder’s consent an agreement should, if practicable, be obtained from him that if the experiment is successful, he will repay to Government the cost of the operation and will maintain such drainage as the Irrigation and Agricultural Officers may prescribe,

(3) the provision of feeder drains to the main draining channels at the cost of Government subject to agreements—as under

(2) above,

(4) the testing by experiment of the drainage measures required to prevent waterlogging and saline efflorescence in areas not yet rendered barren ”

Acting on these instructions two schemes were prepared a small one at Baramati and a big one in the Hol, Murum, Karanja area to cost nearly a lakh of rupees. The first of these, which consisted of rubble drains, placed four feet below the ground, at Baramati—was carried out in February 1913, but on taking over charge of the Poona Irrigation District in March 1913 I pointed out that these shallow rubble drains could not be successful—even if they remained open—and that they would cease to function satisfactorily within a few years. This actually occurred in the case of the Baramati Drains. At the same time it was pointed out that all the work hitherto done was obviously on wrong lines and that unless we started from the beginning and studied the geological and the soil physical conditions, we would continue to fail. I endeavoured to spare as much time as possible to investigating this question, but the Poona Irrigation District, which at that time included the Poona Water Supply, the Widening Sub-division and the Improvement Sub-division, was a very heavy charge and little progress was made.

20 Mr Keatings, I C S , returned from leave in 1914 and Mr Smart who had been acting as Director of Agriculture, was put on Special Duty " to select soils for cane in the Deccan Canal Tracts " The selection was done by the late Mr G N Sahasrabudhe, B Ag , and Mr R G Islur, L C E , was deputed to explain Irrigation Technique

Owing to Mr Smart's report of 1915 being highly controversial it was never published , but in any case a large proportion of the areas selected by him would only have become suitable assuming that drainage were carried out successfully , and no drainage scheme had ever been carried out successfully in the Deccan , whereas several attempts had failed—such as those reported in Dr Mann's Bulletin on " salt lands of the Nira Valley , " which had ceased to function within a few years of construction It was obvious therefore that the next step to take was to investigate how to drain successfully

21 To carry out this and other irrigation investigations the Special Irrigation District was opened in June 1916

It would take too long to describe in detail how success was attained Suffice it to say that the possibility of drainage was found to depend on the deep sub-soil conditions, and that new tools and new methods of measuring the porosity of substrata " in situ " had to be evolved before any progress could be made It was then found that the deep natural sub-soil drainages were often entirely different to the existing surface drainages, old valleys being situated under existing ridges, the old rivers and nalas having changed their courses, and the original valley having become filled up with layer upon layer of soil washed down from the adjoining ridges A notable case of this is the Karha river at Baramati which at one time flowed through the Baramati experimental salt area, but later cut its way through murum and rock—a quarter of a mile to the East of its original course

22 The sub-soil strata including the areas commanded by the canals were therefore mapped and at the same time the porosity of the substrata was measured by recuperation tests

While doing this work, Mr V K Gokhale, Deputy Soil Physicist found that the surface soils (when considered in conjunction with the natural vegetation) indicated sub-soil conditions down to a depth of about ten feet—in other words the surface conditions indicated the " soil series " underneath. This has greatly simplified and cheapened the survey work, which is now done for less than one anna per acre of about 1/3rd the cost of an ordinary contour survey

23 The perennial sections of all the large Deccan Cannals have now been " soil surveyed " in this way and it is possible to predict where damage is likely to occur and where it can be prevented or reduced by drainage

24 The selecting of areas suitable for cane is now based on these surveys, but until drainage is carried out, soil selection will only be partially successful, because not more than one quarter

of the area suitable for cane can be allowed to be in cane blocks without causing widespread damage

25 Although this report deals primarily with sugar-cane blocks it would not be out of place to point out that in 1911 blocks were introduced for ordinary crops. These were called eight months blocks, because cultivators had the right to grow seasonal or eight months crops (between June and February 14th), but the only fixed charge was for the rabi season—for which they had to pay the rabi rate whether crops were grown in the rabi season or not

These blocks were popular at first, but during the run of good years 1915-17, when the canal supply exceeded the demand, they fell off in popularity, partly because some of the rules were not properly understood by the cultivators and partly because owing to the excess supply, water could be got by them if they wanted it—even without eight months blocks—while with blocks they had to pay—even if they did not want the water. Now that the rules are widely known and understood and the run of good years has been followed by a string of lean years, eight months blocks are again popular, and are likely to remain so, but this will only be so where a canal has developed so far that the supply normally falls short of the demand

26 Another type of block, which was tried at Sir George Curtis' suggestion, was known as a ten months' block. The idea at the back of Sir George Curtis' mind was entirely sound, namely that if the canals were allowed to dry out for two months every year the soils would be given a rest and some chance to recover their natural physical state, but the objections to the scheme have only to be stated to show that it could never be successful. These are

(1) Two head of cattle are required per acre of sugar-cane (these could not always be employed usefully for the rest of the year)

(2) One well is required for each two acres of cane (on the average) with full cost of upkeep

(3) The supply is insufficient where cane irrigation is concentrated, (many wells were found to have a very poor supply)

(4) The sub-soil water is unsuitable in large areas

(5) It is difficult to irrigate with the small supply obtained from wells in fields laid out for the large discharges applied where canal water is normally used for irrigation.

The main objection, however, was a financial one—namely that the cost of irrigating an acre for two months from a well was of the order of Rs 40, whereas the saving of water would only amount to the equivalent of

Rs 45— $\frac{1}{2}$ or Rs 7 $\frac{1}{2}$.

27 In 1918, the Revision of blocks on the Nira Left Bank Canal fell due, but as the soil survey work was not sufficiently advanced the old blocks were continued from year to year on annual leases

In all cases of new blocks, however, the areas were inspected by Messrs V K Gokhale, B Ag, and R G Islur, L C E, of the Special Irrigation District, and the selection was done by the Executive Engineer, based on their reports and plans, combined with other information available. At this revision the selection work was done by the Special Irrigation District while the demarcation and fixing of the blocks was done by the Poona Irrigation District. This led to duplication of work, misunderstandings and mistakes, and as a result it was decided that the whole of the block work should in future be done by the Special Irrigation Division*, *vide* Government Resolution No AI—18106, dated 28th November 1921.

28 Before the next revision of blocks on the Nira Left Bank Canal fell due in 1924, three drainage schemes had been completed, one at Baramati and two between Malegaon and Pandhara. Investigations had also been carried out—both in the Nira and Pravara Canal areas—to ascertain the cost of cultivation, outturn and profits from cane grown in various types of soil.

This last investigation showed that cane can be grown successfully in almost any soil except “*chopan*” but that where the soil is very coarse the cultivators require water at very short intervals and put on far more water than is given in deeper soils, under a mistaken idea that more water is required. As it is not possible to vary the period between waterings appreciably, and as in any case cane in shallow soils always leads to a low “*duty*”—and hence loss of revenue—(the excess water finding its way into the sub soil and causing damage to lower lying lands belonging to other cultivators), sugar-cane is not now allowed in shallow soils.

29 Having excluded all “*chopan*” areas and coarse soil areas from the selection, the next point to consider is whether drainage is practicable. This depends firstly on the distance to the nearest natural outlet, either a river or largenala, and secondly on the sub stratum. If the sub-stratum is porous, drainage is possible, otherwise it is not. Large areas must be excluded on this ground at once, thus the whole of the area lying to the east of the Nagar-Manmad Road between Branch No 1 of the Godavari Canal near Kopergaon and Nimbgaon, an area some 21,000 acres in extent, is all unsuitable, there being no outlet and the sub-soil being “*chopan*”. Having excluded areas that cannot be drained or that have no suitable outlet, the remaining areas have to be investigated in greater detail.

Drainage schemes are being prepared for all such areas, and cane is allowed in them on the assumption that drainage will be carried out in the near future. The schemes usually cost from Rs 80 to Rs 120 per acre of damaged land and as about half to one-third of the area in a catchment requiring drainage usually becomes damaged within 20 years,

(Note.—It has, however, been found that where the underlying stratum is soft murum it can be turned into excellent cane land by deep ploughing, manuring and cultivation of suitable crops. This has been done very successfully at the Effluent Farm at Hadapsar in charge of the Special Irrigation Division.)

the cost per acre of land suitable for cane works out to about Rs 40 per acre. Bearing in mind that prior to the opening of the canals such lands were worth about Rs 30 to Rs 80 while they now fetch Rs 300 to 1,000 per acre the cost of protecting the canal areas is a very small item.

30. The canal areas have now been divided up into three classes of land —

A—Land which does not require much drainage or can be easily drained,

B—Land which will be moderately costly to drain, and

C—Land which cannot be drained at a reasonable cost

If enough applications are received for blocks in 'A' land no block will be sanctioned in 'B' land, but in general a considerable area of blocks have to be sanctioned at first in 'B' land

It is expected that within 12 years of the introduction of blocks on the new Canals most, if not all of the blocks will be in 'A' class land

31 It has already been stated in paragraph 17 that the 'band' rules were introduced on the Nira Left Bank Canal in 1913, but they were not standardized nor approved as canal rules till some time later

The drafting of the New Canal Rules was the first work done by the Special Irrigation District, in 1916, but they were not finally sanctioned till 1922. In the same way great delay occurred in introducing the unitisation of areas. Under the 'band' rules areas were divided into $\frac{1}{4}$ acre plots—approximately—but as it was generally held that areas could not be measured accurately, small excesses of 5 per cent were allowed. It was also found that owing to measurements being made from the toes of 'bands' any alteration of a block threw out the unitisation. This was overcome by having all measurements made from mid-band to mid-band, but some of canal officers still maintained that 5 per cent errors were inevitable, despite the fact that many cultivators were found measuring the 5 per cent excesses after correct demarcation.

It was not till the Special Irrigation Division carried out the 1924 Block Revision of the Nira Left Bank Canal that $\frac{1}{4}$ acre units were standardized and carefully demarcated for the first time. In a number of cases it was found that though the total holding of a cultivator far exceeded the minimum unit area of $1\frac{1}{2}$ acres, his land was cut up into a large number of minute plots. The most frequent case was where a survey number was divided into several plots, each of three or four brothers owning some 3 or 4 plots varying in size from a few gunthas to two acres. In several such cases these men rearranged their holdings for the period of the block so as to get their whole area concentrated into one plot. In other words the unit rule led to consolidation of fragmented holdings, and judged by the experience gained in this revision there is little doubt that if Government were to lay down that the smallest plot in which cane would be allowed would be 6 acres, the cane areas would be redistributed accordingly, and within 12 years the area of cane grown would be greater

than with the present $1\frac{1}{2}$ acre minimum unit, because the 'duty' would increase as anything less than 6 acres is an uneconomic holding.

32 In the 1924 Revision of the Nira Blocks, it was found that in several cases Blocks had been gradually extended to land to which water could only be given by heading up to such an extent that there was practically no flow. This caused increased percolation and led to many objectionable practices. Though the area not properly commanded was small (133 acres) the interference to distribution caused was enormous. Thus up to 1913 stone walls were constructed across the canal below most distributaries to head up water.

33 Shallow lands, and damaged lands were also excluded as far as was deemed fair, but in many cases where land had been in block for a number of years the rule was not rigidly enforced especially in cases where the cultivators could improve their lands so as to make them suitable. In doing this work it was found that in many cases land which was entirely unfit for any crop had hitherto been allowed in Block, and many cultivators—especially tenant farmers—had deliberately rented large areas of damaged land at a very low rental so as to increase their area of cane. Cases were in fact met with in which only about half the block area was ever ploughed, so that two-thirds of the good land was under cane all the time and the whole area for a few months in some years.

The block area applied for was approximately 27,000 acres for a permissible block area of 18,000 acres.

34. In 1926 perennial blocks were introduced on the Godavari Canals. They were strongly opposed by the tenant farmers, mainly because blocks are sanctioned in definite areas, whereas their previous cane 'averages' were sanctioned in the name of the farmers, the exact position not being specified. Leases therefore enabled the tenant farmers to move about from place to place—to get better terms or to take up virgin land after the soil in their original areas had been exhausted or damaged, and as Blocks put a check on this, they were not welcomed by the tenant farmers.

All the objections raised by the cultivators were countered in detail and after a considerable delay of 6 months, applications were submitted by the owners (except in one or two villages) and by a large proportion of the tenant cultivators.

35 The total area of Blocks to be sanctioned was 21,000 acres and the area applied for was 29,274 acres but of this only 16,423 acres were sanctioned of which

10,203 acres were in 'A' land
6,220 " " " 'B' "

It will be seen that 12,851 acres or 44 per cent. of the area applied for was refused. Of this

1,054 acres or 3.6 per cent were in coarse soil,
2,023 acres or 6.9 per cent were waterlogged or salt affected

782 acres or 27 per cent were in 'C' Class land;

1,270 acres or 43 per cent were in new areas applied for in 'B' land by lessees

2,367 acres or 8 per cent were late applications and only 514 acres or 18 per cent were refused on account of the unit rule

36 Only 16,423 acres of the full Block area of 21,000 acres were sanctioned, but as a set off there was a large area of standing cane in unsuitable areas which had to be brought to maturity, and as a matter of fact there was great stringency of water towards the end of the season and the area of blocks sanctioned was the maximum limit. This point is one which must be kept clearly in mind whenever Blocks are newly introduced.

Additional Blocks will be sanctioned before 1927 and applications for these have already been received

37 The average Block area was 11.9 acres as against 6.5 acres in the case of the Nira Left Bank Canal redistribution of Blocks (1924), while the average size of a plot was 6.8 acres as compared to 4.5 acres in the case of the Nira

38 Blocks will be introduced on the Pravara Canals in 1928

APPENDIX I

Extract paragraph 3 of Government Resolution, Public Works Department, No. W 1—1012, dated 19th May 1911

3 On distributary No. 29, the method sanctioned in 1907 prescribed —

- (1) the distribution of water by time, to whole blocks,
- (2) the preparation of share lists dividing the supply to the blocks into turns suitable for the areas of crops sanctioned in each block;
- (3) the water-course for the block to be run full for the time specified;
- (4) the encouragement of the use of wells, the whole of the area irrigated by canal plus well water to be charged canal water rate, with no reduction of rate on the sanctioned area if crop fails through attempt to cultivate area larger than that sanctioned,

(5) permission to cultivate more than one-third of holding in block with perennial irrigation, on payment of additional water rate on the additional perennial equal to the difference between the block rate and the rate for perennial outside block, with no reduction of rate if the crop fails through attempt to cultivate as perennial more than the sanctioned one-third.

In sanctioning the experiment, Government expressed fears regarding the effect of allowing the area of sugarcane within blocks to be extended by means of real or merely ostensible well irrigation ; and they directed that a report should be submitted on the conduct and result of the experiment. The report called for does not appear to have been received, and the letter from the Executive Engineer dated 21st March 1911 contains only a passing reference to the system in force on distributary No 29. Government are thus without official information as to the extent to which wells have been used to assist or extend the perennial irrigation within blocks and as to the effect which such use has had on the working of the block system, but they understand that practically no such use has been made, and that consequently the experiment sanctioned on distributary No 29 throws no light on the question of what the effect of such use would be. Outside the blocks, where canal water is not supplied after the middle of February it appears from the Executive Engineer's letter No 2825, dated 20th April 1911 that to a small extent sugarcane is grown successfully, the supply during the hot weather being drawn entirely from wells. Some information regarding the working of the method sanctioned for distributary No 29 is to be gathered from the statements appended to Government Resolution No W I—1007, dated 8th April 1909. It therefore appears as the results of five experiments conducted between 1st January 1908 that the duty per cusec per day of 12 hours for sugarcane varied from 3 22 in the beginning of January to 3 60 in mid April, that the quantity of water required for watering an acre of sugarcane in lands of different qualities in different seasons of the year varied from 7,400 (chimbawni watering of new crop, early in March) to 14,500 (new crop, late in May), and that the average quantity of water required to irrigate an acre of sugarcane under each outlet varied from 7,300 to 18,894. The conclusions to be drawn appear to be that *on the average* in the dry season (January to May) 1 cusec will irrigate 64 acres of cane in, 20 days of 12 hours and that the actual quantity required by any given acre varies very widely according to soil, season and state of crop.

APPENDIX II

No 8402 of 1914

OFFICE OF THE
EXECUTIVE ENGINEER FOR IRRIGATION,
POONA DISTRICT

Poona, 29th August 1914

From

C C INGLIS, Esq.,
Acting Executive Engineer for Irrigation,
Poona District,

To

THE SUPERINTENDING ENGINEER,
Deccan Irrigation Division.

Subject—Experiment carried out in Survey No 48 of Baramati to determine whether continuous pumping of saline subsoil water would improve its quality

Sir,

In accordance with the orders contained in paragraphs 2 and 3 of Government Resolution No W I—1030, dated 23rd May 1911 a pump was fixed on the well in Survey No 48 of Baramati in the middle of an area, which though once fertile had become excessively salt affected Subsoil water which contained some 400 parts per 100,000 was met with some two feet below ground level

2 Before proceeding it is considered advisable to point out that although the first page of the abovementioned Government Resolution suggests that the water at Hol was improved by pumping yet Dr Mann wrote as under in his letter No 1143 to the Director of Agriculture (printed as an accompaniment to the same Resolution) —

“ It may at once be said that the results were disappointing In no case was there any appreciable fall in the depth of the subsoil water as a result of the pumping operations In most cases, the water was fresh from the beginning, and did not change in character during the operations of the pump ”

3 The pumping commenced on 21st November 1911, and was continued until 31st December 1913

4 As the well was pumped dry in 1½ hours, an estimate for Printed as an excavating feeder drains across the valley—see accompaniment plan attached—was submitted (under this office No 2500 dated 4th April 1912) to the Superintending Engineer, Central Division which was sanctioned. Orders to commence the work were issued on the 20th idem, the designed bed-width being 2', with side slopes of ½ to 1 length 1,650 feet with 15 feet depth of cutting at the well and 8' depth at the extremities

5 A great deal of trouble was experienced in carrying out this work, partly because the excavation was in sticky chopan , but chiefly because the salt in the soil affected the feet of the coolies, who could only be persuaded to continue to work at enhanced rates The cost of the work came to Rs 1-10 per 100 cubic feet and the total cost of the experiment amounted to Rs 4,670

	Rs
1 Fixing engine and pump and pumping 1911-12	1,230
2 Excavation of feeder drain	1,612
3 Pumping 1912-13	332
4 Pumping 1913	1,496
	<hr/>
Total	4,670

6 The composition of the samples of water sent to the Agricultural Chemist to the Government of Bombay are as shown in the comparative statement attached (printed as an accompaniment)

It will be seen from this that with the exception of the last sample, which showed a considerable increase over all others, the average salt content per 100,000 was about 370, and was very constant during the whole period of the test There was certainly no appreciable improvement and in this case, at any rate there could be no hope of any

7 Dr Mann who in his No 2737 of 24th November 1910 wrote " Much of the water in the wells is not fit for irrigation But I am very strongly of opinion that such water, if continually pumped out, would tend to improve and much well water now too salt to use might and I believe would tend to become fit for irrigation ", is now convinced that such improvement cannot be hoped for, and this experiment goes a long way to prove it This is my personal opinion as I am unable to see how a large subsoil water table containing salts in solution can be improved appreciably by pumping Were the salt affected area very limited in extent this might be possible , but as the water which flowed in to replace the water pumped out would naturally come from similar land, the mere translocation of such water would not improve it, and it seems reasonable to suppose that in such localities the supply of saline subsoil water is practically unlimited

I have, etc ,

(Signed) C C INGLIS,

Ag Executive Engineer for Irrigation,
Poona Division

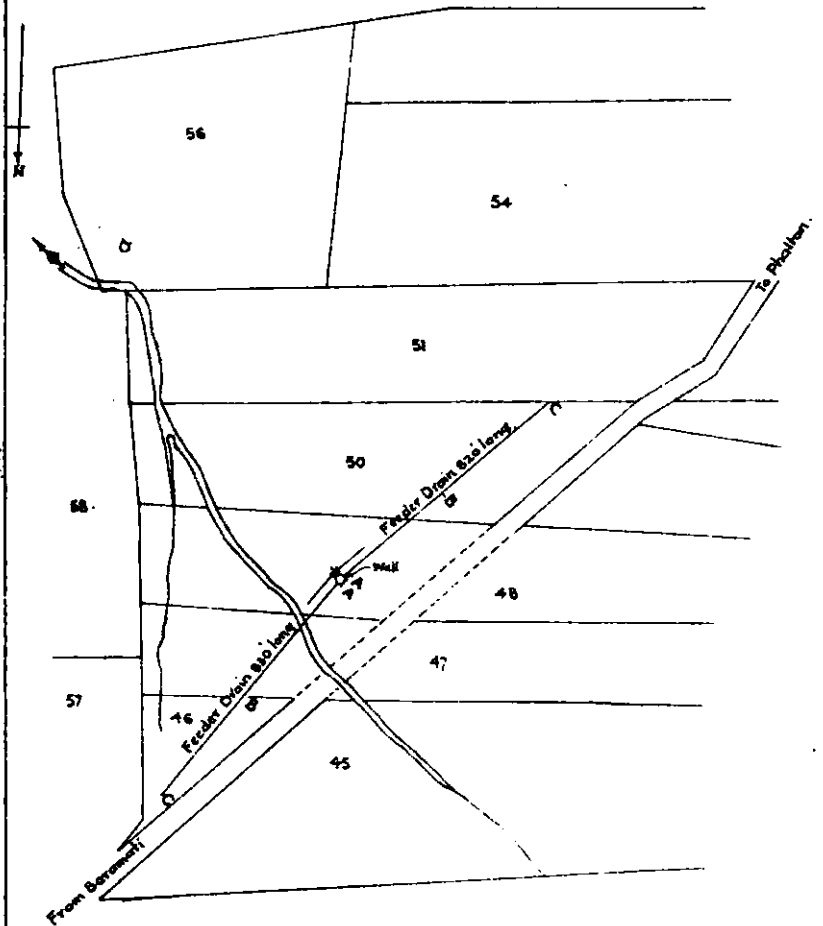
Comparative statement of composition of well water in survey No 40 of Baramati

Items	5-6-11	20-6-11	2-8 11	3 12 11	1 1 12	1 2 12	5-3 12	3-4-12	18-11 12	12-12 12	10-6-13	30-10-13	13-1 14
Total suitable salts containing	370 00	414 00	357 00	372 00	342 00	371 00	380 00	382 00	420 00	388 00	332 00	342 00	529 00
Sodium Carbonate	10 40	5 55	7 20		2 96	7 40		11 10		1 11	3 70	8 88	4 44
Calcium "	15 20	17 60	22 34	12 00	16 00	12 03		16 00	16 00	14 00	18 00	8 00	28 00
Sodium Bicarbonate				17 07	1 50	9 15			14 56	23 77	9 46	19 14	
Sodium Sulphate	230 60	244 91	204 34	245 15	263 99	247 25		216 18	233 75	258 17	215 55	216 77	237 66
Magnesium Carbonate	33 20	27 35	18 12	22 96	27 48	22 96		16 92	22 51	16 63	24 24	19 70	17 97
Sodium Chloride	76 00	80 60	64 34	89 94	82 76	81 63		98 01	82 01	69 30	50 09	57 02	102 17
Magnesium Sulphate		19 27	32 26					18 13					75 36

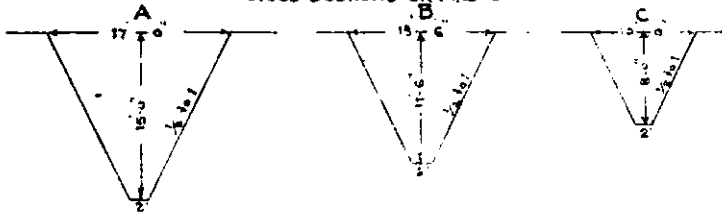
(Signed) C C INGLIS,

Ag Executive Engineer for Irrigation,
Poona Division

Plan Showing the positions of the Feeder Drains
in connection with the Experimental Pumping Station
in Survey N^o 48 of Baramati
Scale 330 to 1 Inch.



Cross Sections on A, B, C



Accept to NT 2500 of 4-4-1912.

(34) P. J. Fitzgibbon
M.I.E. & S. & M.
Superintending Engineer,
Central Division.

(34) N. B. Bostley,
Ac Executive Engineer for Irrigation
Pune District.

M. Singh 208/10