



Modeling and simulation of runoff from an irrigation tank watershed to evaluate the utilizable water

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Received: 1 September 2020 / Accepted: 14 November 2020
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Abstract

The present study consists of hydrological modeling of a tank watershed along with simulation modeling. Two important parameters, such as rainfall and runoff events, were identified for hydrological modeling to assess the validity of the Natural Resources Conservation Service (NRCS) model. The runoff from the watershed was calculated using historical daily rainfall data for 14 years. The tank simulation was performed over a 14-year period using the data obtained from the following: (i) the actual flow realized in the tank, (ii) USDA-NRCS model output, (iii) the estimated irrigation needs, (iv) the estimated net losses, and (v) the elevation–water spread area–storage capacity relationship. For 2008–2009, 50% dependable year with 1239 mm of rainfall, the inflow to the tank was 1.567 MCM, or 37.47% of the rainfall. About 1173 MCM of tank storage was released to meet the irrigation needs of the ayacut. The net loss from the tank storage corresponds to 0.394 MCM, and there was no spillage during the year. With a release quantity of 1173 MCM, only about 50% of the irrigation needs were met. The net loss of 0.394 MCM is approximately 30% of the total tank capacity. The simulation model provides the variation of the storage in the tank, the extent of the satisfied demand, the extent of the spillage, and the net loss. Hydrological modeling and simulation can be used to determine the amount of usable water in the watershed.

Keywords Hydrological modeling · Irrigation · NRCS model · Runoff · Simulation · Watershed

Introduction

The world's natural water cycle, which generates an annual renewable water supply of around 7000 m³ per capita (Shiklomanov 2000), shows that enough fresh water is available every year to meet the demands of the current population of this planet. In some countries, however, the annual supply

of renewable water is less than 500 m³ per capita. In addition, the availability of water in these areas varies significantly over time, resulting in extreme events. Future projections assume that around 60% of the world's population will suffer from water scarcity by 2025 (Cosgrove and Rijsberman 2000). Providing a reliable and safe water supply on a sustainable basis remains difficult for a large population around the world. This can be attributed to a lack of knowledge and policy, a lack of infrastructure, and an inability to provide long-term benefits to society. In India, 90% of the annual runoff occurs during monsoon periods. There are great spatial and temporal differences in precipitation. The demand for drinking water and the demand to meet irrigation needs are increasing dramatically. Though nothing can be done to increase the amount of water, there is certainly much that can be done to deal with it. Options that combine surface water elevation and ground-water management can ensure that sufficient water is made available on a sustainable basis.

Runoff modeling was originated from Mockus rainfall–runoff relationship and Andrew's soil–cover complex (Ponce and Hawkins 1996). Extensive studies were carried out by Mishra and Singh (1999, 2004) on SCS method for

This article is part of the Topical Collection on *Recent advanced techniques in water resources management*

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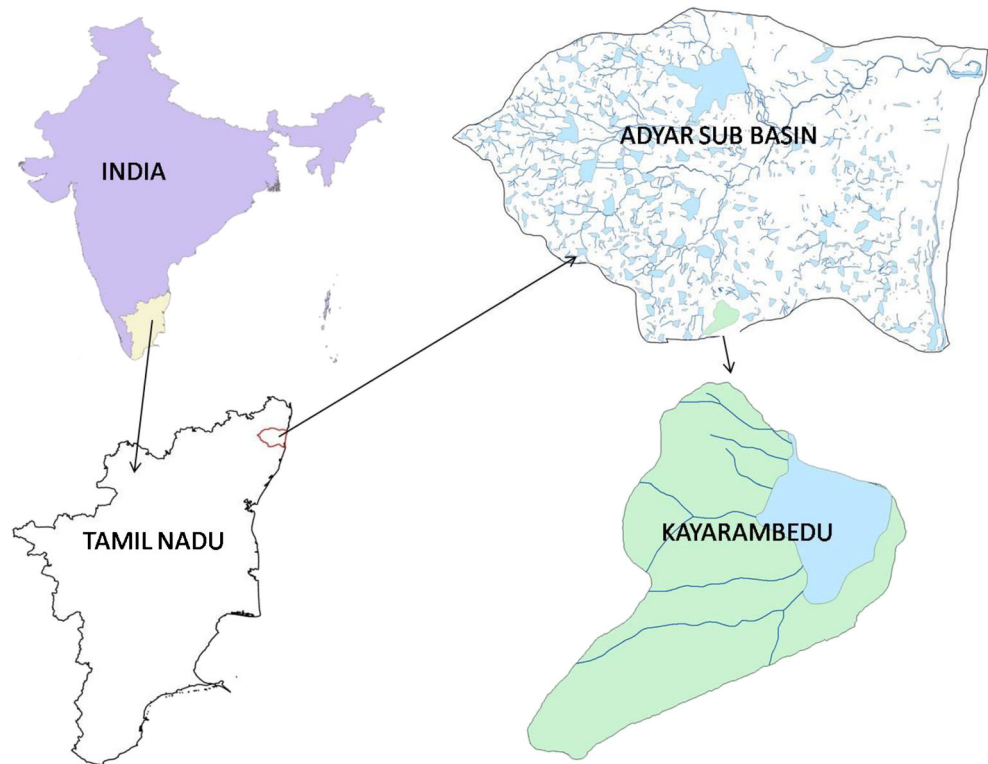
runoff computation. Putty and Hareesha (2001) used the SCS-CN model for the water catchment areas of the humid mountainous region of the Western Ghats, India, to simulate runoff. Soulis et al. (2009) found that the SCS method is very effective in calculating runoff for forest water catchment areas. Stone et al. (2001) estimated the distribution of groundwater recharge in water catchment areas in the USA, based on estimated runoff from high mountain regions and subsequent infiltration into alluvial cones surrounding intermontane basins. Many water-harvesting structures such as check dam cascades, percolation tanks, and farm ponds constructed in Andhra Pradesh augmented water resources and groundwater recharge increased tremendously (Sastry et al. 2002; Virginia 2011). Jothiprakash et al. (2002) examined the response of two infiltration ponds in Agniar-Ambuli-Southvellar river basins, Tamil Nadu, India, in order to assess their potential areas of influence. They observed that the heavily influenced wells were located less than 400 m from the ponds, while the moderately influenced wells were up to 800 m from the ponds. The Natural Resources Conservation Service (NRCS) method formerly known as the SCS method was established by many researchers worldwide for computing runoff (Meher and Jha 2011; Soulis and Valiantzas 2012; Tedela et al. 2012; Kabiri et al. 2013; Panahi 2013; Awadallah et al. 2016). The NRCS curve number method was recognized and demonstrated useful for the surface runoff estimation by several authors for various watersheds in Tamil Nadu (Mohan and Abraham 2010; Viji et al. 2015; Santhanam and Abraham 2018).

Remote sensing data (RS) with verification of soil truth is widely used for land use mapping (CGWB 2000; Dadhwal 1999). RS and geographical information systems (GIS) technology provide spatially continuous data for estimating runoff caused due to rainfall (Pradhan et al. 2010). Thakuria and Saikia (2014) successfully demonstrated a runoff estimation method by integrating RS and GIS into the Buriganga watershed, Assam. Hydrological modeling will be more effective if spatially continuous data is available (Syed et al. 2003; Kobold and Suselj 2005; Gabellani et al. 2007; Cole and Moore 2008; Ruelland et al. 2008; Moulin et al. 2009). The remote sensing system can improve the applicability of the SCS-CN model by taking into account the spatial and temporal variability of land and land use (Schultz 1996; Zhan and Huang 2004; Geetha et al. 2007). Garcia et al. (2008) estimated the availability of surface water in 12 basins in northern Spain by using digital tools. The basins are small, shallow, and not very common in hydrological measurements. The information available necessitated the use of a hydrological method of continuous solid simulation. Razmkhah et al. (2016) assessed the uncertainty of modeling the precipitation runoff based on the spatial correlation effect of precipitation.

The analysis of the catchment area discharge using the SCS-CN method and GIS is very effective (Satheeshkumar et al. 2017). Yasmeen et al. (2017) carried out rainfall-runoff modeling with the NRCS model using geo-spatial techniques in Tarbela sub-catchment, Pakistan. Formetta et al. (2017) used lumped hydrological models to study flood impacts, simulations at ungaged locations, and land use change impacts. Song et al. (2017) developed a Tank model using Simulink and applied to a rainfall-runoff simulation of a watershed to demonstrate the potential of Simulink for hydrological analysis. Regionalized lumped rainfall-runoff models have been widely employed for predicting stream flow of ungaged watersheds because of their simple and effective simulation strategy (Song et al. 2019). Poonia and Tiwari (2020) developed a rainfall-runoff model for Hoshangabad watershed of Narmada River, India, which proved that the ANN network model is an effective tool for predicting hydrological responses in agricultural watersheds. Jaiswal et al. (2020) compared two conceptual models such as Tank and the Australian water balance model and a physically distributed SWAT model for a basin in Chhattisgarh, India. Al-Asadi et al. (2020) used the Hydrological Tank model to simulate rainfall-runoff relationship in the Flint River basin, Georgia, USA. The model used two tanks with eight parameters to simulate daily stream flow from daily precipitation, taking into account the effects of daily evapotranspiration, water storage height, and infiltration rate. Therefore, the NRCS model with simulation is used for runoff computation of small, ungaged catchment areas due to its accuracy and efficiency. The present study is carried out to assess the availability of surface water in Kayarambedu tank using hydrologic modeling for meeting agricultural requirements.

Geographical settings

Kayarambedu tank falls in Adyar sub-basin in Kancheepuram district in Tamil Nadu, India. The area falls under geographical co-ordinates 12° 50' N to 12° 47' N and 80° 02' E to 80° 06' E. The location map of the study area is shown in Fig. 1. The elevation of the Kancheepuram district varies between 0.5 and 230 m above mean sea level. The maximum and minimum temperatures for the district are 37.1 °C and 20.5 °C, respectively. The study area receives rain mainly in the months of October and November up to the north-east monsoon. The average annual rainfall is 1150 mm. Daily rainfall data was collected from Chengalpattu IMD station. Hydraulic particulars of tanks and irrigation details are collected from PWD. The tank has a water spread area of 0.98 km² and water holding capacity of 1.33 MCM. The drainage area of the tank watershed is 3.3754 km². The tank had an original ayacut of

Fig. 1 Location map of the study area

172.80 ha of paddy crop, and the present ayacut area is 136.07 ha. The irrigation requirements for the first crop paddy are met from the tank and the second crop vegetables are met from groundwater. Borehole lithology collected from well drillers showed that the top soil is 1 to 2 m in depth. Weathered and partly jointed rock is present with thickness of 9 to 18 m. Hard and compact rock is present at a depth of 10 m.

Materials and methods

Kayarambedu tank is under the control of Public Works Department, Govt. of Tamil Nadu. The methodology deals with the delineation of watershed, hydrologic modeling with measurement of actual flow realized, application of the NRCS model for determination of runoff for historic period, identification of areas under agriculture, estimation of water requirement for irrigation and domestic purposes, and preparation of water balance for sustainability of water resource.

Surface runoff estimation

Hydraulic particulars of the tank were collected from PWD, Tamil Nadu. Cropping pattern, irrigation requirement, and other water utilization from the tank were assessed from intensive field visit and questionnaire survey. Surface runoff

from rainfall was assessed by applying the NRCS–hydrologic model (Chow et al. 1988).

$$Q = \frac{(P - I_a)^2}{(P - I_a + S)} \quad (1)$$

$$S = \frac{25400}{CN} - 254 \quad (2)$$

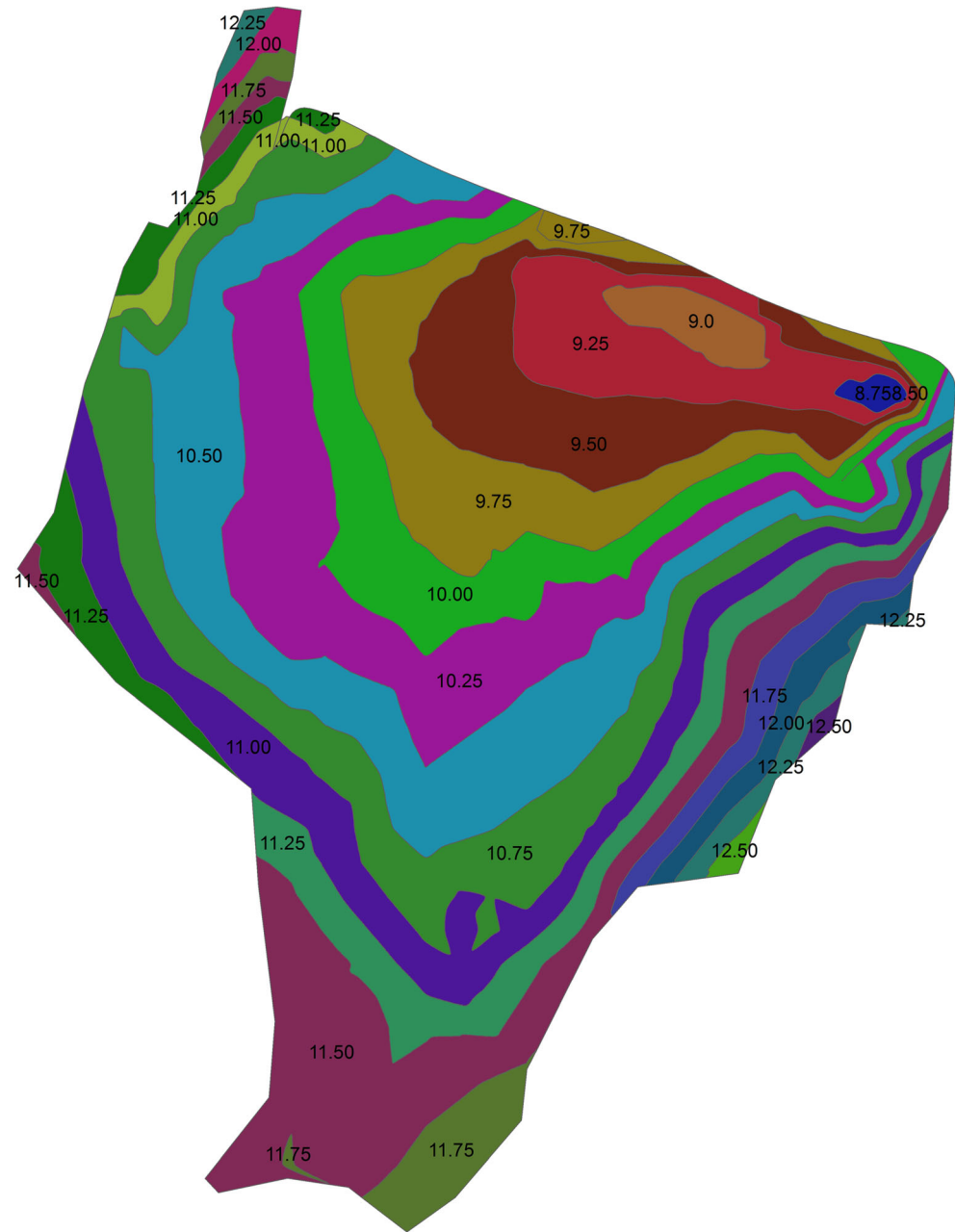
where

P Rainfall, in mm

Table 1 Elevation–water spread area–capacity relationship of Kayarambedu tank

Elevation (m)	Water spread area (m ²)	Storage capacity (m ³)
0	137,259	0
0.15	170,142	25,521
0.4	231,190	83,319
0.65	291,067	156,086
0.9	337,467	240,452
1.15	363,834	331,411
2	407,516	662,245
2.75	439,810	980,124
3.52	472,965	1,330,000

Fig. 2 Elevation contours of the tank bed from spot level survey



CN Curve number
 S Potential maximum retention
 I_a Initial abstraction, a fraction of S
 Q Runoff, in mm

Using $I_a = 0.2 S$, Eq. 1 becomes

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \quad (3)$$

Estimation of curve number

Land use map, daily precipitation data, and soil hydrological group were used to derive the NRCS model curve number.

From the land use map prepared for the study area, the land use details were determined. Curve numbers corresponding to the hydrological soil group for each land use can be obtained (USDA-SCS 1986), and the weighted curve number ($CNII$) corresponds to the previous average moisture condition, namely antecedent moisture condition (AMC) II. The dry state (AMC I) and wet state (AMC III) of the study area are determined using the previous five days of precipitation, i.e., less than 13 mm, 13–28 mm, and more than 28 mm AMC I, II, and III status, respectively. The curve number can be converted for other conditions, namely AMC I and AMC III, using the following relationships (Chow et al. 1988).

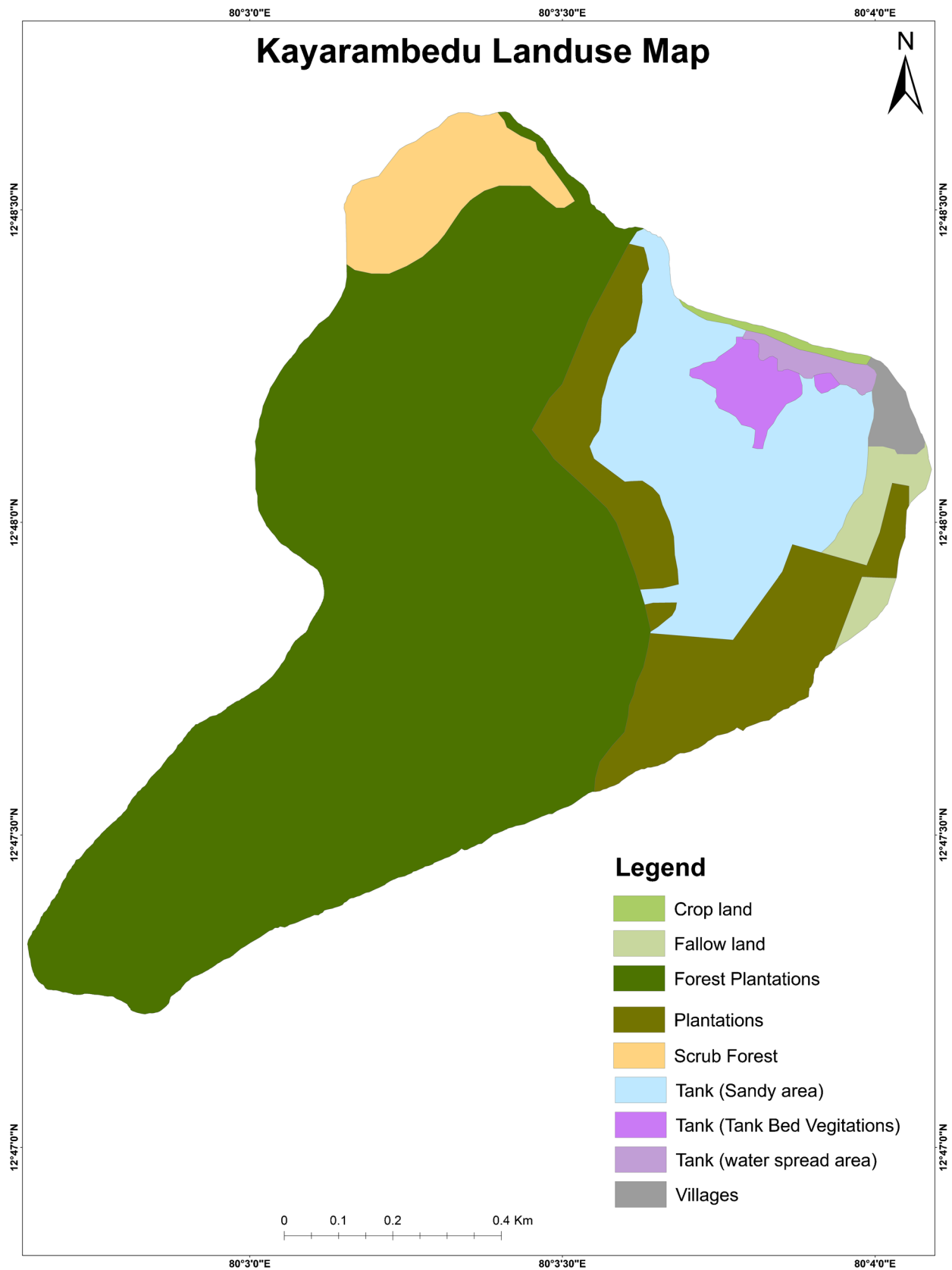


Fig. 3 Land use map of the tank watershed and the ayacut area

Table 2 Land use with the corresponding curve numbers for the watershed

Land use category	Curve number	Area (hectares)
Forest plantations/plantations	79	255.50
Scrub forest	77	16.66
Open space with grass cover	80	5.33
Water bodies	89	48.03
Fallow land	84	7.19
Residential area	85	3.37
Crop land	81	1.46

$$CN I = \frac{4.2CN_{II}}{10 - 0.0584CN_{II}} \quad (4)$$

$$CN III = \frac{23CN_{II}}{10 + 0.13CN_{II}} \quad (5)$$

During the north-east monsoon period from September to November 2014, the runoff obtained from the NRCS model was compared with the quantum of water realized in the tank. The inflow into the tank was measured using a staff gage painted for the purpose. To determine the relationship between water level–water spread area–storage capacity of the tank, a spot level survey was carried out in the tank bed. Water levels were observed daily during the north-east monsoon period from September to November, 2014. Runoff was estimated for the period 2000–2001 to 2013–2014 using the NRCS model with daily time step which was used in the simulation model.

Table 3 Inflow assessed in the tank and estimated inflow from the NRCS model

Date	Water level (cm)	Storage (m ³)
Event 1		
23/10/2014	110	313,219.28
25/10/2014	120	350,871.82
Assessed inflow into the tank = 37,652.54 m ³		
Estimated inflow from the NRCS model = 29,042.80 m ³		
Event 2		
11/11/2014	108	305,942.59
13/11/2014	152	488,639.13
Assessed inflow into the tank = 182,696.54 m ³		
Estimated inflow from NRCS model = 205,279.44 m ³		

During no rainfall period, the decrease in water level is used to compute the net loss. Net loss is due to evaporation and infiltration from the tank water storage. The runoff obtained from the NRCS model was compared with the assessed inflow into the tanks.

Irrigation demand computation

To know the cropping season and crops grown with release from Kayarambedu tank, a detailed questionnaire survey was conducted with the farmers of the ayacut. Evapotranspiration was calculated using the Blaney–Criddle equation (Doorenbos and Pruitt 1977).

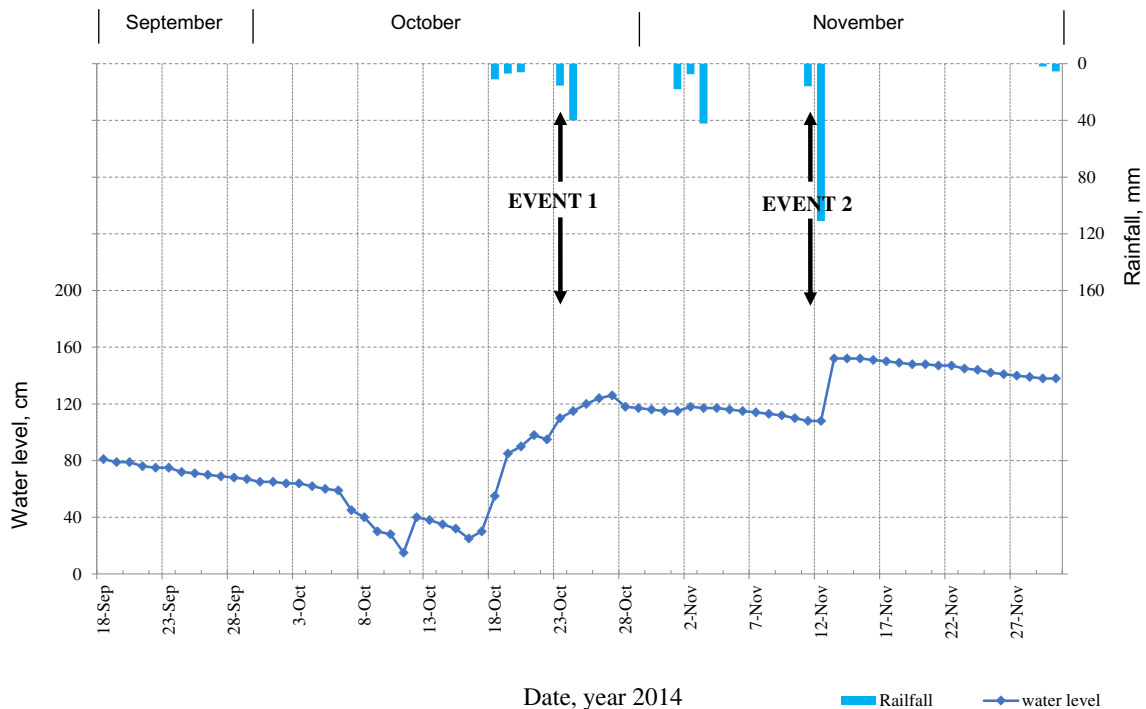
**Fig. 4** Water level in the Kayarambedu tank and rainfall during 2014

Table 4 Annual rainfall and runoff estimated from the NRCS model for the watershed

Water year	Rainfall		Runoff			
	No. of days	Depth (mm)	No. of days	Depth (mm)	As percentage of rainfall	Volume (MCM)
2000–2001	39	1092.3	25	247.81	22.69	0.836
2001–2002	49	1211.1	24	290.20	23.96	0.980
2002–2003	28	575.7	10	67.79	11.78	0.229
2003–2004	65	1765.8	28	423.48	23.98	1.429
2004–2005	44	1648.0	29	653.76	39.67	2.207
2005–2006	59	3608.0	49	2110.84	58.50	7.125
2006–2007	38	1379.0	21	624.76	45.31	2.109
2007–2008	71	1899.5	39	668.71	35.20	2.257
2008–2009	44	1238.8	27	464.20	37.47	1.567
2009–2010	55	1439.0	30	489.95	34.05	1.654
2010–2011	67	1489.0	29	410.98	27.60	1.387
2011–2012	52	1810.0	40	597.66	33.02	2.017
2012–2013	60	1435.4	28	397.87	27.72	1.343
2013–2014	64	769.3	17	111.55	14.50	0.377
Minimum	28	575.7	10	67.79	11.78	0.229
Maximum	71	3608.0	49	2110.84	58.50	7.125

$$ET_o = p(0.46T_{\text{mean}} + 8)$$

$$(6) \quad ET_{\text{crop}} = ET_o \times K_c \quad (7)$$

where

T_{mean} = mean daily temperature (°C)

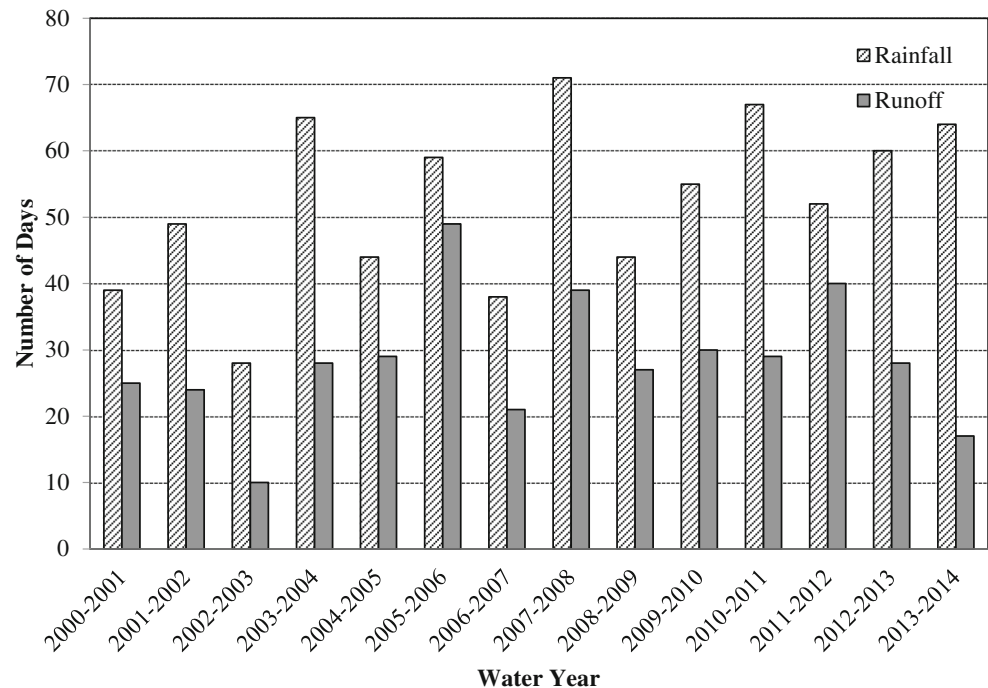
p = mean daily percentage of annual daytime hours.

Crop coefficient (K_c) for paddy for various growth stages was computed, and crop evapotranspiration is estimated as

Irrigation water need was computed from the method given by Brouwer and Heibloem (1986)

$$IN = ET_{\text{crop}} + SAT + PSL + WL - P_e \quad (8)$$

where

Fig. 5 No. of days with rainfall and runoff for Kayarambedu tank watershed

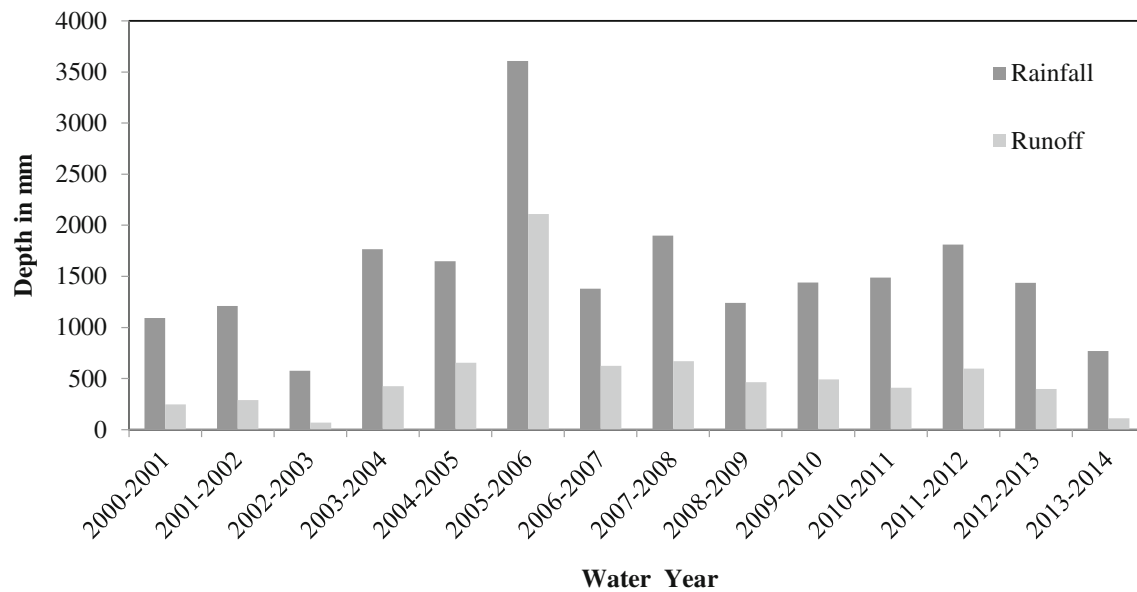


Fig. 6 Depth of annual rainfall and runoff for Kayarambedu tank watershed

SAT water needed to saturate the soil for land preparation
 PSL percolation and seepage losses
 WL water needed to establish a water layer
 P_e effective rainfall

$$P_e = 0.8 P - 25 \text{ if } P > 75 \text{ mm/month}$$

$$P_e = 0.6 P - 10 \text{ if } P < 75 \text{ mm/month}$$

where P = rainfall in mm/month

Outflow from the tank is by release for irrigation and/or spills. Net losses include evaporation and infiltration from tank storage.

The equation can be written as,

$$\text{End storage} = \text{beginning storage}$$

$$+ \text{inflow} - \text{release} - \text{net losses} - \text{spill} \quad (10)$$

Simulation

Tank simulation is carried out using mass balance equation for the tank which is given as,

$$\text{End storage} = \text{beginning storage} + \text{inflow} - \text{outflow} - \text{net losses} \quad (9)$$

The inflow to the tank is obtained from NRCS model output. Net loss is computed as the decrease in water level during no rainfall period. Monthly time step is adopted in the simulation model. The average water spread area for net loss computation and the release to meet irrigation demand in case of partial release are arrived through iterative procedure using elevation–water spread area and storage capacity.

Table 5 Computation of irrigation demand for paddy for representative year 2008–2009

Month Item	Sept	Oct	Nov	Dec	Jan	Feb
Percentage of annual daytime hours, p	0.28	0.27	0.26	0.26	0.26	0.27
Average temperature, T_{mean} (°C)	29.55	28.00	26.00	24.80	24.60	25.80
Potential evapotranspiration, Et_o (mm/day)		5.64	5.19	4.95	5.02	5.27
Crop coefficient, K_c		1.10	1.10	1.20	1.30	1.00
Crop water requirement ET_{crop} (mm/day)		6.20	5.71	5.94	6.53	5.27
ET_{crop} (mm/month)		192.24	171.26	184.10	202.39	147.42
SAT, mm	200.00					
PSL, mm/month @4 mm/day		124.00	120.00	124.00	124.00	112.00
WL, mm		100.00				
P_e , mm	78.20	178.20	402.20	42.20	0.00	0.00
Irrigation demand, mm	121.80	238.04	0.00	265.90	326.51	259.42

Table 6 Summary of simulation of Kayarambedu tank

Year	Inflow (m ³)	Release		Net losses (m ³)	Spill (m ³)	Maximum storage reached (m ³)
		m ³	As % of demand			
2000–2001	668,296	455,003	21.06	213,293	0	168,549
2001–2002	976,987	612,905	28.37	364,082	0	194,099
2002–2003	228,812	95,150	4.40	133,662	0	49,121
2003–2004	108,1132	578,215	26.76	502,918	0	640,016
2004–2005	1,744,724	1,315,539	60.88	429,186	0	993,644
2005–2006	7,098,516	2,042,278	94.52	675,111	4,381,128	1,330,000
2006–2007	2,108,849	1,419,676	65.70	451,120	238,052	1,330,000
2007–2008	2,106,309	1,519,065	70.30	587,244	0	543,610
2008–2009	4,286,164	1,587,497	73.47	544,780	2,153,887	1,330,000
2009–2010	1,571,479	1,151,342	53.29	420,137	0	1,211,559
2010–2011	1,382,103	1,003,629	46.45	378,474	0	260,531
2011–2012	1,958,922	1,368,277	63.33	590,646	0	730,270
2012–2013	1,342,893	876,893	40.58	466,001	0	582,622
2013–2014	374,910	226,137	10.47	148,773	0	1048

Tank capacity = 1,330,000 m³Irrigation demand = 2,160,715 m³

Results and discussions

Field investigation

In order to carry out a hydrological modeling of the tank, in addition to the precipitation in the area, the runoff entering the tank was assessed from the change in the storage of the tank. From the observed water level in the tank, the storages are computed. To know the storage for any given water level, the water depth–water spread area–storage capacity relationship was established. To get an insight into the recharge potential of the tanks, infiltration test was conducted in the tank bed. The loss due to evaporation and infiltration namely net losses was assessed considering the water level observations taken during non-rainy periods. Water samples were collected from the tank and tested

for quality parameters in Tamil Nadu Water Supply and Drainage Board and found to be good for domestic purposes and excellent for irrigation (IS 10500:2012)

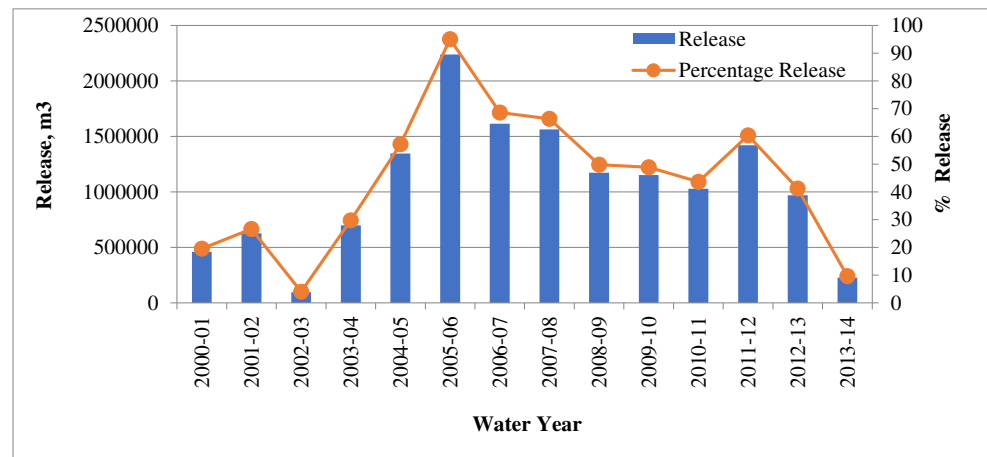
Elevation (depth)–water spread area–storage capacity relationship

Elevation contours were prepared from the spot level survey conducted in the water spread area of the tank, and the same is presented in Fig. 2. Based on the elevation contours, water spread area corresponding to each elevation was determined. The storage capacity between successive contours was determined utilizing the difference in contour elevation and average water spread of the contours in the lower and higher elevation. Table 1 shows the relationship between elevation

Table 7 Monthly simulation for Kayarambedu tank for the water year 2008–2009

Month	Beginning storage (m ³)	Inflow (m ³)	Irrigation demand (m ³)	Net losses (m ³)	Release (m ³)	Spill (m ³)	End storage (m ³)
July-08	0	0	0	0	0	0	0
Aug-08	0	73,600	0	44,324	0	0	29,276
Sep-08	29,276	181,980	236,762	43,436	167,821	0	0
Oct-08	0	163,507	462,720	38,295	125,212	0	0
Nov-08	0	1,082,263	0	82,380	0	0	999,883
Dec-08	999,883	65,535	516,880	114,099	516,880	0	434,439
Jan-09	434,439	0	634,462	71,800	362,639	0	0
Feb-09	0	0	504,277	0	0	0	0

Fig. 7 Irrigation demand met from Kayarambedu tank during the water years



(depth)–water spread area–storage capacity for the Kayarambedu tank.

Infiltration tests

The infiltration test was conducted according to the procedure set forth in the Virginia Department of Conservation and Recreation (DCR) Stormwater Construction Specification, No. 8, USA (2011) - Infiltration Practices. The infiltration value for the water spread area of the tank was obtained as 17 cm/h.

Net loss assessment

Water level variation during the north-east monsoon period from 18 September 2014 to 30 November 2014 was observed, and water level decrease during periods of no rainfall was noted. The average water level decrease per day for the no rainfall period is taken as the net loss from the tank due to evaporation and infiltration from the tank bed. The net loss per day computed for Kayarambedu tank watershed was 0.94 cm.

Hydrological modeling

The water potential of the Kayarambedu tank watershed was assessed using the USDA-NRCS model. Hydrological modeling regards the water year as July through June of the following year and uses a daily time step. Initially, hydrological modeling was carried out for the period 18 September 2014 to 30 November 2014, and the output was used to compare the assessed quantum of inflow into the tank for the selected rainfall events. The hydrological model was then used to determine the rainfall excess/runoff for the historic period of 14 years from 2000–2001 to 2013–2014. Land map of the watershed was prepared utilizing Satellite imagery Resourcesat-2, LISS IV FMX dated 12-Jun-2014 procured from National Remote Sensing Centre, Hyderabad, and

Survey of India (SOI) toposheet (Fig. 3). Kayarambedu tank is having a free catchment area of 3.375 km². For Kayarambedu tank watershed, land use categories present, area covered under each land use, and the corresponding curve number are given in Table 2.

The weighted curve number for the drainage area of 3.3754 km² is 80.52. The curve numbers for AMC I, II, and III are 63.44, 80.52, and 90.48 respectively. Daily water levels observed in Kayarambedu tank during the north-east monsoon period along with rainfall values of that area for that period are plotted and are presented in Fig. 4. From Fig. 4, the periods during which there is increase in the water level were captured. Two rainfall events were considered for comparison of inflow into the tank obtained from (1) the observed water level in Kayarambedu tank (2) and the rainfall excess obtained from the USDA-NRCS model.

For the period 18 September to 30 November 2014, the USDA-NRCS model was applied to estimate the runoff depth for the rainy days. For the two rainfall events selected, Table 3 gives the details of tank water level with the corresponding storages in the tank, assessed inflow from the storage in the tank and the estimated inflow using runoff depth obtained from the NRCS model. The results indicate that for event 1, the inflow estimated from the NRCS model comes to around 20% less than the flow realized in the tank, whereas for event 2, the estimated inflow from the NRCS model is around 10% more than the flow realized in the tank. The annual precipitation and runoff estimated from the daily NRCS time step model for 14 years from 2000–2001 to 2013–2014 are shown in Table 4. It can be seen that the annual rainfall varied from 575.7 (2002–2003) to 3608.00 mm (2005–2006). The rainfall excess percentage varied from 11.78 to 58.50 and the annual runoff from 0.229 MCM to 7.125 MCM during the 14 years: 2000–2001 to 2013–2014. Figure 5 presents number of days of rainfall and runoff year wise, and Fig. 6 presents the depth of annual rainfall and runoff for Kayarambedu tank watershed.

Computation of irrigation demand

Paddy crop is grown from September to February of the following year with the water supply from the Kayarambedu tank in accordance with current practices. Irrigation demand for paddy is calculated for representative year 2008–2009 for Kayarambedu tank ayacut. The total irrigation requirement for rice cultivation in the ayacut area is 1211 mm (Table 5), with an efficiency of 70% the actual irrigation water requirement corresponding to approximately 1730.80 mm.

Simulation of Kayarambedu tank

Monthly time step was used for the simulation model with starting live storage in the tank as zero on 1 July 2000. Aggregated daily runoff from the NRCS model was used as inflow for simulation. The simulation was carried out from July to February of the following year for each hydrological year, as the crop growing season Kayarambedu ended in February. Table 6 presents the summary of simulation of Kayarambedu tank. Table 7 gives the monthly Simulation results for Kayarambedu Tank for the water year 2008–2009. Figure 7 shows the irrigation demand met in percent for all the 14 years, and it can be seen that Kayarambedu tank gets filled up only for 3 years and spill occurs. Simulation results showed that Kayarambedu tank with an ayacut area of 136.07 ha could not meet the irrigation demand for a single crop of paddy grown during September to February for almost 13 years out of 14 years of study. Farmers numbering 68 out of the total number of 73 farmers own wells. This indicates that the farmers are using well water conjunctively.

Kayarambedu tank has a full capacity of 1.33 MCM. For the 50% dependable year 2008–2009, the inflow was 1.567 MCM of which 1.173 MCM is released to meet the irrigation demand of the ayacut and 0.394 MCM is the net loss which is about 30% of full tank capacity. Only 50% of irrigation demand was met with the release quantity of 1.173 MCM and there was no spill.

Conclusions

Hydrologic modeling shows that the difference between the inflow estimated from the NRCS model and the actual inflow realized in the tank comes to around 10 to 20%. Elevation–water spread area–storage capacity relationship for Kayarambedu tank developed helps in assessing the storage of tank at any water level in the gage provided. The groundwater in the ayacut area of Kayarambedu tank is being extensively used for irrigation. Kayarambedu tank with its full capacity of 1.33 MCM is utilized for irrigating its own ayacut, and there is no scope to utilize the tank water for any other purpose. In respect of releases to meet the irrigation demand, it

can be seen that for only 1 year, the release met 95% of the irrigation demand; for 5 years, more than 50% demand could be met; and for 7 years, the release to meet irrigation demand was less than 50%. The study also proves the applicability of the USDA-NRCS curve number method for runoff computation of small ungaged watersheds.

Funding The work was carried out with the financial support received from the Natural Resources Data Management System (NRDMS), Department of Science and Technology (DST), Government of India. The financial support for the work is greatly acknowledged.

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