J. Indian Water Resour. Soc.,
Vol. 39, No. 1, Jan., 2019

WATER MANAGEMENT PLAN AT VILLAGE LEVEL: A CASE STUDY OF IBRAHIMPUR MASAHI GRAM PANCHAYAT (DIST. HARDIWAR)

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ABSTRACT

Water Management Plan has been developed for better utilization of village land and water resources of Ibrahimpur-Masahi village (Bhagwanpur Block, district Haridwar, Uttarakhand).The baseline data pertaining to village population, livestock and crop acreage was collected primarily from the revenue Dept., Govt. of Uttarakhand. Various hydrological field investigations (soil characteristics, water quality, ground water level, etc.) were also conducted in the study area for this study. The water budgets as per the existing and proposed practices were estimated and compared water savings for the village. The Plan considers effective utilization of land, water and other available natural resources. Additional water availability through water conservation measures facilitates livelihood opportunities.

***Keywords**: Water Demands Estimation (existing & suggested practices), Water Availability, Village Level, Water Budgeting, Water Management Plan*

INTRODUCTION

The villages are backbone of our rural economy which is primarily based on agricultural activities. The existing practices of irrigation (viz. flooding) are known for very low water use efficiency and low crop productivity due to greater loss of precious water. Hence, water budgeting and water management planning at village level can extremely be useful for farmers in order to utilize water judiciously. The Government of India has great task to improve the water use efficiency by 20%, witnessing the fact that wastage of water in agriculture sector is significant and highest among all sectors. The sector-wise water demands estimation and identification of ways to conserve water in each sector at village levels is prime need to judiciously utilize the precious water resource. Village ponds are ancient time tested traditional means of water conservation. A majority of the traditional sources of water in villages are on the verge of disappearing/shrinking due to encroachment, siltation, water quality deterioration, emergence of water hyacinth and eutrophication. The ponds located in the Haridwar District are also suffering from various hydrological problems and are at the verge of extinction, which require immediate attention to restore them on priority basis. Renovated ponds may be useful to store rainwater for various uses. Therefore, water conservation and its management of village ponds is essential for proper utilizing the water for beneficial use in the society. The water conservation and rain harvesting may be helpful for improving the livelihood of the people by reducing the uncertainty of human life.

STUDY AREA

The Ibrahimpur Masahi revenue village (Tehsil: Bhagwanpur, District: Haridwar, Uttarakhand) consists of mainly five sub-villages under its jurisdiction, which includes- Ibrahimpur Masahi, Masahi Kala, Belki Masahi, Inayatpur and Halzora. The study area is falling between Shipla Nadi and Halzora Nadi (tributaries of Solani River). The location map of the study area is given in Fig. 1. The Shipla Nadi-Halzora Nadi watershed lies from 29^0 56' to 30^0 05' North latitude and 77^0 48' to 77^0 55' East longitude under SOI Toposheet Nos. 53 F/16 and 53 G/13 (1:50,000). The geographical area of the Shipla Nadi-Halzora Nadi watershed is 101.5 km^2 upto river bridge at village Imlikhera. The area of Ibrahimpur Masahi revenue village is 14.26 km^2 which represents about 1/7th of the watershed area upto Imlikhera bridge.

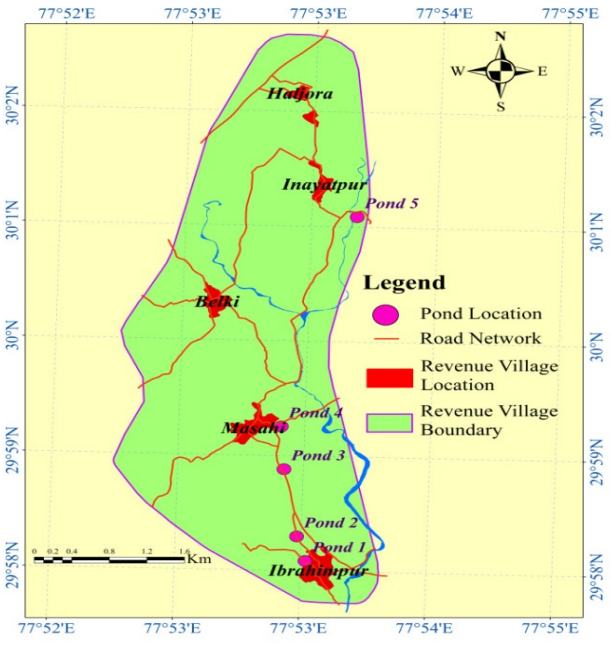

Fig.1: Map of the village area (Ibrahimpur Masahi, Dist. Haridwar)

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DATA AND METHODOLOGY

In this study, the necessary data from different sources (primarily from revenue Dept., Govt. of Uttarakahnd) was obtained for human population, cattle and crop acreage and types in the area. Additionally, the village level data on demography, dwelling amenities, public buildings, etc. were also collected from door to door during surveys in the village. Various field investigations were carried out to study soil characteristics (infiltration, soil texture and soil moisture, etc.) under different land uses. The rainfall data of 27 years (1987 to 2013) was analysed to estimate dependable rainfalls at 50% and 75% frequency levels based using data of meteorological observatory of NIH, Roorkee. The water management plan of the village Ibrahimpur Masahi mainly consists of the following steps:

- Collection of necessary baseline data of the village
- Estimation of water demands for various uses (viz. domestic, livestock, agricultural, etc.)
- Estimation of water availability from different sources based on rainfall pattern
- Estimation of the overall water budget of the village
- Desired actions to reduce water deficits
- Estimation of projected water availability based on the suggested practices/actions
- Estimation of the projected water budget of the village

After collecting necessary baseline data, the estimation of water demands for various uses (viz. domestic, livestock, agricultural, etc.) were carried out using recommended guidelines. The drinking water demand in the village was estimated @ 70 lpcpd based on reports of the then Ministry of Drinking Water & Sanitation (now DDWS, GoI) applicable for rural households. The vision for rural domestic water supply in the strategic plan of the Ministry is to cover all rural households with safe piped drinking water supply @ 70 lpcd (MDWS, 2013) instead of 55 lpcpd as provisioned under the Assured Rural Water Supply Programme (ARWSP, GOI). The total livestock water requirement annual (LWR, m^3/annum) basis was estimated by adding water required for all domestic animals such as-cattle/cow family (85 l/d), buffaloes (85 l/d), bovines/cow family/yak (85 l/d), sheep (10 l/d), goat (10 l/d), swine(15 l/d), and poultry (0.4 l/d) as per Frasier and Myers (1983). Crop water requirement was estimated broadly using Inductive method based on standard crop deltas (Varshney, et. al, 1983; Garg, 2005).

The estimation of water availability from different sources has been carried out based on long-term rainfall data available in the NIH and estimating (i) groundwater recharge from rainfall (from non-agricultural and agricultural areas), (ii) groundwater recharge from canal, (iii) direct canal irrigation, (iv) irrigation return flow, (v) recharge through ponds, (vi) availability of treated wastewater , etc., as applicable.

The suggested actions in the Village to reduce water deficits includes- (i) change of flood irrigation system to drip irrigation to reduced the crop water requirement, (ii) collection of water runoff from village/s and creation of ponds in the vicinity aimed to enhance groundwater recharge, (iii) implementation of roof-top rainwater harvesting system to conserve rain water, (iv) implementation of natural wastewater treatment system for recycling and reuse.

RESULTS AND DISCUSSION

Preparation of Water Management Plan

Water Management Plan (WMP) creates a framework for water management options to be introduced for broader national development planning in a structured way. IWRM strives for cross-sectoral integration and engages water users from different sub-sectors to develop solutions to challenges that are appropriate in terms of social and environmental impacts as well as economic efficiency. At national and basin level, IWRM principles have been used to integrate water demand from different sectors of society and to balance with water availability and to coordinate up-stream with down-stream uses. At the local level, IWRM concept may be equally useful to link water demand, water supply and water resources management in a sustainable way, involving communities in the decision making process. The deliberations were made with concerned stakeholders/villagers while developing this WM plan. Singh & Goyal (2018) has discussed the estimation of water demands for various uses and rainwater harvesting potential of this village in detail based on other similar other studies by various investigators. The cropping pattern of the village Ibrahimpur Masahi (Dist. Haridwar) is given in Table-1.

Table 1: Season wise crops grown in village Ibrahimpur Masahi
(Source: Revenue Dept, Uttarakhand)

S.No.	Season	Type of Crops	Area (ha)
1.	**Rabi**	Wheat, Vegetables, Fodder (i/c Berseem/Jayee), Pulses (Massoor)	**427**
2.	**Kharif**	Sugarcane, Paddy (Rice), Maize, Vegetables (i/c chillies), Gardens (Floriculture), Fodder (i/c Jowar/Til),	**669**
3.	**Zaid**	Gardens (Mango), Fodder (i/c maize & bajra), Pulses	**84.5**

A LULC map of the study area is given in Fig. 2. The season wise crop water demands (Rabi, Kharif and Zaid) were estimated for the village Ibrahimpur Masahi, which are given in Fig. 3.

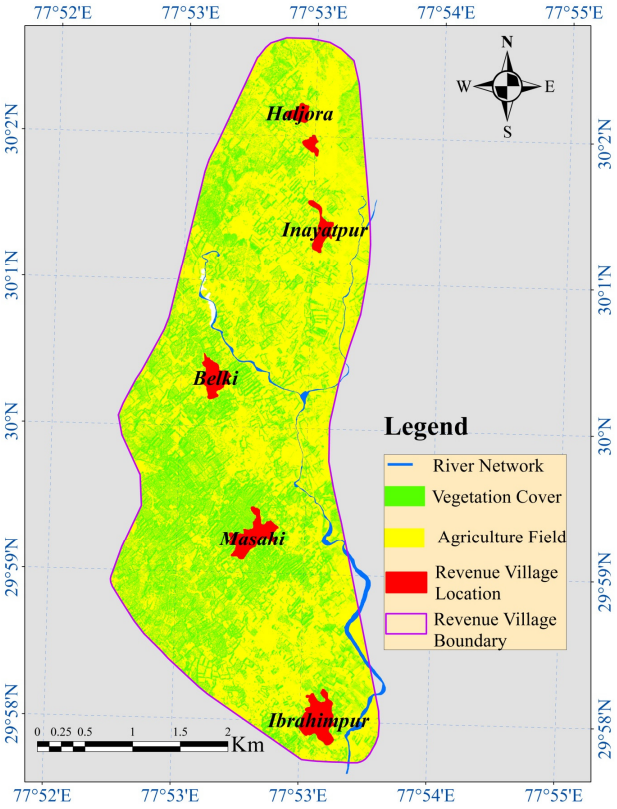

Fig. 2: LULC map of the village Ibrahimpur Masahi (Dist. Haridwar)

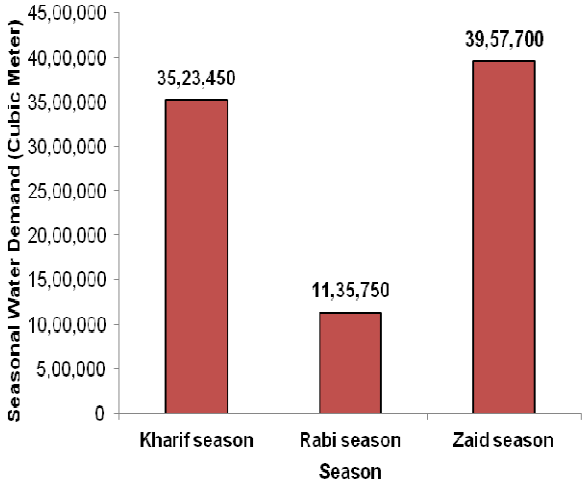

Fig. 3: Crop Water Demands of the village Ibrahimpur Masahi (Dist. Haridwar)

Infiltration tests were conducted under different land uses (Agriculture, Pond bed, Forest Land, Grass Land and Fallow Land) in the study area. The initial infiltration rates were obtained in the order of 9.8 cm/hr, 3.82 cm/hr, 57.3 cm/hr, 3.12 cm/hr and 4.58 cm/hr under Agriculture, Pond bed, Forest Land, Grass Land and Fallow Land, respectively. The final infiltration rates were obtained in the order of 1.96 cm/hr, 0.72 cm/hr, 2.4 cm/hr, 1.1 cm/hr and 0.96 cm/hr under Agriculture, Pond bed, Forest Land, Grass Land and Fallow Land, respectively. Accordingly, the study area lies under Hydrologic Soil Group-A (Final Infiltration Rate: > 0.3 in/hr) and Hydrologic Soil Group-B (Final Infiltration Rate: 0.15 to 0.30 in./h), respectively (Table 2).

Table 2: Hydrologic soil groups in the study area (Village-Ibrahimpur Masahi)

S.No.	Site	Landuse	Initial infiltration rate (cm/h)	Final infiltration rate (cm/h)	Hydrologic soil group
1	Ibrahimpur Masahi	Agriculture	9.8	1.96	A
2	Ibrahimpur Masahi	Pond	3.82	0.72	B
3	Belki	Forest Land	57.3	2.4	A
4	Inayatpur	Grass Land	3.12	1.1	A
5	Belki	Fallow Land	4.58	0.96	A

The total water demand (domestic, livestock and agricultural) is given in Table 3

. **Table 3: Estimated total water requirement for Village Ibrahimpur Masahi**

S.No.	Sector	Water requirement (MCM/Year)
1.	Domestic (for human population as per GOI Census, 2011)	0.182
2.	Domestic (Livestock)	0.247
3.	Agriculture	8.569
Total		**8.998**

Estimation of Rainwater availability

The Monthly Rain Water Availability (MCM) at Ibrahimpur Masahi Revenue Village Level (area=14.26 Sq. km) and at watershed level upto Imlikhera bridge (area= 101.5 Sq. km) was estimated on the basis of 50% dependable Rainfall. The results are given in Table 4. Accordingly, the annual rainwater availability at village level was obtained 12.35 MCM and at watershed level (upto Imlikhera) in the order of 88 MCM, respectively.

Table 4: Monthly rain water availability (MCM) at Ibrahimpur Masahi village and watershed level

Month	Rainfall (mm) at F= 50%	Rain Water Availability (MCM)	
		At Watershed Scale (upto Imlikhera bridge)	Ibrahimpur Masahi Village
January	14.6	1.5	0.2
February	37.2	3.8	0.5
March	10.8	1.1	0.2
April	5.4	0.5	0.1
May	32.0	3.2	0.5
June	66.9	6.8	1
July	271.7	28	3.9
August	300.1	30	4.3
September	123.9	13	1.8
October	0.10	0	0
November	0.16	0	0
December	3.40	0.3	0
Total	**866.3**	**88**	**12**

The existing estimated water budget of the revenue village based on existing practices of water management is given in Fig. 4, which clearly indicates higher water demands (163% than availability) for various uses (viz. agriculture, domestic and livestock).

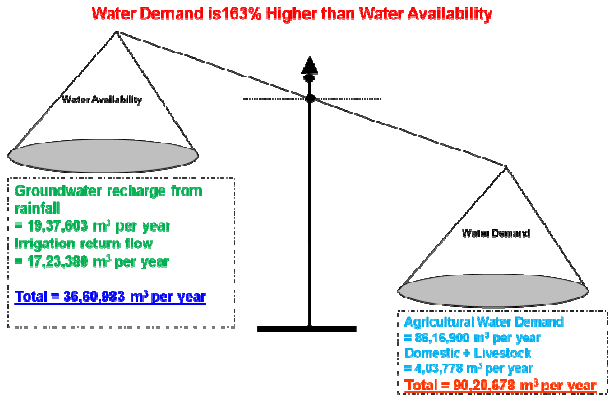

Fig. 4: Water budget of the Ibrahimpur Masahi village (based on existing practices)

By adopting IWRM Plan/suggested actions as discussed above, there is need to reduce water deficits in the village by adopting (i) change of flood irrigation system to drip irrigation to reduced the crop water requirement by about 50%, (ii) collection of runoff from sub villages and creation of ponds in the vicinity aimed to enhance groundwater recharge, (iii) implementation of roof-top rainwater harvesting system to conserve rain water, (iv)implementation of natural wastewater treatment system for recycling and reuse.

According to above suggested practices, the water availability can be increase by 29% than the demands for various designated uses in the revenue village (Fig. 5).

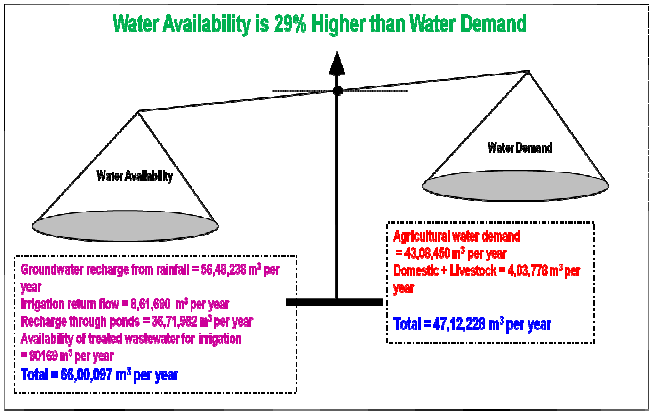

Fig. 5: Water budget of the Ibrahimpur Masahi village (based on suggested practices)

CONCLUSION

A water management plan has been developed for the Ibrahimpur-Masahi Gram Panchayat (Dist. Haridwar, Uttarakhand). The water budgeting has been carried out in this study under two scenario, viz. for existing and suggested best practices, respectively. The water budget based on existing practices shows higher water demands (163% than availability) for various uses (viz. agriculture, domestic and livestock). Whereas, according to various suggested practices (viz., adopting micro irrigation, rain water harvesting, wastewater treatment & reuse, etc.), the water availability can be increase by 29% than the demands for various designated uses in the study area. The Plan considers effective utilization of land, water and other available natural resources increasing livelihood opportunities for villagers. The suggested plan demonstrates conversion from a water-deficit status to a water-surplus status through appropriate water conservation practices, which will be beneficial approach to farmers while proper implementing by the concern stakeholders. Additional water availability through water conservation measures (rooftop water harvesting, renovation of ponds and establishing environmental friendly natural treatment systems for domestic wastewater treatment in villages (viz. constructed wetlands/floating wetlands) can improve rural economy/livelihood opportunities, water security and environmental conditions in the villages. The outcome of this study will be useful for Gram Panchayats/local administration to prepare village development plans (based on model village concept) by utilizing findings of study related to water management plan as developed for this village.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, NIH, Roorkee for allowing us to carry out an internal study entitled “Water Conservation and Management in Ibrahimpur Masahi Village of Haridwar District (Uttarakhand)” under Plan budget. The authors are also thankful to all concerned scientists/scientific staff of the Institute for providing time to time valuable help for field/lab investigations. The authors are also thankful to Dr. Dinesh Kumar (Ex Sr. RP, RMOD, NIH) to provide valuable technical input in this study.

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