ESTIMATION OF GROUND WATER DRAFT

By

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1.0 INTRODUCTION:

India is a vast agricultural country, the estimated ultimate irrigation potential being 133 m.ha. Out of this 55 m.ha. accounts for minor irrigation projects. In spite of increase in the irrigation potential, the gap between potential created and its utilization has been widening. In respect of minor irrigation projects it was presumed earlier that there was no gap between potential and utilization but it is now recognized that there is a gap (Ref.7). To know the actual widening of this gap, irrigation potential utilization need to be determined. Also to bridge this gap, proper planning and development of irrigation is imperative. Water balance of the area will determine the gap between potential created and that utilized and will provide useful information for planning and development of irrigation. Water balance study requires the assessment of various recharge and discharge components as accurately as possible. One of the important discharge component is the draft from the groundwater reservoir.

The main sources of draft from groundwater are minor irrigation works. In spite of its paramount importance in the preparation of water balance, proper care is not taken to obtain

information for each of the minor irrigation works in respect of c rop areas irrigated,draft system,unit draft and hours for which wells are operated,etc.,are not collected in a systematic and rational manner. Thus, the statistics relating to minor irrigation works suffers from inadequacy of details. Wells used for irrigation are of different types,some are operated by electricity or diesel engines,for others the lift is done by different devices. like a persian wheel or Rahat. Reliable statistics are required to be collected in respect of number of wells for different types. Their discharge should be ascertained and the period for which they are operated should be determined. Figures relating to the area served by each of the minor irrigation works and crop grown should be collected. For collecting these adequate statistics, it is necessary that the sample surveys should be conducted.

2.0 SAMPLING AND DATA GATHERING PROCEDURES:

In most the cases,the area for which the information is to be collected is large and the wells are more in number. Hence, a representative sample of wells need to be selected and survey is need to be carried out to obtain the data. The information is then analysed and deduced for the entire system. The wells selected for this purpose are known as sample wells. Generalization made in this wayis acceptable only if the sample has been selected in such a manner as it represents the population as closely as possible with an expected margin of errors acceptable for the objectives of the survey. Depending upon the nonsimilarity of the elementsto be surveyed,more than one representative sample should be chosen.

The data that enumerators will be required to gather can be obtained either by interviewing the farmers/owners or by observing and recording the information at site. In practice, it is common to combine interviews and field observations for gathering informations for obtaining more and reliable data. At times, repeated interviews need to be conducted in order to get more information. It will also help in confirming the information obtained earlier. These questions can be posed to the farmers in two different ways,as open-ended questions, or multiple type questions. The points considered important in data gathering are :

i) In a long term survey, open-ended questions could be used in the first period, and afterwards the information they provide could be used to compile multiple choice questions and their list of possible answers.

ii) The farmer should only be asked questions that he is willing and able to answer. The questions should be worded in such a way that they are easy for him to understand and simple to answer. Also, it is required that the questions should not upset the farmer or influence his answers. The questions must be simple and natural.

iii) The attitude of the authorities(conducting survey) towards survey will influence the attitude ofthe formers to answer. Therefore, proper care must be taken in this respect. If the cultivators understand the reasons for conducting the survey and are in favour of it,then only they can provide valuable information.

iv) Whatever procedure is followed, it is important to keep everything in open. Acting in this way will help to prevent the spread of rumours, such as the data is being collected for taxation, etc.

3.0 VARIABLES INVOLVED AND DATA TO BE COLLECTED :

The sample survey for minor irrigation works involves a large number of variables that need proper attention. For convenience, information to be collected is grouped as given below :

1. General information about the minor irrigation wells.
2. Information based on type of purpose for which extracted water is being utilized.
3. Information relating to the type of devices used for extracting ground water.

The variables involved alongwith the format for collection of data, for each of the above group, is given below :

3.1 SAMPLE QUESTIONNAIRE FOR GENERAL INFORMATION :

Well No. :

Date :

Name of enumerator :

1.Owner : Block : District :

2.Village: Block: District:

3.Longitude _____ Latitude _____

4.Date of construction _____

5.R.L.of Well(Measuring point)_____

6.Ground-level at well point _____

7.Distance of nearest well

Sl.No.	Location of well under reference	Location of neighbouring well	Radial distance of these neighbouring wells from well under reference

8. Type of well :

Whether open well/dug-cum-bore well/bore well

9. Size/Depth of well :

a) Diameter of well _____

b) Depth of well _____

c) Size and depth of bore and details of pipe and strainer _____

10. Aquifer Characteristics

a) Bore-log charts or details of soil strata

Type of soil Strata	Depth from G.L.	Sieve Analysis	USDA classification	Remarks

b) Whether recuperation or draw down tests for open well and pumping tests for tube-wells have been carried out.

c) If yes, give particulars about the details of tests and test procedures and values of aquifer parameters.

- type of test and test procedure _____
- details of analysis _____
- procedure used for estimating the parameters _____

- values of parameters

S/Sy = _____

T = _____

11. Construction : Put a tick mark against correct answer .

a) Masonry ( ) b) Non-Masonry ( )

12. Put a tick mark against correct answer

a) In regular use ( ) b) Abandoned ( )

If abondoned, reasons therefore

_____

_____

_____

_____

13. Capacity of well/tubewell _____

14. Quality of water _____

15. Whether the charges in groundwater levels were abnormal at any time Yes/No

if yes, year of such change and extent

_____

3.2 SAMPLE QUESTIONNAIRE FOR COLLECTING INFORMATION REGARDING THE PURPOSE FOR WHICH THE WATER EXTRACTION IS DONE

Well No. :

Date :

Name of enumerator :

1. What are the purposes served by the extracted water ?

a) Irrigation ( )

b) Municipal and domestic ( )

c) Industrial ( )

d) Irrigation and domestic/municipal ( )

e) Domestic/municipal/and industrial ( )

2. Approximate percentage distribution of water (e.g.80 percent for irrigation purposes and 20 percent for domestic/municipal.)

Irrigation ( ) Domestic/Municipal( ) Industrial( )

A) Irrigation Purpose

1.(a) Command area is _____ha.

(b) Please give the other information in the following table.

Crops grown	Area under each crop	Growing period	No.of irriga-tions	Depth of each irriga-tion	Source of water and quantity of such apply

2. Details of field channel : Relevant information should be given in the following table.

Field Channel No.	Length	Size	Depth of flow	Type of soil*	Whether lined or unlined	Area irrigation crop-wise Crop I	Crop II	Crop III

* Rocky/Black cotton/Alluvial/Loose Sandy.

(B) Domestic/Municipal purpose

1.Population and livestock served by the well _____

2.Approximate average per capita daily consumption of water

(depending upon the living standard)

3. Municipal uses and their users _____

(C) Industrial purpose.

Type of industry for which the water is being supplied

2. Average monthly water requirements of the industry for the process other utilities and colony

Also give the monthly water requirement in the following table :

Month	Consumption		
	Process	Utilities colony	Total

3. Other sources, if any, from which the water needs of the industry are being fulfilled and its percentage to total requirement.

3.3. SAMPLE QUESTIONNAIRE FOR COLLECTING INFORMATION REGARDING LIFTING DEVICES USED FOR WATER EXTRACTION

Well No. :

Date :

Name enumerator :

1. Type of lifting device used

(a) Manual lifting ( )

(b) Animal Lifting ( )

(c) Mechanical Lifting( )

2. In case of manual lifting give the following information :

a) Capacity of water-cane\bucket and No. of lifts per hour

b) Lifting hours : Information should be given in the following table :

Month	Average working hours in a day based on sample survey	Total number of working days.

In case of irrigation well the information would be given with respect to annual cropping pattern in the following table :

Crop	average working hours	Total number of working hours

3. In case of animal lifting give the following details :

a) Capacity of mote/number and capacity of buckets _____

b) Number of lift per cycle per hour _____

c) The number of animal used for this purpose _____

d) Lifting hours

Month	Average working hours in a day (based on sample survey)	Total number of working days

4. In case of mechanical lifting, give the following details :

A) i) Type of pump used : strike out which is not applicable

shallow-well centrifugal pump/jet pump/reciproca - ting piston pump/air-lift pump/any other type.

ii) Specification of pumps and motors/engine _____

iii) Discharge capacity _____

iv) Discharge measurement using measuring device :

which type of device is used for flow measurement ? Broad-crested weir/Sharp-crested weir/triangular notch/venturi meter/orficementer/orifice/bendimeter/ jet flow/timed volume (strike out whichever is not applicable)

a) In case of Broad crested/sharp crested/Triangular notch give the following details:

i) Dimensions of the weir :

Length of the weir = _____m

Width of the crest = _____m

Notch-angle(in case of triangular notch) = _____m

ii)What isthe head over the weir crest ?

_____m

b) In case of venturimeter/orificementer,give the following defails :

i) Manometric liquid used _____

ii) Area of the pipe _____m^2

Area at the throat _____m^2

iii) What is the difference in the levels of manometric liquid in the limbs ?

c) In case of orifice give the following details :

i) Size of orifice :

diameter = _____m

width of orifice (in case of large rectangular orifice) = _____m

ii) Head over the orifice = _____m

iii)In case of large rectangular orifice = _____

Head over the top of the orifice (H_1) = _____

Head over the bottom of the orifice(H_2)=_____

d) In case of bend meter,give the following details :

i] Manometric liquid used _____

ii) What is the difference of the levels in the two limbs ?

e) In case of jet flow, what is the maximum distance travelled by jet ?

In X - direction = _____m

In Z - direction = _____m

f) In case of timed-volume measurement, give the following details :

Time taken = _____ sec.

Volume of water collected = _____ m^3

If the measuring device is calibrated, what is the average coefficient of discharge ?

v) What is the total head for which the water is being lifted ?

B) Manpower used and its chargeable cost _____

C) Cost of repairs _____

D) Consumption of diesel and electrical power !

Information should be given in the following table :

Month	Diesel consumed litre	Electricity consumed	Rate cost

E) Pumping hours : Information should be given in the following table.

Month	Average working hours in a day (based on sample survey)	Total number of working days

4.0 ASSESSMENT OF DRAFT

After collecting the necessary data in appropriate formats (as mentioned in 3.1,3.2 and 3.3), the assessment of draft is to be done in two ways. First,the draft is to be calculated based on the use for various purposes served by it, and second, the draft is to be assessed from the capacity of the system used and number of hours the system works.

4.1 Assessment of the Draft based on the Use for Various Purposes.

The basic equation for draft estimation for irrigation purpose is :

draft = crop water requirement-effective rainfall + transmission losses

since estimation of losses can not be done, a percentage of draft is taken as losses and the equation becomes.

$$\text{draft} = \frac{\text{Crop water requirement - effective rainfall}}{(1-x)}$$

Where x is ascertained as losses represented as fraction of the flow based on the justment keeping in view the length and type of water courses and field channels, or ascertained in the field. For ascertaining crop water requirements as above, the surveys should be carried out in the field.

Using the data of number of irrigations applied for each crop, its area and depth of water applied at each irrigation, the water applied to the crops can be estimated. Allowing for losses during transmission, the water pumped from the well over the period under consideration can be assessed. This will serve as a check for the value of draft estimated by other means.

For domestic purposes, the draft is assessed by knowing the population and the average water consumption per capita, as given below :

draft = (population) x (per capita water consumption)

The water used for livestock is estimated in the same manner. The data directly gives the requirement and the same is assumed to be the draft from the wells for the case of industrial use.

4.2 Assessment of Draft Based on Capacity of System and Number of working hours :

The basis of estimation of draft is as given below :

Total draft = discharge x total working time or total pumping time .....(1)

Thus draft, the discharge is required to be calculated. Calculation of discharge for the various types of lifting systems is presented below :

In case of Manual/animal lifting, the draft is directly calculated from capacity of system and the working hours. In case of mechanical device basic equation used for the calculation of capacity is

$$Q = \frac{75 \times (H.P.) \times n}{W \times H} \quad .....(2)$$

Where Q = rate of discharge in m^3/S

W = specific weight of water kgt/m^3

H = total head to be lifted in meters

n = efficiency of the pumping sets

Efficiency of pumps will be determined from power input and water pumped using the usual relationship formulae.

In case of measuring devices, the discharge is calculated from the data using the relevant standard discharge formulae. The draft is obtained by multiplying capacity or discharge,

so calculated, by working hours. The figures for the draft obtained para 4.1 and 4.2 are to be reviewed and final draft can be obtained, based on judgement.

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