Issn 0973-9777 Volume-6 Number-2 March-April 2012

The Indian Journal of Research Anvikshiki

Bi-monthly International Journal of all Research
www.onlineijra.com

Engineering and Technology

Anvikshiki
The Indian Journal of Research
Bi-Monthly International Journal of All Research

Abstracts and Indexing

Listed in ICMJE ICMJE ,www.icmje.org, Academia.edu, banaras.academia.edu, ebookbrowse.com, BitLibrary! http:/ www.bitlib.net/, Tech eBooks ,freetechebooks.com, ARTAPP.NET ,artapp.net,Catechu PDF /printfu.org, File Away,www.fileaway.info, KMLE ,docslibrary,http://www.docslibrary.com, MyCelular.ORG ,Android Tips, Apps, Theme and Phone Reviews http://dandroidtips.com, , http://www.edu-doc.com, www.themarketingcorp.com,Dunia Ebook Gratis duniaebook.net, ,www.cn.doc-cafes.com., Google ,http://scholar.google.co.in, http ://nkrc.niscair.res.in/ Browse by Title.Php ?Keyword=A

Website : www.onlineijra.com.Motilal Banarasi Das Index,Varanasi, Motilal Banarasi Das Index,Delhi. Banaras Hindu University Journal Index,Varanasi. www.bhu.ac.in, D.K.Publication Index, Delhi. National Institute of Science Communication and Information Resources Index, New Delhi.

Subscriptions

Anvikshiki,The Indian Journal of Research is Published every two months (January,March,May,July,September and November) by mpasvo Press,Varanasi.u.p.India. A Subscription to The Indian Journal of Research : Anvikshiki Comprises 6 Issues in Hindi and 6 in English and 3 Extra Issues. Prices include Postage by Surface mail,or For Subscription in the India by Speed Post. Airmail rates are also available on request. Annual Subscriptions Rates (Volume 3,6 Issues in Hindi,6 Issues in English and 6 Issues of science 2012):

Advertising & Appeal

Inquiries about advertising should be sent to editor's address. Anvikshiki is a self financed Journal and support through any kind or cash shall be highly appreciated. Membership or subscription fees may be submitted via demand draft in faver of Dr. Maneesha Shukla and should be sent at the address given below. Sbi core banking cheques will also be accepted.

All correspondence related to the Journal should be addressed to

B.32/16 A., Flat No.2/1,Gopalkunj,Nariya,Lanka, Varanasi, U.P.,India

Mobile : 09935784387,Tel.0542-2310539.,e-mail : maneeshashukla76@rediffmail.com,www.anvikshikijournal.com

Office Time : 3-5 P.M.(Sunday off)

Journal set by

Maheshwar Shukla,maheshwar.shukla@rediffmail.com

9415614090

Printed by

mpasvo Press

Maneesha Publication

(Letter No.V-34564,Reg.533/2007-2008)

B-32/16-A-2/1,Gopalkunj,Nariya,Lanka

Varanasi,U.P.,India

Anvikshiki
The Indian Journal of Research
Volume 6 Number 2 March 2012

Engineering and Technology
Papers

PRINT ISSN 0973-9777,WEBSITE ISSN 0973-9777

BANARAS HINDU UNIVERSITY
DEPARTMENT OF CHEMICAL ENGINEERING & TECHNOLOGY
(CENTRE OF ADVANCED STUDY & DST DEPARTMENT UNDER FIST)
INSTITUTE OF TECHNOLOGY
(Varanasi – 221005)
(Established by Parliament by Notification No.225 of 1916)

Message

Scientific discoveries and advancement affect our lives by providing new policies and regulations that provide broad national direction and by new products that enhance our lives. Technology and engineering translate scientific knowledge into action. At the same time, technological innovations often require further research into materials, devices and processes. Engineers use the knowledge of science, mathematics, economics and appropriate experience to find suitable solutions to the problems and helps in creating an appropriate mathematical model for analysis.

This special issue on Engineering and Technology 2012 of Anvikshiki brings together the latest developments in technology and gives a base for the future work to be done in respective areas.

I wish the journal to be a great success.

Bhawna

Bhawna Verma
Assistant Professor
Department of Chemical Engineering & Technology
Center of Advanced Study
Institute of Technology
Banaras Hindu University
Varanasi – 221005

Fax (फैक्स) : 091-0542-2368092 **Email:** head.che@itbhu.ac.in; ☎ 0542-2368092, 6702029, 2307045, 6702024

BANARAS HINDU UNIVERSITY
DEPARTMENT OF CHEMICAL ENGINEERING & TECHNOLOGY
(CENTRE OF ADVANCED STUDY & DST DEPARTMENT UNDER FIST)
INSTITUTE OF TECHNOLOGY
(Varanasi – 221005)
(Established by Parliament by Notification No 225 of 1916)

Message

I express my sincere gratitude to the editorial board of prestigious journal ANVIKSHIKI for believing in my technical competencies and choosing me as a reviewer of special issue on Engineering and Technology 2012. I understand that with great role comes great responsibilities. I will try to fulfill this highly valued responsibility with best of my technical knowledge and human values. This journal has been a guiding beacon for scientific community for numerous years & has gained the prestige due to it's original & rich articles. The contribution of ANVIKSHIKI in field of scientific research is immense.

I wish for the phenomenal success of special issue on Engineering and Technology,2012 of ANVIKSHINKI.

Probhat

P K S Dikshit
Professor
Department of Civil Engineering
Institute of Technology
Banaras Hindu University
Varanasi 221005

Editorial Note

As my nomination as an Subject Expert and Editor for this Special Issue on Engineering & Technology 2012, I have worked a lot to make it successful. I do whatever task is at hand to the best of my ability. I take pride in my work and give hundred percent every time. For those submissions that were not suitable for publication, we tried to let authors know very quickly of our decision, giving them a chance to submit their manuscript to another journal if they so desire. I am fully aware that the prestige and quality of an ANVIKSHIKI Journal depends upon the altruistic participation of reviewers and the fairness and promptness with which the review process is conducted. In this regard, I wish to express my sincere gratitude to all board members for their nice cooperation and sustained effort. However, because of the increased number of submissions and the diversity of research fields involved, we have a difficult task ahead of us requiring a more rapid tempo of review. At the same time, from now on the authors themselves should assume their own inescapable responsibilities. The editor will return immediately any manuscript that is incomprehensible to reviewers on account of substandard grammar and syntax.

Finally, it is a pleasure to thank my Editor in chief for their nice cooperation and valuable suggestion. Now, we all look forward to embarking in a journey that can take ANVIKSHIKI on to the next plateau of excellence.

I hope you will enjoy reading this issue and we welcome your feedback .

With best regards,

Jyoti Prakash

OTHER MPASVO JOURNALS

1. **World Journal of Modern and Ayurvedic Medical Science** (Appear on 2012, Format of the Serial : Online, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
2. **World Journal of Science Development**(Appear on 2012, Format of the Serial : Online & Print, Frequency : Bi-Annual) Life Time Fee : Indian Members 10,000/-rs. International Members $5000
3. **World Journal of Social Research** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
4. **World Journal of Humanities Research** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
5. **World Journal of Commerce and Management** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
6. **World Journal of Literature and Languages** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
7. **International Journal of Physics Inventions** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
8. **Asian Journal of Women's Studies and Development** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
9. **Asian Journal of Environmental Studies** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
10. **Asian Journal of Education and Knowledge** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
11. **World Journal of Home Science Research** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
12. **Asian Journal of Religion, Philosophy and Peace Studies** (Appear on 2012, Format of the Serial : Online & Print, Frequency : Annual) Life Time Fee : Indian Members 5000/-rs. International Members $5000
13. **Global Journal of Engineering and Technology (**Appear on 2012, Format of the Serial : Online & Print, Frequency : Six Monthly) Life Time Fee : Indian Members 10,000/-rs. International Members $5000**)**

Introducing "Global Journal of Engineering and Technology"

Dear Colleague,

Global Journal of Engineering and Technology Research (GJET) is a multidisciplinary peer-reviewed journal published six monthly by mpasvo Journals (http://www.onlineijra.com/gjet). GJET is dedicated to increasing the depth of the subject across disciplines with the ultimate aim of expanding knowledge of the subject.

Call for Papers

GJET will cover all areas of the subject. The journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence, and will publish: Original articles in basic and applied research, Case studies, Critical reviews, surveys, opinions, commentaries and essays.We invite you to submit your manuscript(s) to **maneeshashukla76@rediffmail.com** for publication in the six Monthly Issue. Our objective is to inform authors of the decision on their manuscript(s) within eight weeks of submission. Following acceptance, a paper will normally be published in the next issue. Instruction for authors and other details are available on our website; www.onlineijra.com/gjet

GJET is an Open Access Journal

One key request of researchers across the world is unrestricted access to research publications. Open access gives a worldwide audience larger than that of any subscription-based journal and thus increases the visibility and impact of published works. It also enhances indexing, retrieval power and eliminates the need for permissions to reproduce and distribute content. GJET is fully committed to the Open Access Initiative and will provide free access to all articles as soon as they are published.

Best regards,

Dr. Maneesha Shukla.

Editor in chief,

NAME OF JOURNAL

Global Journal of Engineering and Technology (GJET)

ISSN

ISSN ……… in process

FREQUENCY

Six-monthly

LANGUAGE

English

LAUNCH DATE

July 1,2012

EDITOR-IN-CHIEF

Dr. Maneesha shukla, Gopalkunj, flat no 1, Naria, Lanka , Varanasi, up, India. maneeshashukla76@rediffmail.com

subject expert

Jyoti Prakash Srivastava

EDITING

Global Journal of Engineering and Technology (GJET)

Gopalkunj, flat no 1,

Naria, Lanka , Varanasi,

up, India pin 221005

Telephone: 0542-2310539

Mobile: 0-99-35-78-43-87

E-mail: maneeshashukla76@rediffmail.com

http://www.onlineijra.com/gjet

http://www.anvikshikijournal.com/gjet

PUBLISHER

Mpasvo

maneesha prakashan evam shodha viveka sanstha

Gopalkunj, flat no 1,

Naria, Lanka , Varanasi,

up, India pin 221005

Telephone: 0542-2310539

Mobile: 0-99-35-78-43-87

E-mail: maneeshashukla76@rediffmail.com

http://www.onlineijra.com/gjet

http://www.anvikshikijournal.com/gjet

Global Journal of Engineering and Technology (GJET)

E-mail: maneeshashukla76@rediffmail.com

Guidelines for Authors

Global Journal of Engineering and Technology is an open access journal that provides rapid publication (six monthly) of articles in all areas of the subject such as: civil, mechanical, chemical, electronic and computer engineering as well as production and information technology. The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published approximately 3 month after acceptance.

Electronic submission of manuscripts is strongly encouraged, provided that the text, tables, and figures are included in a single Microsoft Word file (preferably in Arial font).

Submit manuscripts as e-mail attachment to the Editorial Office at: maneeshashukla76@rediffmail.com A manuscript number will be mailed to the corresponding author same day or within 72 hours.

The **cover letter** should include the corresponding author's full address and telephone/fax numbers and should be in an e-mail message sent to the Editor, with the file, whose name should begin with the first author's surname, as an attachment. The authors may also suggest two to four reviewers for the manuscript (GJET may designate other reviewers).

Global Journal of Engineering and Technology will only accept manuscripts submitted as e-mail attachments.

Article Types

Three types of manuscripts may be submitted :

Regular articles: These should describe new and carefully confirmed findings, and experimental procedures should be given in sufficient detail for others to verify the work. The length of a full paper should be the minimum required to describe and interpret the work clearly.

Short Communications: A Short Communication is suitable for recording the results of complete small investigations or giving details of new models or hypotheses, innovative methods, techniques or apparatus. The style of main sections need not conform to that of full-length papers. Short communications are 2 to 4 printed pages (about 6 to 12 manuscript pages) in length.

Reviews: Submissions of reviews and perspectives covering topics of current interest are welcome and encouraged. Reviews should be concise and no longer than 4-6 printed pages (about 12 to 18 manuscript pages). Reviews are also peer-reviewed.

Review Process

All manuscripts are reviewed by an editor and members of the Editorial Board or qualified outside reviewers. Decisions will be made as rapidly as possible, and the journal strives to return reviewers' comments to authors within 3 weeks. The editorial board will re-review manuscripts that are accepted pending revision. It is the goal of the JETR to publish manuscripts within 10 weeks after submission.

Regular articles

All portions of the manuscript must be typed **double-spaced** and all pages numbered starting from the title page.

The **Title** should be a brief phrase describing the contents of the paper. The Title Page should include the authors' full names and affiliations, the name of the corresponding author along with phone, fax and E-mail information. Present addresses of authors should appear as a footnote.

The **Abstract** should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The Abstract should be 100 to 200 words in length.. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.

Following the abstract, about 3 to 10 **key words** that will provide indexing references should be listed.

A list of non-standard **Abbreviations** should be added. In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelled out and introduced in parentheses the first time it is used in the text. Only recommended SI units should be used. Authors should use the solidus presentation (mg/ml). Standard abbreviations (such as ATP and DNA) need not be defined.

The **Introduction** should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Materials and methods should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail.

Results should be presented with clarity and precision. The results should be written in the past tense when describing findings in the authors' experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. Discussion, speculation and detailed interpretation of data should not be included in the Results but should be put into the Discussion section.

The **Discussion** should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

The **Acknowledgments** of people, grants, funds, etc should be brief.

Tables should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph form or repeated in the text.

Figure legends should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or Powerpoint before pasting in the Microsoft Word manuscript file. Tables should be prepared in Microsoft Word. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

References: In the text, a reference identified by means of an author‘s name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author‘s name should be mentioned, followed by ’et al‘. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like ’a‘ and ’b‘ after the date to distinguish the works.
Examples:
Abayomi (2000), Agindotan et al. (2003), (Kelebeni, 1983), (Usman and Smith, 1992), (Chege, 1998; Chukwura, 1987a,b; Tijani, 1993,1995), (Kumasi et al., 2001)
References should be listed at the end of the paper in alphabetical order. Articles in preparation or articles submitted for publication, unpublished observations, personal communications, etc. should not be included in the reference list but should only be mentioned in the article text (e.g., A. Kingori, University of Nairobi, Kenya, personal communication). Journal names are abbreviated according to Chemical Abstracts. Authors are fully responsible for the accuracy of the references.

Examples:
Chikere CB, Omoni VT and Chikere BO (2008). Distribution of potential nosocomial pathogens in a hospital environment. Afr. J. Biotechnol. 7: 3535-3539.
Moran GJ, Amii RN, Abrahamian FM, Talan DA (2005). Methicillinresistant *Staphylococcus aureus* in community-acquired skin infections. Emerg. Infect. Dis. 11: 928-930.
Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing *Escherichia coli* in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.
Pelczar JR, Harley JP, Klein DA (1993). Microbiology: Concepts and Applications. McGraw-Hill Inc., New York, pp. 591-603.

Short Communications
Short Communications are limited to a maximum of two figures and one table. They should present a complete study that is more limited in scope than is found in full-length papers. The items of manuscript preparation listed above apply to Short Communications with the following differences: (1) Abstracts are limited to 100 words; (2) instead of a separate Materials and Methods section, experimental procedures may be incorporated into Figure Legends and Table footnotes; (3) Results and Discussion should be combined into a single section.

Proofs and Reprints: Electronic proofs will be sent (e-mail attachment) to the corresponding author as a PDF file. Page proofs are considered to be the final version of the manuscript. With the exception of typographical or minor clerical errors, no changes will be made in the manuscript at the proof stage. Because GJET will be published freely online to attract a wide audience), authors will have free electronic access to the full text (in both HTML and PDF) of the article. Authors can freely download the PDF file from which they can print unlimited copies of their articles.

Copyright: Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, or thesis) that it is not under consideration for publication elsewhere; that if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher.

Fees and Charges: Overseas Authors are required to pay a $250 Processing fee and Indian Authors are required to pay a Rs 3000/- Processing fee. Publication of an article in Global Journal of Engineering and Technology is not contingent upon the author’s ability to pay the charges. Neither is acceptance to pay the handling fee a guarantee that the paper will be accepted for publication. Authors may still request (in advance) that the editorial office waive some of the handling fee under special circumstances.

Letter No.V-34564,Reg.533/2007-2008 INDIAN JOURNAL OF RESEARCH(2012)**6,24-31**
ANVIKSHIKI ISSN 0973-9777 Advance Access publication 16 Jan. 2012

RUNOFF ESTIMATION FROM SCS-CN: A CRITICAL REVIEW

KAILASH NARAYAN*, SABITA MADHVI SINGH** AND P. K. S. DIKSHIT***

Declaration

The Declaration of the authors for publication of Research Paper in The Indian Journal of Research Anvikshiki ISSN 0973-9777 Bi-monthly International Journal of all Research: We, *Kailash Narayan, Sabita Madhvi Singh and P. K. S. Dikshit* the authors of the research paper entitled RUNOFF ESTIMATION FROM SCS-CN: A CRITICAL REVIEW declare that , We take the responsibility of the content and material of our paper as We ourself have written it and also have read the manuscript of our paper carefully. Also, We hereby give our consent to publish our paper in Anvikshiki journal , This research paper is our original work and no part of it or it's similar version is published or has been sent for publication anywhere else.We authorise the Editorial Board of the Journal to modify and edit the manuscript. We also give our consent to the Editor of Anvikshiki Journal to own the copyright of our research paper.

Abstract

One of the popular methods for estimating the depth of surface runoff, water recharge, stream flow, infiltration, soil moisture content, and landfill leachate production from precipitation for a given rainfall event is the Soil Conservation Service Curve Number (SCS-CN)method. Of late, several inconsistencies in its soil moisture accounting procedure have been pointed and a more rational procedure suggested. Recently, a modification incorporating an expression for estimation of initial soil moisture store level, a crucial parameter, was suggested. The modifiedSCS-CN perform better than all other versions in all classified applications based on land use, soil type, combinations of land use and soil type, and precipitation regimes.Accurate surface runoff estimation techniques suitable for ungauged watersheds are relevant to areas such as India where hydrologic gauging stations are not widely available. The natural resources conservation services curve number (NRCS-CN) method is one of the most widely used methods for quick and accurate estimation of surface runoff from ungauged watersheds.

Key Words : SCS-CN, NRCS-CN,Rainfall,Runoff

1. Introduction

Most of the agricultural watersheds in India are ungauged, having no past records of the rainfall–runoff processes (Sarangi*et al*., 2005). This has led to the development of techniques for estimating surface runoff from ungauged basins (Chattopadhyay and Choudhury, 2006). Of the several methods for runoff estimation from ungauged watersheds, the soil conservation service curve number (SCS-CN) (renamed as natural resources conservation services curve number (NRCS-CN), USDA 1994) method along with its derivatives has been widely applied to ungauged watershed systems and has proved to be a rapid and accurate estimator of surface runoff (Mishra *et al*., 2003). The watershed hydrologic responses that lead to the generation of surface runoff are governed by the interaction of precipitation with the topographic,

*(Correspondence Author)Research Scholar, Department of Civil Engineering (Institute of Technology) Banaras Hindu University Varanasi (U.P.) India. e-Mail : kailash.narayan@ gmail.com
**Research Scholar, Department of Civil Engineering (Institute of Technology) Banaras Hindu University Varanasi (U.P.) India. e-Mail : sabitamadhvi@ yahoo.co.in
***Professor, Department of Civil Engineering (Institute of Technology) Banaras Hindu University Varanasi (U.P.) India. e-Mail : pk_sd@yahoo.com

land use and soil physical properties of the land surface. Therefore, the use of a geographic information system (GIS) is preferred over the traditional techniques such as quantify surface runoff by storing and analysing the factors responsible for runoff. The estimation process becomes more efficient, interactive and less cumbersome when the GIS is used for storing, interpreting and displaying the data required in CN-based runoff estimation techniques.

The method is simple and useful for ungauged watersheds and accounts for four major runoff producingwatershed characteristics, viz., soil type, land use/treatment, surface condition and antecedent moisture conditions (Ponce and Hawkins, 1996; Mishra and Singh, 2003). The method has been a topic of much discussion in hydrologic literature for the last three decades (McCuen, 1982; Hjelmfelt, 1991; Hawkins, 1993; Steenhuis*et al*., 1995; Ponce and Hawkins, 1996; Yu, 1998; Mishra and Singh, 1999, 2002, 2003; Michel et al., 2005; Schneider and McCuen, 2005; Mishra et al., 2006; Sahu*et al*., 2007). Despite several modifications of the SCS-CN method have been suggested and reported in literature, a need for further improvement of the method has been experienced (Ponce and Hawkins, 1996; Mishra and Singh, 2002). Michel *et al.* (2005) pointed out several inconsistencies in the soil moisture accounting (SMA) procedure of the SCS-CN method and proposed a more rational procedure.

An estimation of surface runoff is essential for reducing sediments and consequent hazards because runoff is the driving force behind soil erosion. Although many hydrologic models are available for the estimation of runoff, most physically based models are limited because of their large number of input parameters and complicated calibration requirements (Wu *et al*., 1993; Kothyari and Jain, 1997). The objective of this paper is application of CN in efficient way so we can maintain our land/watershed form the erosion of soil.

2. Methodology

2.1 Background of SCS-CN

The CN was initially developed as a design tool to estimate runoff from rainfall events onAgricultural fields. (i) The sources of the original data are very obscure and difficult to verify. (ii) The method is now used as The method for computing peak runoff rates and volumes for Urban Hydrology.(iii) TR-55 (Technical Release no. 55), a simplified NRCS tool essentially joins the NRCS runoff equation with unit hydrograph theory for the computation of these runoff rates.

The SCS (1972) defined the following four types of runoff: (i) *Channel* runoff-occurs when rain falls on a flowing stream or on the impervious surfaces of a stream flow-measuring installation.(ii) *Surface runoff* occurs only when the rainfall is greater than the infiltration rate. (iii) *Subsurface* runoff-occurs when the rainfall meets an underground zone of lower transmission.(iv)*Base flow*-occurs when there is a fairly steady flow from the natural storage.

The SCS-CN method estimates direct runoff with the curve numbers indicating the proportions of surface and subsurface flow, larger curve numbers represent a greater proportion of surface runoff. Research has shown that the method is less accurate for smaller curve numbers, representing subsurface flow.

Essentially, four steps are necessary to evaluate runoff from intense rainfall by the method developed by the SCS (1972). The first step is to determine the hydrologic soil group of the particular soil to be studied from a master list of soils prepared by the SCS. All soils are classified in one of four different categories-ranked A-D on the basis of their runoff potential. *Class* A soils mostly consist of deep, welldrained sands and gravels with low runoff potential and high infiltration and water transmission rates. *Class B* soils have moderately fine to moderately coarse textures and are considered to have moderate infiltration rates when completely wet. *Class C* soils have moderately fine to fine textures with slow infiltration and water transmission rates. *Class D* soils are primarily clay soils or soils with clay pans that have slow infiltration rates when wet.

The second step is to determine the five-day antecedent moisture condition (AMC) of the particular soil from the daily precipitation record. This is also referred to as Antecedent RunoffCondition (ARC). This provides a measure of soil wetness. In this situation, the precipitation totals that will shift the soil from one antecedent moisture class to another, vary with the season of the year. One series of five-day precipitation totals is applied to the dormant season and a second series of five-day precipitation totals is used during the growing season. The AMC values for the upper, average, and lower conditions are termed AMC I, AMC II, and AMC III, respectively.Table 1 gives the seasonal fiveday accumulated rainfall limits for the three antecedent moisture condition classes.

The third step is to decide-on the basis of the land cover, the cultivation treatment, the hydrologic condition of the soil, and the hydrologic soil group of the particular soil-the actual runoff curve number to use in determining daily runoff from precipitation. Land use, cover treatment, and hydrologic condition can be determined based on the following summaries fromthe SCS (SCS, 1972).

Total 5-Day Antecedent Rainfall

T A B L E 1 *Seasonal five-day rainfall totals for various antecedent moisture condition classes*

Antecedent moisture Condition Class	Dormant season(In)	Growing season(In)
Dry I	<0.5	<1.4
Average II	0.5 to 1.1	1.4 to 2.1
Wet III	>l.l	>2.1

The Runoff Curve Number (RCN) can be adjusted for differing AMC based upon the above equations and criteria.

2.2 Theory of SCS-CN Model

The method is summarized by using curve numbersto represent a single parameter relation betweenrainfall depth and runoff depth. The single parameterrelation is S; the transform of S is CN (Clopper,1980). The SCS method uses only three factors tomodify S: season of year and antecedent precipitationwhich together, provide a rough measure of theexpected value of soil moisture; the hydrologic soilcovercomplex which reflects the effects of vegetation;and land use which represents some, but not all, ofthe watershed influences on infiltration and overlandflow (Martin, 1979; Montgomery, 1980; Clopper,1980). However, many factors influence infiltrationand therefore can be correlated with S includingrainfall pattern, initial soil moisture, tillage practice,physical soil properties, and influences of vegetationroots and stems. Factors which influence overlandflow and flow attenuation include surface roughness(resulting from both soil and vegetation), surfacestorage, slope, size of watershed overland flow area,and rate of precipitation. Thus, the CN method hasbeen shown to be sensitive to the selection of thecurve numbers which differ with soil type, vegetationcover, and hydrologic soil conditions.

Geetha*et al*. (2005)studied the applicability of the modified NRCS-CN conceptto identify the dominant runoff generation process in watersheds.The pronounced modifications were the incorporationof seasonal variation of CN and variations in the dailystorages using evaporation and transpiration estimates.

2.3 Modification in SCS-CN

Mishra and Singh (2002) modified this method for long-term hydrology simulations by incorporating an evapotranspiration component, modifying the initial abstraction estimation techniques and extending it for computation of infiltration and runoff rates. Bhuyan*et al*. (2001) used the modified curve number

(CN) technique for predicting surface runoff by adjusting the CNs based on the estimated AMC ratios. It was shown that the CN approach could be used for accurate prediction of runoff depths from storm events over ungauged watersheds.

2.4 CN Methods used in the Interface

To date, researchers have reported eight modifications of theoriginal NRCS-CN approaches (Mishra and Singh, 2003).Considering the application of the modified CN methodsunder different topographic, hydrologic soil group and landuseconditions, and their contrasting characteristics relatingto initial abstraction and antecedent moisture conditions,three modified CN methods were selected for inclusion in theinterface as well as the original NRCS-CN formulae. Themethods are briefed in the following subsections.

(i) NRCS-CN method : The NRCS-CN method is based on the water balance equation and two fundamental hypotheses (SCS, 1956). The first hypothesis equates the ratio of the amount of direct surface runoff Q to the total rainfall P (or maximum potential surface runoff) with the ratio of the amount of infiltration F_c to the amount of the potential maximum retention S. The second hypothesis relates the initial abstraction I_a to the potential maximum retention. Thus, the NRCS-CN method consisted of the following equations:

(a) Water balance equation:

$$P = I_a + F_c + Q \qquad (1)$$

(b) Proportional equality hypothesis:

$$\frac{Q}{P - I_a} = \frac{F_c}{S} \qquad (2)$$

(c) I_a-S hypothesis:

$$I_a = \lambda S \qquad (3)$$

Where P is the total rainfall; I_a the initial abstraction; F_c the cumulative infiltration F_c excluding I_a; Q the direct runoff; S the potential maximum retention or infiltration; and λ the regional parameter dependent on geologic and climatic factors ($0.1 \leq \lambda \geq 0.3$). The relation between I_a and S was developed by analysing the rainfall and runoff data from experimental small watersheds (SCS, USDA, 1956) and is expressed as $I_a = 0.2S$. Combining the water balance equation and proportional equality hypothesis, the NRCS-CN method is represented as:

$$Q = \frac{(P - F_s)^2}{(P - F_s + S)} \qquad \text{for } P \geq I_a \qquad (4)$$

$$Q = 0 \qquad \text{for } P \leq I_a \qquad (5)$$

The potential maximum retention storage S of watershed is related to a CN, which is a function of land use, land treatments, soil type and antecedent moisture condition of watershed. The CN is dimensionless and its value varies from 0 to 100. The S-value in mmcan be obtained fromCN by using the relationship:

$$S = \frac{25{,}400}{CN} - 254 \qquad (6)$$

(ii) Modified CN method (CN I) : The modified CN I method is based on the concept of zero initial abstraction ($I_a = 0$), i.e. immediate ponding for calculating the runoff depth Q froma given rainfall depth P. Using this concept in the original NRCS-CN proportionality hypothesis (i.e. Eq. (2)), the resulting equation for surface runoff estimation was obtained:

$$Q = \frac{P2}{S+P} \tag{7}$$

The two extremely dry and wet scenarios, which may produce runoff, were not considered in the original NRCS-CN method due to its concept of runoff occurring only after fulfilling the initial abstraction I_a requirements. Therefore, this modified CN method was considered in this study toaccount for the conditions prevailing in watershed systems under high-intensity rainfall events.

(iii) Modified CN method (CN II): In this modification of the CN method, the initial abstractionI_a was modified by associating a non-dimensional parameter λwith the potential maximum retention S, which is represented as I_a- λS. The parameter λdepends on the time of ponding t_p and Horton's constant á and are associated as: λ = át_p. In contrast with the hypothesis of the original NRCS-CN method, which assumes the time of ponding to be zero, this modification considered the time of ponding from the beginning of rainfall to the initiation of the runoff process. Under these modifications, the equation for estimation of surface runoff using the modifiedCN II was:

$$Q = \frac{(P - \lambda S)^2}{(P - S(\lambda - 1))} \tag{8}$$

(iv) Modified CN method (CN III): In this modification, the cumulative infiltration Fc parameterused in the original NRCS-CN method was divided into basicand dynamic components during the rainfall–runoff processes.The modified CN III method highlighted the basic infiltration component during the rainfall–runoff processes, whereas the original NRCS-CN method did not consider this parameter directly. However, in the hypothesis of the NRCS-CN method, the actual infiltration (F_c - I_a) was considered without any specific attention both basic and dynamic infiltration components in the runoff generation process. Therefore, the modified CN III method could provide meaningful and accurate predictions of runoff for longer duration rainfall events, in which the basic infiltration component is more predominant. Therefore, in the original NRCS-CN hypothesis, by substituting the components of F_s and $F_d$against appropriate parameters of Eq. (2), the final expression of surface runoff depth was :

$$Q = \frac{(P-F_S)^2}{(P-F_S+S)} \tag{9}$$

2.5 Co-relation between Modified CN

Three AMCs were defined as dry (lower limit of moisture or upper limit of *S*), moderate (normal or average soil moisture condition), and wet (upper limit of moisture or lower limit of *S*), and denoted as AMC I, AMC II, and AMC III, respectively (Mishra and Singh, 2003). The CN value of AMC II (CNII) was provided by the SCS-CN manual and the CN value of AMC I (CNI) and CN value of AMC III (CNIII) can be calculated by applying the following equations (USDA SCS, 1985):

$$CN\ I = \frac{4.2\ CN\ II}{(10 - 0.058CN\ II)} \tag{10}$$

$$CN\ III = \frac{23\ CN\ II}{(10 + 0.13CN\ II)} \tag{11}$$

2.6 Solution of Runoff Equation

Over the years, data collected in the field has been analyzed. This data has been produced in a number of forms. One is graphically as an "X-Y" graph, shown below. On the "x" axis is the independent variable, in this case the amount of rainfall in inches. On the "y" axis is the dependent variable, the amount of direct runoff of water in inches(TR-55 (Technical Release no. 55)).

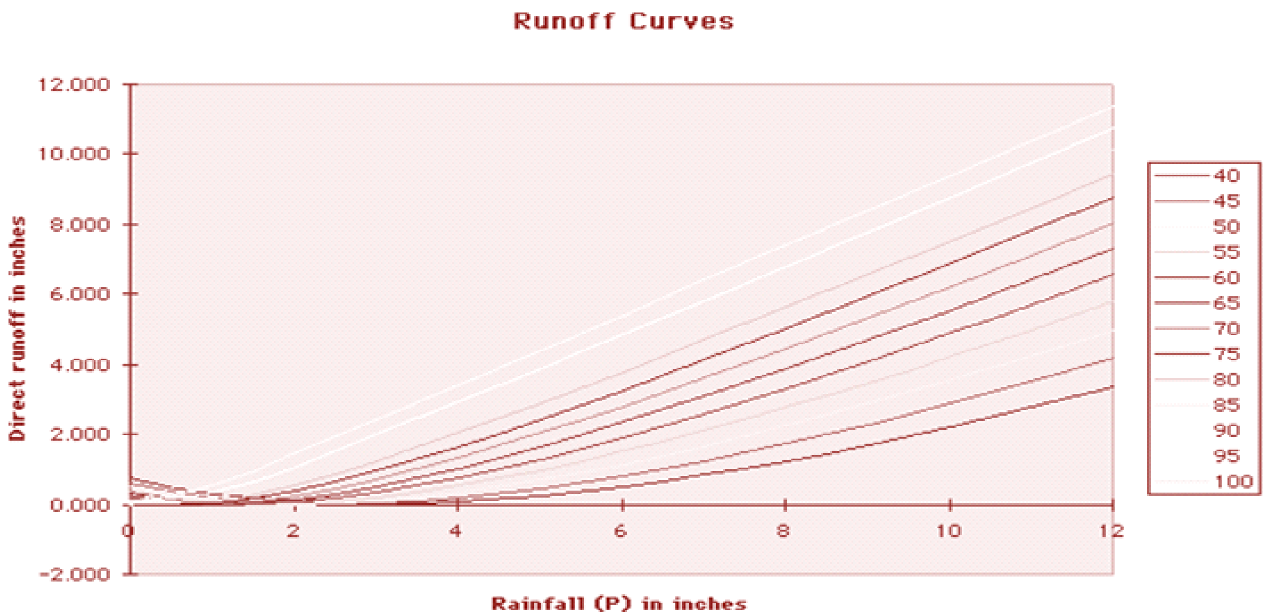

Figure1 *Solution Of Runoff Equation*

3. Result

In India, accurate information on runoff is scarce and only available in a few selected sites. Thus, there is an urgent need to generate information on basin runoff and sediment yield for the acceleration of the watershed development and management programmes (Zade*et al*., 2005).The SCS-CN model is a simple, empirical model with clearly stated assumptions and few data requirements. Therefore, it has been widely used for water resource management, storm water modeling and runoff estimation for single rainfall events in small agricultural or urban watersheds (Greene and Cruise, 1995; Tsihrintzis and Hamid, 1997; Lewis *et al*., 2000; Chandrmohan and Durbude, 2001; He, 2003; Liu *et al*., 2005; Mishra *et al*., 2006; Liu and Li, 2008; Sahu*et al*., 2010a).

4. Conclusion

The Curve Number method (SCS, 1972), also known as the Hydrologic Soil Cover Complex Method, is a versatile and widely used procedure for runoff estimation. In this method, runoff producing capability is expressed by a numerical value varying between 0 - 100. In the past 30 years, the SCS method has been used by a few researchers because it gives consistently usable results (Rao et. al.,1996; Sharma et al. 2001; Chandramohan and Durbude, 2001; Sharma and Kumar, 2002) for runoff estimation.On the basis of corroboration of modified CN the finding that the NRCS-CN-based surface runoff predictions are very sensitive to the antecedent moisture conditions (AMC) of watershed systems. This necessitates further modification of the CN-based methods to include more limiting scenarios and any realistic indices to account for the antecedent moisture conditions prevailing in the watershed during and before the rainfall event. When CN and the amount of rainfall have been determined for the watershed, determine runoff by using Figure 1.

References

BHUYAN S J; KOELLIKER J K; BARNES P L (2001). Modification of curve number adjustment technique for prediction of runoff. In: Presented in Soil Erosion Research for the 21st Century, Proceedings of the International Symposium, 3–5 January 2001, Honolulu, HI, USA, 701P0007 (Ascough II J C; Flanagan D C, eds), pp 287–290. ASAE, St. Joseph, MI

BONDELID, T.R., MCCUEN, R.H., JACKSON, T.J.(1982), Sensitivity of SCS models to curve number variation. Water Resources Bulletin 18, 111–116.

CHATTOPADHYAY G S; CHOUDHURY S (2006), Application of GIS and remote sensing for watershed development project—a case study. Map India 2006 *www.gisdevelopment.net*

CLOPPER, P.E.(1980), Antecedent Moisture Consideration in the SCS Curve Number Rainfall-Runoff Model, M.S. Thesis, Colorado State University, Fort Collins.

CHANDRMOHAN, T. & DURBUDE, D. G. (2001), Estimation of runoff using small watershed models. *Hydrol. J*. *24*(2): 45–53.

GEETHA K; MISHRA S K; RASTOGI A K; ELDHO T I; PANDEY R P (2005), Identification of dominant runoff generation process using the modified SCS-CN concept. Recent Advances in Water Resources Development and Management, pp 477–491

GREENE, R. G. & CRUISE, J. F. (1995), Urban watershed modeling using geographic information system. *J. Water Resour. Plann. Manage*. *121*(4): 318–325.

HAWKINS, R.H.(1993), Asymptotic determination of runoff curve numbers from data. J. Irrig. Drain. Eng.-ASCE 119 (2), 334–345.

HE, C. (2003), Integration of geographic information systems and simulation model for watershed management. *Environ. Model. Softw. 18*(8–9): 809–813.

HJELMFELT Jr., A.T. (1991), Investigation of curve number procedure. J. Hydrol. Eng.- ASCE 117 (6), 725–737.

LEWIS, D., SINGER, M. J. & TATE, K. W. (2000), Applicability of SCS curve number method for a California oak woodlands watershed. *J. Soil Water Conserv*. *55*(2): 226–230.

LIU, X. Z., KANG, S. Z., LIU, L. D. & ZHANG, X. P. (2005), SCS model based on geographic information and its application to simulate rainfall-runoff relationship at typical small watershed level in Loess Plateau. *Trans. CSAE* (in Chinese). *21*(5): 93–97.

LIU, X. Z. & LI, J. Z. (2008), Application of SCS model in estimation of runoff from small watershed in Loess Plateau of China. *Chin. Geogra. Sci*. *18*(3): 235–241.

MARTIN, C.D.(1979), Critique of the SCS Runoff Model, M.S. Thesis, The Pennsylvania State University, University Park.

MISHRA S K; SINGH V P (2002), SCS-CN method: part-I: derivation of SCS-CN based models. ActaGeophysicaPolonica, 50(3), 457–477

MISHRA S K; SINGH V P; SANSALEVE J J (2003), A modified SCS-CN method: characterization and testing. Water Resources Management, 17, 37–68

MISHRA S K; SINGH V P (2003), Soil Conservation Service Curve Number Methodology, Vol. 43. Kluwer Academic Publishers, Dordrecht, The Netherlands.

MISHRA S K; SINGH V P (1999), Another look at the SCS-CN method. Journal of Hydrological Engineering ASCE, 4(3), 257–264

MISHRA, S.K., SAHU, R.K., ELDHO, T.I., JAIN, M.K. (2006), An improved Ia–S relation incorporating antecedent moisture in SCS-CN methodology. Water Resources Management 20, 643–660.

MISHRA, S. K., TYAGI, J. V., SINGH, V. P. & SINGH, R. (2006), SCS-CN-based modeling of sediment yield. *J. Hydrol*. 324(1–4): 301–322.

MICHEL, C., VAZKEN, A., PERRIN, C.(2005), Soil conservation service curve number method: how to mend a wrong soil moisture accounting procedure. Water Resource. Res. 41, 1–6 W02011.

MONTGOMERY R.J.(1980), A Data-Based Evaluation of the SCS Cover Number Method for Runoff Predictions, M.S. Thesis, Colorado State University, Fort Collins, pp 16-22.

PONCE, V.M., HAWKINS, R.H.(1996), Runoff curve numcer: has it reached maturity? Journal of Hydrologic Engineering - ASCE 1, 11–19.

SAHU, R K, MISHRA, S K, ELDHO, T I, JAIN, M K (2007). An advanced soil moisture accounting procedure for SCS curve number method. Hydrological Processes 21(21): 2872–2881.

SAHU, R. K., MISHRA, S. K. & ELDHO, T. I. (2010a.), Comparative evaluation of SCS-CN-inspired models in applications to classified datasets. *Agr. Water Manage*. *97*(5): 749–756.

SARANGI A; ADRAMOOTOO C A; ENRIGHT P; PRASHER S O; PATEL R M (2005). Performance evaluation of ANN and geomorphologycased models for runoff and sediment yield prediction for a Canadian watershed. Current Science, 89(12), 2022–2033

SCS (1956). Hydrology. National Engineering Handbook, Supplement A, Section 4 Chapter

SCHNEIDER, L.E., MCCUEN, R.H.(2005), Statistical guidelines for curve number generation. J. Irrig. Drain. Eng.-ASCE 131 (3), 282–290.

STEENHUIS, T.S., WINCHELL, M., ROSSING, J., ZOLLWEG, J.A., WALTER, M.F.(1995), SCS runoff equation revisited for variable-source runoff areas. J. Irrig. Drain. Eng. 121, 234– 238.

TSIHRINTZIS, V. A. & HAMID, R.(1997), Urban stormwater quantity/quality modeling using the SCS method and empirical equations. *J. Am. Water Resour. Assoc*. *33*(1): 163–176.

YU, B.(1998), Theoretical justification of SCS method for runoff estimation. J. Irrig. Drain. Eng. 124, 306–310.

ZADE M; RAY S S; DUTTA S; PANIGRAHY S (2005), Analysis of runoff pattern for all major basins of India derived using remote sensing data. Current Science, 88(8), 1301–1305

Note for Contributors

SUBMISSION OF PAPERS

Contributions should be sent by email to Dr. Maneesha Shukla Editor-in-Chief, Anvikshiki, The Indian Journal of Research (maneeshashukla76@rediffmail.com). www.onlineijra.com

Papers are reviewed on the understanding that they are submitted solely to this Journal. If accepted, they may not be published elsewhere in full or in part without the Editor-in-Chief's permission. Please save your manuscript into the following separate files-***Title; Abstract; Manuscript; Appendix.*** To ensure anonymity in the review process, do not include the names of authors or institution in the abstract or body of the manuscript.

***Title*:** This title should include the manuscript, full names of the authors, the name and address of the institution from which the work originates the telephone number, fax number and e-mail address of the corresponding author. It must also include an exact word count of the paper.

***Abstract*:** This file should contain a short abstract of no more than 120 words.

MANUSCRIPT: This file should contain the main body of the manuscript. Paper should be between 5 to 10 pages in lenth,and should include only such reviews of the literature as are relevant to the argument. An exact word count must be given on the title page. Papers longer than 10 pages (including *abstracts, appendices and references*) will not be considered for publication. Undue length will lead to delay in publication. Authors are reminded that Journal readership is abroad and international and papers should be drafted with this in mind.

References should be listed alphabetically at the end of the paper, giving the name of journals in full. Authors must check that references that appear in the text also appear in the References and *vice versa.* Title of book and journals should be italicised.

***Examples*:**

BLUMSTEIN,A.and COHEN,J.(1973),'A Theory of Punishment' *Journal of Criminal Law and Criminology*,64:198-207

GUPTA,RAJKUMAR(2009),*A Study of The Ethnic Minority in Trinidad in The Perspective of Trinidad Indian's Attempt to Preserve Indian Culture*, India: Maneesha Publication,

RICHARDSON,G(1985),Judicial Intervention in Prison Life', in M. Maguire ,J. Vagg and R. Morgan, eds., *Accountability and Prisons*,113-54.London:Tavistocs.

SINGH,ANITA.(2007),*My Ten Short Stories*,113-154.India:Maneesha Publication.

In the text,the name of the author and date of publication should be cited as in the Harvard system(e.g.Garland 1981: 41-2;Robertson and Taylor 1973;ii.357-9)If there are more than two authors, the first name followed by *et al.* is manadatory in the text,but the name should be spelt out in full in the References. Where authors cite them as XXXX+date of publication.

Diagrams and tables are expensive of space and should be used sparingly. All diagrams, figures and tables should be in black and white, numbered and should be referred to in the text.They should be placed at the end of the manuscript with there preferred location indication in the manuscript(e.g.Figure 1 here).

Appendix: Authors that employ mathematical modelling or complex statistics should place the mathematics in a technical appendix.

NOTE : Please submit your paper either by post or e-mail along with your photo, bio-data, e-mail Id and a self-addressed envelop with a revenue stamp worth Rs.51 affixed on it. One hard copy along with the CD should also be sent.A self-addressed envelop with revenue stamp affixed on it should also be sent for getting the acceptance letter. Contributors submitting their papers through e-mail, will be sent the acceptance letter through the same. Editorial Board's decision will be communicated within a week of the receipt of the paper. For more information, please contact on my mobile before submitting the paper. All decisions regarding members on Editorial board or Advisory board Membership will rest with the Editor. Every member must make 20 members for Anvikshiki in one year. For getting the copies of 'Reprints', kindly inform before the publication of the Journal. In this regard, the fees will be charged from the author.

" After submission, the manuscript is reviewed by two independent referees. If there is disagreement between the referees , the manuscript is sent to third referee for review. The final decision is taken by the Editor in chief".

Search Research papers of The Indian Journal of Research Anvikshiki-ISSN 0973-9777 in the Websites given below

http://nkrc.niscair.res.in/BrowseByTitle.php?keyword=A

National Knowledge Resource Consortium

www.icmje.org

www.kmle.co.kr

www.banaras.academia.edu

www.docslibrary.com

www.printfu.org

www.freetechebooks.com

www.scholar.google.co.in

www.fileaway.info

www.www.edu-doc.com

www.dandroidtips.com

www.cn.doc-cafes.com

www.google.com

ISSN 0973-9777

09739777

₹ 1600/-