Geographical Analysis of Water Resources and Management in Ahmadpur Tahsil

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Abstract

Water is an essential natural resource. It is becoming more and more a scarce and valuable resource as population and consumption rise. Other side water resource management is very poor in developing country. Especially region like marathwada management of water resource is very poor. The scarcity of water is a well-known fact in many parts of the marathwada region. Frequent news regarding water shortage & floods proves that there is having improper system of water management. Today water resource management is very important for sustainable development Present study water resource geographical analysis have been done to generate water resource information using GIS and RS technology. As per present study estimation; Ahmadpur tahsil receives about 687.15 Million Cubic Meter (MCM) water through annual precipitation, it is basic water resource. Out of this, 343.47 MCM water wastes in the natural evaporation- transpiration, reaming 343.68 MCM water flows through rivers and aquifers. Ahmadpur tahsil 87.91 MCM water is inflow water. Overall in Ahmadpur tahsil estimated surface water potential is 215.35 MCM and groundwater potential is 128.33 MCM, Ahmadpur tahsil total potential water is about 431.59 MCM (215.35 +128.33+ 87.91 = 431.59) in present situation. Currently Out of total potential water resource 345.47 MCM (255.50 + 89.97 = 345.47) water collects via various surface water and groundwater resources structure. As per population and agriculture of Ahmadpur tahsil annually water demand is about 304 MCM. Ahmadpur tahsil area water availability is more than its demand; but due to spatial variation in water resource distribution and lack of water resource management Ahmadpur tahsil people are facing water scarcity problem.

KEYWORDS: Water resource, Water resource development, Water resource management, Water scarcity problem & solution.

Introduction: Water is a natural resource, fundamental element for life, livelihood, food security and sustainable development. Water resource is becoming more and more a scarce and valuable resource as population and consumption rise. Other side water resource management is very poor in developing country. Especially region like marathwada management of water resource is very poor. The scarcity of water is a well-known fact in many parts of the marathwada region. Frequent news regarding water shortage & floods proves that there is having improper system of water management. Today water resource management is very important for sustainable development. Remote Sensing (RS) and geographical information system (GIS) technology plays an important role for understanding complex structure of water resource. Also give perfect solution in water resource management with in budge and time limit. It is known that water resource management requires proper water resource information. Bases on water resource information of study area some water resource management strategies have been found out; which can help to overcome water shortage problem of Ahmadpur tahsil.

Study Area: Ahmadpur tahsil is selected as a study area, which is one of the tahsil of Latur District in eastern Maharashtra. Its latitude and longitude extends is about 18° 30' 28" to 18° 50' 20" North latitude and 76° 40' 34" to 77° 10' 20" East longitude covering an area of 783 sq. km. It is situated on 450m to 600m above mean sea level. This region is of basalts rock and black soil. The major perennial rivers systems are Manar and Waki passes through the Ahmadpur tahsil.

Objectives: - calculate water resource potential - to determine water resource development - to determine water resource management and to examine water resource management strategy. These objectives are considered for geographical analysis of water resources and management in Ahmadpur tahsil.

Data and Methodology: Present study five (56 B/10, B/13, B/14 and 56 F/1, F/2) SOI toposheets on 1:50000 scale are used to define study area and there drainage system. Soil and surface water resource information of the study area has been collected from water resources information system of India (India-WRIS) and Google Earth to make soil and water resource distribution map. NRSC, ISRO, thematic Services, Bhuvan's 1:50000 scale land use land cover map is used to understand study region land utilization. Rainfalls temporal distribution data of 25 years has been collected from Latur NIC department and rainfall spatial distribution data from Hydrology Project Water Resources Dep. Gov. of Maharashtra (India). Groundwater resource information is obtained from Groundwater surveys and development agency (GSDA) and filed survey. Additional information of water resource has been collected from irrigation department, Agriculture department, Socio- economic review, district statistical abstract of Latur district and field work.

Present study Ahmadpur tahsil area is divided in to 16 watersheds using Arc GIS software's Arc hydrology tool for geographical analysis of water resource. All watersheds AH-1 to AH- 16 code is given for study convenience. Digitization work has been carried out for entire geographical analysis of watershed using GIS software (Arc GIS version 9.3).The attributes were assigned to create the digital data base for watershed layer.

Runoff co-efficient is calculated based on field site observation. Field observation has been done in land use, soil and slope category. For runoff co-efficient calculation soil depth, land use and slope percentage these three parameter layers are used. Weighted overlay analysis has been in Arc GIS software for runoff co-efficient, groundwater recharge efficiency, groundwater storage efficiency, water resource development, water resource management, water resource management outcome.

Water resource development: Water resource development is calculated using following procedure.

$$\textbf{Water resource development \%} = \frac{\text{Water resources structure annual production capacity}}{\text{Annual potential of water resource}} * 100$$

Source: Compiled by the Author

Water resource management: Water resource management is calculated in three stages first is water resource development management, second is water supply management and third is water use management.

$$\textbf{Water resource management percentage} = \frac{\text{Wrdm \% (0.20) + Wsm \% (0.30) + Wum \% (0.50)}}{3}$$

Where:

Wrdm = Water resource development's management, **Wsm** = Water supply management,

Wum = Water use management

0.2 = It is constant value (In water resource management 20 percent weighted is given to Water resource development management)

0.3 = It is constant value (In water resource management 30 percent weighted is given to Water supply management)

0.5 = It is constant value (In water resource management 50 percent weighted is given to Water use management)

Source: Compiled by the Author

Water resource development / Water supply management: Water resource development management and water supply management percentage of study area is calculated using following method.

Water resource development management = Wrdsme * 0.4 *100

Water supply management = Wrdsme * 0.6 *100

Where:

Wrdsme = **Water resource development & supply management efficiency**

$$\textbf{Wrdsme} = \frac{\text{Total used water}}{\text{Total developed water resources structures water}}$$

0.4 = It is constant value (Water resource development management contributes 40 percent in development & supply management efficiency. It is judged on filed practice.)

0.6 = It is constant value (Water resource supply management contributes 60 percent in development & supply management efficiency. It is judged on filed practice.)

Source: Compiled by the Author

Water use management: In water use management evolution can do in three stages first is agriculture water use management, second is domestic water use management and third is industrial water use management.

$$\textbf{Water use management (Wum)} = \frac{\text{Awum + DIwum}}{2} * 100$$

Where:

$$\textbf{Awum} \text{ (Agriculture water use management)} = \frac{\text{Area under drip and sprinkler irrigation}}{\text{Total area under irrigation}} * 100$$

DIwum = Domestic and industrial water use management, it is 20 percent constant considered based on filed practice

Source: Compiled by the Author

Water resource management outcome: Water resource management outcome is calculated in three water resource management category. First is water resource development management outcome second is water supply management outcome and third is water use management outcome.

Water resource development management outcome: Water resource development management outcome is evaluated using following procedure.

Water resource development management outcome

= (0.4 * Nwrdsme) * total water resource water

Where:

0.4 = It is constant value (40 percent outcome of water resource development management & supply management outcome come through water resource development management. It is considered on filed practice.)

Nwrdsme = Non water resource development & supply management efficiency. It is calculated using following formula.

Nwrdsme = (1 - Wrdsme)

Source: Compiled by the Author

Water supply management outcome: Water supply management outcome is evaluated using following procedure.

Water supply management outcome = (0.6 * Nwrdsme) * total water resource water

Where:

0.6 = It is constant value (60 percent outcome of water resource development management & supply management outcome come through supply management. It is considered on filed practice.)

Nwrdsme = Non water resource development & supply management efficiency. It is calculated using following formula.

Nwrdsme = (1 - Wrdsme)

Source: Compiled by the Author

Water use management outcome: Water use management outcome is evaluated using following procedure.

Water use management outcome = (0.25 * Nwumf) * total water resource

Where:

0.25 = 25 percent of total water resource water can be produce through water use management outcome. It is constant value judged base on filed practice.

Nwumf = Non water use management factor. It is calculated using following formula.

Nwumf = (100 - water use management percentage) / 100

Source: Compiled by the Author

Result & Discussion: In order to proper use of water resource, it is necessary to first understand water resource site and situation information. Also it supports to water resource management.

Water resource of Ahmadpur tahsil: Ahmadpur tahsil area total surface water resource potential is about 303 MCM out of that 255 MCM water collect in various surface water resources. About 48 MCM water is residual as surface water resource balance which is required to natural flow survive. Only few of that can be utilize. Watershed-wise

maximum surface water resource balance found in AH-6, AH-10, AH-14 and AH-8 watershed.

Ahmadpur tahsil total groundwater is about 128.33MCM water out of that 89.96 MCM water is withdrew via dug-wells and bore-wells. There groundwater balance is about 38.35 MCM. Watershed-wise high groundwater balance is observed in AH-4, AH-11, AH-12 and AH-14 watershed area there in future groundwater can be developed. Low groundwater balance is observed in AH-1, AH-6 and AH-16 watershed area it is below 1 MCM. AH-7 and AH-15 watersheds are overexploited; in this area ground recharging process need to implement. Study area's AH-6, AH-7, AH-8, AH-9, AH-10 and AH-14 watersheds are rich in groundwater and it will help to provide water to local demotic and agriculture. Currently about 21.87 percent water resource developments management is found in this area so in feature need to pay attention in new water resources development management. Ahmadpur tahsil area farm pond, cement bandhare, kholhapuri type bandhare etc. are suitable surface water resources. Ahmadpur tahsil area dug-well groundwater resource is suitable only surrounding area of dug-well recharging process is required. Bore-well is not suitable structure because this area come under basalt hard rock zone: this hard rock can't store more than 2 percent of rainfall water. Also this rainfall water can't percolate in deeper zone due to hard rock so it can withdraw via dug-wells but bore-wells make hole in to hard rock and help to percolate upper zone groundwater in to deeper zone. Ahmadpur tahsil area maximum close and running bore-wells are found and coming day bore-wells will increase as per demand. Its effect groundwater level is falling down every year.

Water resource development: Total Ahmadpur tahsil about 80 percent water resource developments is observed out of total water resource potential. Water resource development is not unique in all watershed of Ahmadpur. Overall watershed's 55-60 percent water resource development is found. High water resource development is found in AH-13, AH-7, AH-16 and AH-5 watershed area. It is more than 80 percent. AH-5 and AH-13 watershed area water resource development is more than region's demand but due to lack of water resource management this area water comes under shortage problems. Medium water resource development is found in AH-14, AH-9, AH-3 and AH-12 watershed. It is between 60 to 80 percent. Out of these in AH-12 and AH-14 watershed area water resource is less compare to water demand; AH-3 and AH-9 watershed area developed water resources can full fill water demand but proper water resource management is required. Low water resource development is found in AH-6, AH-15, AH-10, AH-2, AH-11, AH-1, AH-8 and AH-4 watershed. It is below 60 percent. Out of these in AH-4 watershed area water resource is developed more than this area water demand, this area water resource management is not proper hence it is suffering from water scarcity. In AH-8, AH-1, AH-2 and AH-10 watershed area proper water resource development is required.

Water resource management: Water resource management analysis is completed in three stages water resource development management, water supply management and water use management. These three stages are much correlated to each other.

Water resource development's management: Water resource development's management include water resource potential and region's water demand, where to develop water resources, which type of water resources should be develop, water resource development's budget, water resources monitoring , maintenance etc. things.

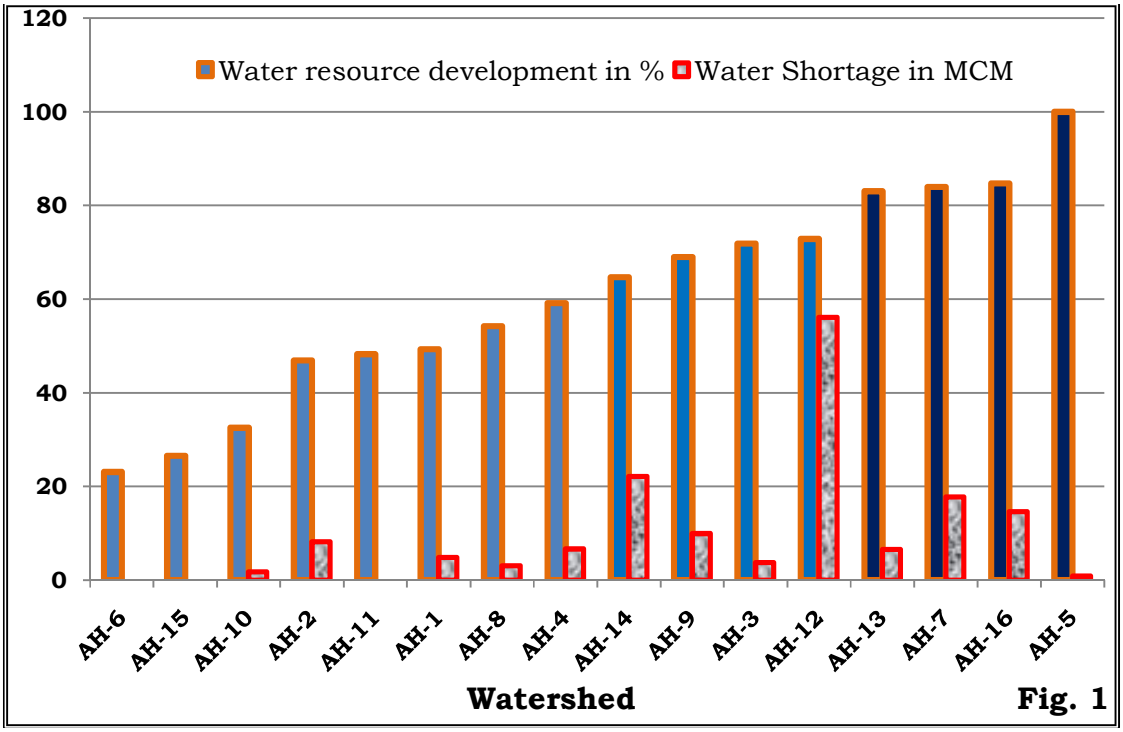

Fig. 1

Ahmadpur tahsil an average 21.87 percent water resource development's management is found. Water resources are not developed at proper place where they are required another thing that these water resources types are not as per region environment that why there people are facing water storage problem. There water resources are unable to supply water as per requirement. Watershed wise high water resource development's management is found in AH-11watershed area, it is more than 40 percent; medium water resource development's management is found in AH-7, AH-13, AH-14, AH-16, AH-3, AH-8, AH-10 and AH-6 watershed area, it is between 20 to 40 percent ; low water resource development's management is found in AH-5, AH-2, AH-1, AH-4, AH-15, AH-9 and AH-12 watershed area.

About 78.97 MCM water can produce through proper implication of water resource development management in Ahmadpur. Maximum water can produce via water resource development management in AH-5, AH-12, AH-13, AH-9 and AH-14; Minimum in AH-15, AH-6, AH-8, AH-11, AH-10, AH-1, AH-3 and AH-7 watershed area.

Water supply management: Water supply management include water resource potential and region's water demand, where to develop water supply system , which type of water supply system should be develop, water supply development budget ,water supply monitoring ,maintenance etc thing.

Ahmadpur tahsil an average 32.81 percent water supply management is observed. Yet proper water supply systems are not developed in Ahmadpur tahsil. There is very less monitoring and maintenance found in water supply system. Hence supply system unable to supply water as per user water demand. Watershed wise high water supply management is found in AH-10, AH-6 and AH-11 watershed area; it is more than 50 percent. Medium water supply management is found in AH-9, AH-12, AH-7, AH-13,

AH-14, AH-16, AH-3 and AH-8 watershed area; it is between 20 to 40 percent. Low water supply management is found in AH-5, AH-2, AH-1, AH-4 and AH-15 watershed area; it is below 20 percent.

About 118.46 MCM water can produce through proper implication of water supply management in Ahmadpur. Maximum water can produce via water supply management in AH-5, AH-12, AH-13, AH-9, AH-14 and AH-16 watershed area; Minimum in AH-15, AH-6, AH-8, AH-11and AH-10 watershed area.

Water use management: Water use management means increase water use efficiency. Water use is an important element of water resource management. Water use management plays important role in area where is having high water shortage crisis. Water use management consist two type of water use management mode. One is water saving mode another is water reuse mode. Overall Ahmadpur tahsil about 16.68 percent water use management is observed. Yet there is no public awareness about water use. Also most people use tradition method to use water. Hence water use management is found less in Ahmadpur. Watershed-wise high water use management is found in AH-9 watershed area; it is above 30 percent. Medium water use management is found in AH-12, AH-11, AH-3, AH-2 and AH-4 watershed area; it is between 20 to 30 percent. Low water use management found in AH-1, AH-5, AH-15, AH-10, AH-14, AH-6, AH-16, AH-7, AH-8 and AH-13 watershed area.

About 73.15 MCM water can produce through proper implication of water use management in Ahmadpur. Maximum water can produce in AH-5, AH-12, AH-13, AH-9 and AH-14 watershed area; minimum in AH-15, AH-6 and AH-8 watershed area via water use management.

Water shortage problem solution: At this stage Ahmadpur tahsil area water shortage is about 156.74 MCM water. It can be solve via water resource management, water supply from other watershed area and new water resources creation method. Ahmadpur tahsil area about 270.58 MCM water can generate via water resource management, about 35-40 MCM water can circulate via water supply system from excess to scarcity watershed area and about 224.23 MCM water can produce via new water resource creation in current situation. If proper water resource management implements then AH-1, AH-2, AH-3, AH-4, AH-5, AH-6, AH-9, AH-10, AH-11 and AH-13 watershed area 100 % water shortage problem can solve. Proper water resource management implements for AH-12 watershed gives 39 percent solution, for AH-7 watershed gives 40 percent solution, for AH-14 watershed gives 73 percent solution and for AH-8 watershed gives 76 percent solution. AH-12, AH-7, AH-8 and AH-14 watershed area residual water shortage problem can solve through water supply from other watershed area and new water resources creation work. For AH-8 watershed area along with proper water resource management new water resource need to develop for full fill water demand. For AH-7 watershed area along with proper water resource management new water resources need to develop and 8.57 MCM water should be supply from nearest AH-6 watershed area to overcome water shortage problem. For AH-12 watershed area along with proper water resource management new water resource need to develop and 22.76 MCM water should be supply from nearest AH-5, AH-11 watershed area to full fill water demand of AH-12 watershed area. Proper water resource management implementation and new water resource creation work is require to full fill water demand of AH-14 watershed area.

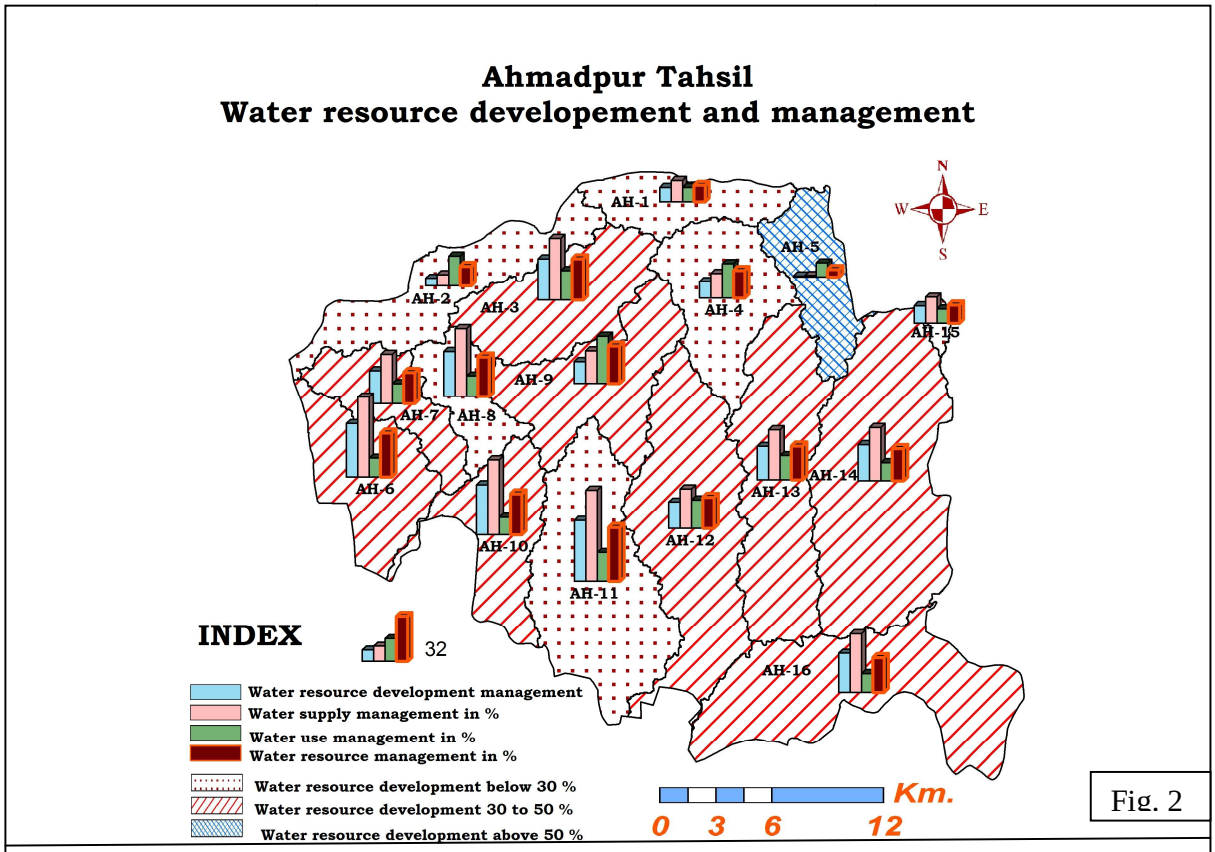
Ahmadpur Tahsil
Water resource developement and management
AH-1
AH-2
AH-3
AH-4
AH-5
AH-6
AH-7
AH-8
AH-9
AH-10
AH-11
AH-12
AH-13
AH-14
AH-15
AH-16
N
S
E
W
INDEX
32
Water resource development management
Water supply management in %
Water use management in %
Water resource management in %
Water resource development below 30 %
Water resource development 30 to 50 %
Water resource development above 50 %
Km.
0 3 6 12

Fig. 2

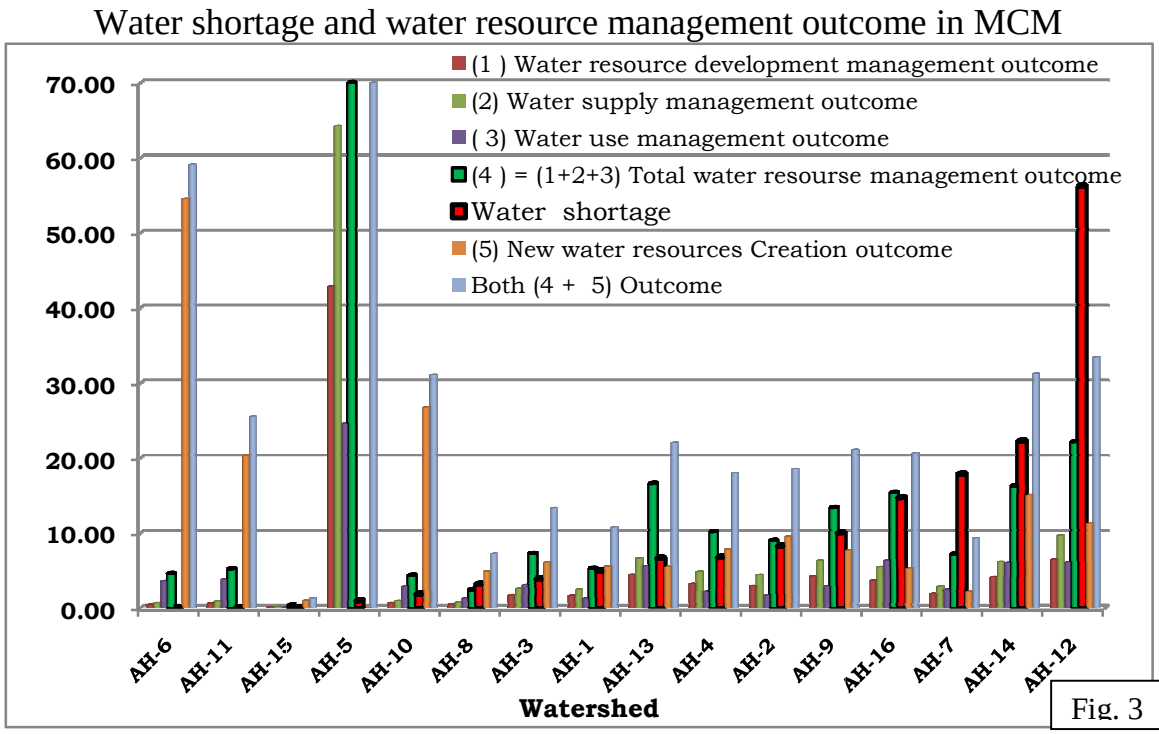
Water shortage and water resource management outcome in MCM
(1) Water resource development management outcome
(2) Water supply management outcome
(3) Water use management outcome
(4) = (1+2+3) Total water resourse management outcome
Water shortage
(5) New water resources Creation outcome
Both (4 + 5) Outcome
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
AH-6
AH-11
AH-15
AH-5
AH-10
AH-8
AH-3
AH-1
AH-13
AH-4
AH-2
AH-9
AH-16
AH-7
AH-14
AH-12
Watershed

Fig. 3

Watershed	Water shortage in MCM	(1) Water resource development management outcome in MCM	(2) Water supply management outcome in MCM	(3) Water use management outcome in MCM	(4) = (1+2+3) Total water recourse management outcome in MCM	(5) New water resources Creation outcome in MCM	Both (4 + 5) Outcome in MCM	(6) Water shortage solution via Water recourse management in %	(7) Water shortage solution via new water resources Creation outcome in %	Water shortage solution via both action (6 + 7) in %
AH-1	4.879	1.61	2.41	1.2	5.22	5.5	10.72	100	100	100
AH-2	8.213	2.93	4.39	1.66	8.97	9.52	18.49	100	100	100
AH-3	3.794	1.67	2.51	3.05	7.23	6.03	13.26	100	100	100
AH-4	6.695	3.2	4.8	2.13	10.14	7.79	17.93	100	100	100
AH-5	0.896	42.82	64.23	24.53	**131.56**	0	**131.5**	100	100	100
AH-6	**0**	0.4	0.6	3.55	4.55	54.53	**59.08**	100	100	100
AH-7	17.79	1.88	2.83	2.41	7.12	2.15	9.27	**40**	**12**	**52**
AH-8	3.119	0.46	0.7	1.22	2.38	4.82	7.2	**76.62**	100	100
AH-9	9.976	4.2	6.3	2.85	13.34	7.68	21.02	100	100	100
AH-10	1.8	0.6	0.91	2.82	4.33	26.73	31.06	100	100	100
AH-11	**0**	0.56	0.84	3.77	5.17	20.31	**25.48**	100	100	100
AH-12	56.15	6.44	9.66	6.03	22.13	11.26	33.39	**39**	**20**	**59**
AH-13	6.577	4.4	6.6	5.54	16.53	5.45	21.98	**100**	**82**	100
AH-14	22.19	4.09	6.13	5.99	16.21	15.01	31.22	**73**	**67**	100
AH-15	**0**	0.09	0.14	0.08	0.31	0.94	1.25	100	100	100
AH-16	14.65	3.61	5.42	6.32	15.35	5.26	20.61	100	35	100
Total	**156.74**	**78.97**	**118.4**	**73.15**	**270.57**	**182.9**	**391.99**	**89.288**	**82.25**	**94.437**

Computed by researcher

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Reference:

1. Kumaraswamy.K (2009):" Sustainable development of water resources – A case study from Tamil Nadu", Enrich Environment- Multidisciplinary international research journal, ISSN 0974-6064, Volume-2, Issue-5, pp55-61.
2. Ministry of water resources government of India (2009): "Ground water resource estimation methodology, pp1-107
3. Ministry of the environment operations division (2008) : "Technical guidance document for surface water studies in support of category 3 applications for permit to take water"
4. Mohamad bin Abd Manap (2010): "Delineation of groundwater potential zones using remote sensing and gis approach in malaysia", pp121-127.
5. Narasimhan T .N. (2008): "A note on India's water budget and evapotranspiration" J. Earth Syst. Sci. 117, No. 3, June 2008, pp237–240
6. Nenny Miryani Saptadji and Yudha Artika (2012): "surface water potential analysis and groundwater conservation concept at kamojang geothermal field", Thirty-Seventh Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 30 - February 1, 2012
7. Omotayo B. Adebo ye and Olarewaju M. Alatise (2008): "Surface Water Potential of the River Osun at Apoje Sub-basin Nigeria", Soil & Water Res., 3, 2008 (2):pp74–79
8. P.Jagadeeswara Rao (2009): "Selection of groundwater potential zones in and around Madhurawada Dome, Visakhapatnam District - A GIS Approach", J. Ind. Geophys. Union, Vol.13, No.4, pp191-200.
9. Sitender (2011): "Delineation of groundwater potential zones in Mewat District, Haryana,India", international journal of geomatics and geosciences,Volume 2, No 1, 2011, ISSN 0976 – 4380,pp270-281.