Arrangement of watershed from overflowing lookout applying the SWAT prototypical and SUFI-2 (case study: Kasiliyan watershed, Mazandaran Province, Iran)

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Abstract
Overflows are an ordinary singularity that origins substantial fatalities of lifecycle and possessions and anthropological civilizations each time and persons have recognized it as a predictable occurrence. In this investigation, to forecast the overflowing in Kasiliyan SWAT hydrological prototypical was applied. Evidence wanted to be this investigation, with topographical maps, terrestrial usage, soil information, and climatological information, information about steady precipitation, temperature, and current degree were organized earlier. SUFI-2 database was applied for prototypical standardization. Subsequently the standardization and optimization of the prototypical, justification of the prototypical in the study zone was completed. The standardization of the prototypical was done from 2004 to 2010 and corroboration was completed from 2011 to 2014. To examine the consequences of arithmetical gauges $R^2$, $bR^2$, and Nash Sutcliffe constant were applied. Afterward prototypical standardization the particular constants were 0.79, 0.66, and 0.79 and the individual corroboration constants were 0.79, 0.76, and 0.71. The sensitivity consequences of 25 components that are important on overflow aquatic displayed that static components of groundwater improper current, its period, and the smallest quantity of aquatic essential for groundwater improper current are more complex than other components. Quantity Kasiliyan component curvatures were applied for overflow washbasin. Kasiliyan washbasin was separated into 24 zones to investigate the overflowing design. Lastly applying the overhead professed Mockups, it was decided that sub basin number 7 had the primary-rank with runoff 128.06, sub basin number 12 had the next rank with overflow in relations of overflowing and sub basin number 2 with a 12.62 has the minimum quantity of overflow.

Keywords Topographical maps · Overflowing · Flood managing · SWAT prototypical · Kasiliyan basin · Hydrological · Groundwater · Runoff

Introduction
As well as destructive anthropological existences, flood damage outbreaks the district’s agronomic domains and productive earth in numerous conducts (Fatahi Nafchi et al. 2021, 2022; Abdollahi et al. 2021; Ostad-Ali-Askari 2022; Ostad-Ali-Askari and Shayan 2021; Ostad-Ali-Askari et al. 2017a, b; Ostad-Ali-Askari and Shayannejad 2021; Ostad-Ali-Askari 2022a, b). Destruction of seaside walls, overflowing of grounds by residues and filling of pools of barriers are other reimbursements triggered by overflows. In what way superficial flows are dispersed in most portions of Iran does not encounter the period requirements of water. There is an essential to control superficial flows in nearly all belongings. Consciousness of the quantity of current (runoff capacity) owing to precipitation and its measurable and qualitative variations in dissimilar periods and districts is one of the significant depends of water possessions development. The requirement of water possessions and precipitation in diverse watersheds to instrument water developments to be attentive of the position and on the one hand the absence of a satisfactory system of positions for gauging climatological and hydrological components instead of the position of applying secondary approaches for example It discloses hydrological models for simulating current and calculating runoff capacity in watersheds. Iran is one of the nations that
encounter the two issues of water deficiency and water over- 
flow. Numerous grounds of agronomy, manufacturing and 
consumption water make the essential procedures to switch 
the water and avoid its consumption, in addition to the 
appropriate packing and usage of water. Flood water and soil 
evaluation prototypical is one of the greatest extensive perils 
that mostly impacts persons since people have designated 
flood-prone zones for lifespan. Flood regulator and inhibi-
tion of likely compensations have extensive been measured. 
Hydraulic mockups are extensively applied by hydrologists 
and water possessions administrators as an instrument to 
examine water organization. They examined the impacts of 
weather variation on water possessions in diverse watersheds 
in Iran and applied the SWAT prototypical to pretend the 
hydrological comeback of the watershed to climate varia-
tion. Terrestrial usage alteration has the capability to control 
water possessions and can similarly be applied to restrained 
and alleviate the damaging properties of climate alteration. 
Corrosion and deposit were one of the issues intimidating 
the expansion of water resources in these zones. The soil 
and water assessment model have been used to model soil 
erosion. The consequences display that the daily observa-
tions noted are very adjacent to the consequences simulated 
with SWAT software. Significant standardization and uncer-
tainty of the SWAT prototypical were considered on a great 
measurement. In many revisions, important standardization 
and uncertainty investigations of important SWAT mock-
ups have been showed. In many investigations, the build-
ing and standardization of a combined hydrological proto-
typical from Iran applying SWAT and numerous features 
of simulated water possessions and invention presentation 
and water superiority per unit of superficial hydrological 
backcome were measured. Depend on the consequences of 
the prototypical; the components of the channel erodibility 
curve number and canal exposure were documented as the 
greatest sensitive components of the prototypical for deposit 
condensation. The goal of the current study is to arrange 
sub-basins in terms of flooding applying the SWAT perfect 
in the Kasiliyan watershed. Assumed the extensive apply of 
this prototypical on a worldwide gauge, attaining this goal 
can be the source for ordering sub-watersheds for the opera-
tion of connected plans and evade spending a lot of currency 
in redundant zones. It is essential to control the monthly 
and annular profits of the stream. A gage station cans quan-
ty the input water. In the default of the quantity position, 
an automatic model, e.g. SWAT, can be used to assess the 
stream and the input runoff. The high-tech mockups can 
achieve exact and complex designs in a short period. So 
as to compute the watershed runoff, the prototypical needs 
such powerful climatological information as precipitation, 
temperature, wind speed, solar radiation and relative humid-
ity, and instead we require the watershed washbasin data 
as well as the curve number and the roughness constant. 
Owing to the restriction in the quantity of weather positions 
in some watershed basins, the standards recorded in a posi-
tion do not signify the entire watershed. There is an essential 
to compute the runoff approximation fault. This investigation 
is depending on SWAT, goals to examine the compassion of 
the stream runoff approximation to differences in the most 
projecting climatological components with precipitation, 
solar radiation, wind, humidity and temperature.

**Materials and Methods**

The situation to be considered is restricted to Kasillian 
watershed (positioned in Northern jungles of Alborz high-
land in Iran) with Sangdeh, Darzikela, Sootkela, Valikchal 
and Valikbon towns. The zone of Kasillian watershed is 
nearly 66.82 square kilometers and the foremost river gives 
for 16.9 km. The topographical organizes of the streams are 
as surveys: latitude from 36˚-02’ to 36˚-11’ N, and longitude 
from 53˚-10’ to 53˚-26˚ E. There is an instrument place on 
Kasillian River at Valikbon. The position, constructed in 
1970, is located at longitude of 53˚-17’ and the latitude 36˚-
10’ to quantify its Discharge. This model takes the precipi-
tation, temperature, solar radiation, wind speed and relative 
humidity information accessible into account to stimulate 
the runoff. The stated numerical components were recovered 
from Pol-e-sefid cineoptic, Sangdeh and Darzikela clima-
tology, Valikchal precipitation-scale, and Valik hydrometer 
positions. Principles of runoff modeling assessment gauges 
in diverse stages of SWAT model application is shown in 
Table 1. Optimum standards of sensitive components after 
calibration for the study zone is shown in Table 2.

**Water Balance Equation in SWAT Model**

\[
SW_t = SW_0 + \sum (R_{day} \cdot Q_{surf} - E_a \cdot W_{seep} - Q_{gw})
\]

(1)

where \(SW_t\) in Eq. 1 is the final water content in the soil, T 
time (day), \(SW_0\) is the quantity of main water in the soil, \(R_{day}\) 
is the amount of precipitation per day, \(Q_{surf}\) is the amount 
of surface runoff per day, \(E_a\) is the amount of daily evapotran-
spiration, \(W_{seep}\) is the amount of water penetrating into the

| Validation Stage | Calibration Stage | Assessment gauges and model application phases |
|------------------|-------------------|---------------------------------------------|
| 0.79             | 0.79              | \(R^2\)                                      |
| 0.75             | 0.79              | NS                                          |
| 0.72             | 0.66              | \(Br^2\)                                    |
Table 2 Optimum standards of sensitive components after calibration for the study zone

| Max  | Min   | Optimal Amount | Parameter        | Row |
|------|-------|----------------|------------------|-----|
| 0/083450 | -0/231052 | -0/031202 | R_CN2.mgt | 1 |
| 0/599746 | -0/047065 | 0/483565 | V_ALPHA_ BF gw | 2 |
| 336/465985 | 90/965236 | 260/705965 | V_GW_DELAY. gw | 3 |
| 1/752605 | 0/352963 | 0/965756 | V_GWQMN.gw gw | 4 |
| 0/182562 | 0/066252 | 0/090652 | V_GW_REVAP. gw | 5 |
| 0/856235 | 0/682635 | 0/796325 | VESCO.hru | 6 |
| 0/301052 | 0/040895 | 0/046189 | V_CH_N2.rte | 7 |
| 126/695859 | 62/526362 | 87/962563 | V_CH_K2.rte | 8 |
| 0/486359 | 0/009526 | 0/381956 | V_ALPHA_BNK. rte | 9 |
| 0/125759 | -0/120958 | 0/019019 | R_SOL_AWC(1). sol | 10 |

Subcoral region and $Q_{gw}$ is the amount of penetration into the aquifer. The SWAT model needs complete numbers and data from the study zone, for example daily rainfall information, maximum and minimum temperature, average relative humidity, average wind speed and solar radiation energy during the desired period. To run the model, daily rainfall information of rain gauge station and synoptic station situated in the zone were applied. In this investigation, to begin working with the prototypical, original the plans and diagrams of the sub-basins and channel system those were formerly organized. They were named to the model software situation. At this phase, the watershed zone and sub-basins and physical features of the watershed are planned by the prototypical. By using of land use soil maps and Hydrological response units and grade stages were described. The plans were combined in the prototypical software situation and formerly climatological information is applied and the essential stations are presented to the model. Formerly, added essential data was entered physically in the software tables. Subsequently this stage, the model was well-organized and the consequences were examined.

$$Q_{surf} = \text{Surface Runoff (mm)}, R_{dly} = \text{Daily rainfall depth (mm)}, S = \text{Humidity retention parameter (mm)}.$$  

The moisture preservation component alters spatially with variations in soil usage organization domains and gradients and briefly with variations in soil moisture. The moisture preservation component is explained as surveys as Eq. 2:

$$S = 25.4 \left( \frac{1000}{CN} - 10 \right)$$  (2)

Somewhere CN is the curve number (number zero to 100) is connected to the ground which be contingent on the physical possessions of the ground and S is the humidity preservation component (mm). In this investigation, the curve number component was applied to examine the overflowing of the Kasiliyan watershed. After calibration and validation of the prototypical and gaining the optimum standards of sensitive components applying the optimum standards of the components defined in the model calibration phase, the model was performed once more. Formerly, in the S model catalogue file, the number of curves of each sub-domain was changed with the least probable number of 40, individually, and the curve of other sub-spheres was expected to be persistent, and the model was applied for each sub-realm discretely. Lastly, subsequently the model was applied for all sub-basins and the consequences were verified, the consequence of each sub-basin on the hydrograph curve was contrasted by comparing the output hydrograph and the flood possible of each sub-basin was defined. Then the consequences were assessed. Along with the sensitivity analysis of the model, operative components were recognized and applied in model optimization.

Results and Discussions

After applying the SWAT model, the model is regulated to the SWAT model applying a SUFI-2 program in the procedure of SWAT-CUP software. For calibration, the seven-year measurement statistics (2004–2010) of daily rainfall, temperature and flow were applied. The consequences were assessed. Conferring to the sensitivity analysis of the model, effective components were recognized and applied in model optimization. In overall, the gained consequences are suitable and the efficacy of SWAT model in pretending the monthly runoff discharge of Kasiliyan river basin is suitable. After the model calibration phase, the model was assessed. The model assessment similarly has suitable consequences. At this phase, along with the optimum consequences of the calibrated phase, applying river information from 2011 to 2014, the stream movement was pretend.

Conclusions

Overflows are an ordinary singularity that origins substantial fatalities of lifecycle and possessions and anthropological civilizations each time and persons have recognized it as a predictable occurrence. In this investigation, to forecast the overflowing in Kasiliyan SWAT hydrological prototypical was applied. Evidence wanted to be this investigation, with topographical maps, terrestrial usage, soil information, and climatological information, information about steady precipitation, temperature, and current degree were organized earlier. SUFI-2 database was applied for prototypical standardization. Subsequently the standardization and optimization
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Author contributions KOAA designed this research, wrote this paper, collected the necessary data and did analysis of the data. Corresponding author participated in drafting the manuscript, contributed to the collection of data and interpretation of data and edited the format of the paper under the manuscript style. Corresponding author participated in the data collection and data analysis.

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Declarations

Conflicts of interest Author have declared that he have no conflicts of interest.

Ethical approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

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