

THE BIBLIOMETRIC STUDY OF FLOOD DISCHARGE BY UNIT HYDROGRAPH METHOD NAKAYASU SYNTHETIC (HSS) AND SOIL CONSERVATION SERVICE (SCS)

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ABSTRACT

Urban territorial expansion and forest disclosure are two examples of large-scale modifications necessary because of population growth and the rising demand for land. The paper analyzes the various facets of urban development and the essential role that hydrology plays in planning construction projects and water infrastructure. Hydrology study becomes essential for engineers designing and developing structures involving water resources, especially when flood conditions arise. The paper explores two commonly used flood hydrograph approaches, the Nakayasu Synthetic and the Soil Conservation Service (SCS) Unit Synthetic, concentrating on the design of flood discharge and its significance in flood management. The study provides insight into the feasibility of existing hydrograph techniques for determining flood discharge and is based on bibliometric data from earlier studies.

Keywords: *Flood Discharge; Nakayasu Synthetic; SCS Unit Synthetic; VOSviewer.*

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INTRODUCTION

The process of converting land to suit urban residents' needs for the infrastructure and amenities necessary for a city's expansion is called urban development. The state's large-scale forest disclosure, urban territorial expansion, and agricultural area expansion are necessary due to the increasing population and consequent demand for land for housing and other infrastructure [1]. In planning a construction, engineers must consider several factors contributing to the construction site. Hydrology becomes a crucial data source, especially during the planning and constructing of buildings related to water resources. One of the hydrology cases that will play a significant role in building and construction sites such as floods.

The flood discharge value is required for planning and serves as the foundation for developing water structures. This value influences planning regarding the building's strength, efficiency, and economic worth [2]. Thus, comprehending hydrological data is essential to carrying out hydrological analysis and building water structures, including flood control buildings, irrigation buildings, river management, etc. [3]. A flood is a hydrometeorological calamity that occurs as surface flow discharge rises beyond storage capacity, causing overflow on the ground surface or running off [4]. An area of flooding caused by prolonged, heavy rain flushed the residential area because of the river's capacity to handle the water that entered and overflowed. The need to perform flood management was the driving force behind the study's assessment of the design flood discharge.

While determining the capacity and dimensions of hydraulic buildings or even flood control, water resources planning infrastructure and management, including those set-in rivers,

the design flood is the amount of flood discharge that is established as a basis to ensure that potential damage from floods, whether direct or indirect, is limited and that the permitted level of flooding is not exceeded [5]. Once planning watersheds and managing floods, it is essential to determine the maximum flood discharge to predict the hydrological behavior of the watershed. The unit hydrograph is a common approach used in peak flow estimation and in the production of complex flood hydrographs [6]. The direct runoff hydrograph created by a single unit (inch) of sufficient precipitation (discharge) spread evenly over a water basin is known as a unit hydrograph. A watershed's DRH can be estimated by combining unit hydrographs with watershed and precipitation data [6]. Any actual precipitation can be used to derive the unit hydrograph, which is a straightforward linear model [7].

This study will primarily investigate two flood hydrograph methods: the Nakayasu Synthetic (HSS) method and the Method Hydrograph Unit Synthetic Soil Conservation Service (SCS) since it has been hypothesized that these two approaches are the most often applied hydrograph techniques. The Nakayasu Synthetic Unit Hydrograph is one of the most common used techniques [8]. Nakayasu, a Japanese national, developed an effective method used in many water resource planning, particularly for analyzing immeasurable watershed floods (DAS). In conjunction, the Hydrograph Unit Synthetic Soil Conservation Service (SCS) technique uses assumptions for a triangular hydrograph based on uniform rainfall [9].

Water structure design and construction and the management of natural calamities depend significantly on the computation of a watershed's runoff volume and pick discharge value. As a result, various techniques have been developed. They state that the bibliometric study's primary data will derive mainly from these prior studies. This study aims to evaluate the applicability of the hydrograph method, which is currently used in study research for determining flood discharge.

METHOD

The bibliometric method, assisted by VOSviewer, is used in this study to assess the Crossref literature on RIS. This program can map the associations between keywords, authors, and citations. The references were compiled starting in 2000, emphasizing Planning and Hydraulic engineering. With all the gathered regards from VOSviewer, a map will be created with the help of Publish or Perish 8 software. The map, generated using bibliographic data, will be listed using text information from the reference manager taken from VOSviewer. A co-occurrence network of author keywords was built with VOSviewer for this study's keyword analysis. Using this research method, it is possible to establish how closely connected two keywords are based on how frequently they appear in the same article. Researchers can obtain an accurate image of scientific knowledge generation in terms of patterns, associations, and conceptual organization of the study issues covered by mapping a network of linked keywords, representing published articles' main content.



Figure 1. Scopus Bibliometric Data Interpretation Flow

The second stage of data filtering emphasizes the relevant subject by rendering the articles particularly relevant to each other. This filter primarily applies to journals published between 2000 and 2023 with a selected number of 1000 publications. Many of the chosen subject areas are in civil engineering. Document types include conference papers, articles, reviews, book chapters, and conference reviews, with sources ranging from journals, conference proceedings, trade journals, book series, and books selected as the reference set's parameters.

RESULTS AND DISCUSSION

Keyword Analysis

Utilizing an assortment of keywords from publish or perish and VOSviewer software, the network analysis managed to identify over a dozen ranges along with specifics regarding flood discharge studies and the Hydrograph Unit Method. The keywords mainly used for clustering the publications are “Flood hydrograph” and “peak discharge.” The following methods frequently used for unit hydrographs automatically link with these two keywords and other underlying concepts that reinforce their significance, including land use, watershed, flood discharge, and urban flood.

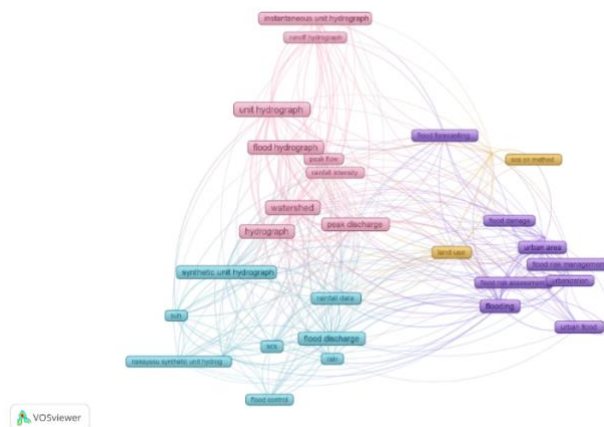


Figure 1. Network display of unit hydrograph keywords

The most relevant term, with an occurrence number of 48 and a comparatively low relevance point of 0.34, according to the keyword occurrence amount, is "peak discharge." The keyword "urban flood management" holds the highest relevance point, with a score of 4.74 and an occurrence number of 16. The SCS method contains an occurrence number of 36 with a relevance point of 0.92, while the Nakayasu method has a 12-occurrence number with 2.20

issues of relevance.

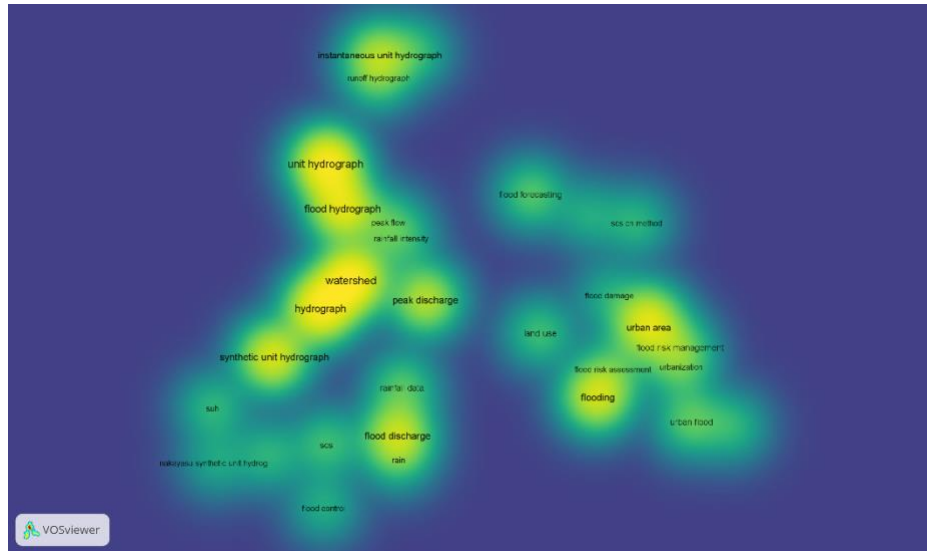


Figure 2. Density display of unit hydrograph keywords

Figure 3, density display, shows that the more frequently research is conducted, the less intense the yellow color, the larger the circle's diameter, and the denser the keywords. Conversely, the fading of the tint indicates a decrease in completed studies. The obtained density map suggests that the keyword "unit hydrograph" has the highest occurrence rate (85) out of all the other keywords. Given that the primary term in this study for this bibliometric clustering is unit hydrograph. To investigate the unit hydrograph method trend and research area in this discipline, the word frequency analysis method is the procedure of identifying keywords or subject words that may convey the paper's key points from the content's information and distributing them in high and low order.

Annual Appearance

Figure 4 displays the overall number of publications on "Unit Hydrograph" throughout 23 years, from 2000 to 2023. The chosen publication is gathered explicitly with the help of publish or perish 8 to analyze the trend in the unit hydrograph method study. Based on 1000 publications, 507 publications have been identified as relevant for this study, following the clustering of the results.

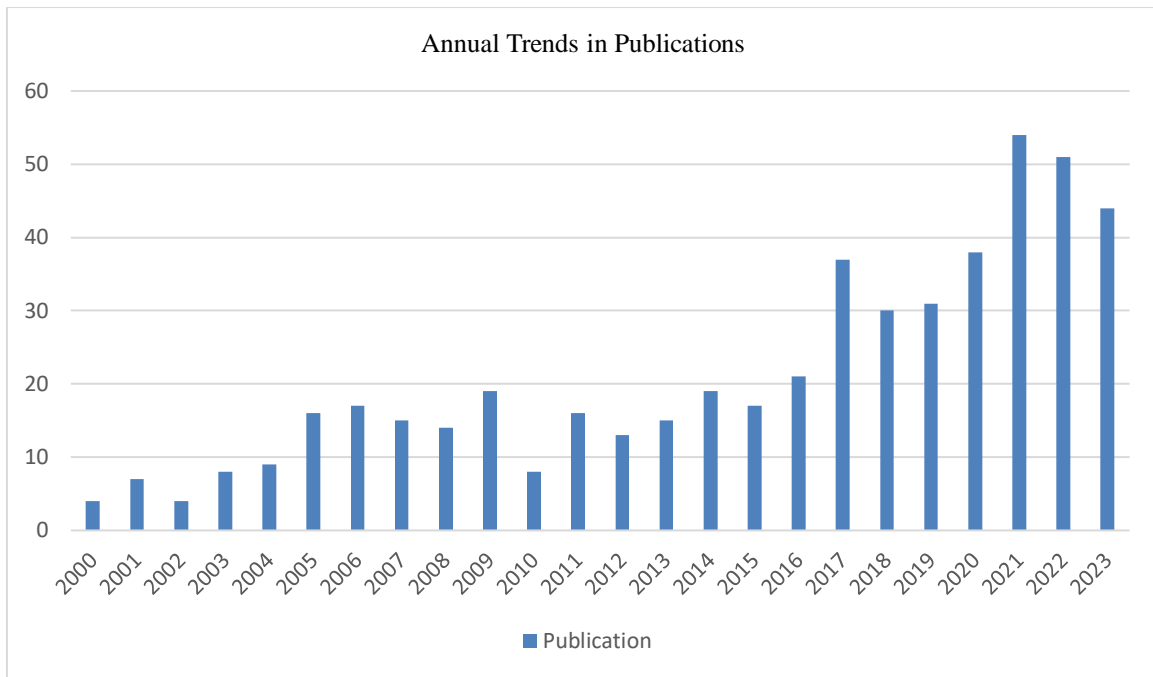


Figure 3. Annual Trends based on the publications

Based on the generated graphic, the growth of trend on this study topic is significantly high, especially starting in 2017. The substantial rise in publications can be attributed to organizations' widespread interest in studying the unit hydrograph method. With a peak number of 54 journals in 2021, as opposed to a starting position of 4 publications in 2000. It proves that the unit hydrograph study has experienced a significant increase of 1,250% growth. Research trends regarding the unit hydrograph approaches are anticipated to expand in 2024.

Regional Publications Analysis

Bibliometric analyses can draw attention to differences in the impact and output of research between various national regions. Acknowledging these differences opens doors for focused interventions, distribution of resources, and cooperative projects aimed at resolving issues and building a fairer global research environment. The cluster data analysis showed that Asia significantly contributes to worldwide research on the unit hydrograph method. Asian countries have regularly published many research publications in various disciplines.

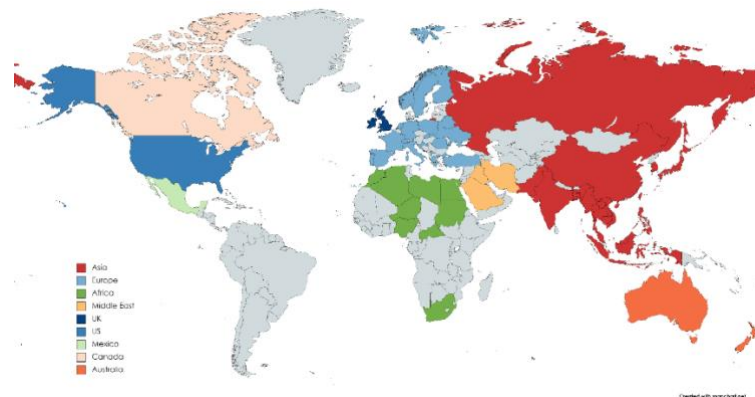


Figure 4. Region Division

To probe further into the regions served by these studies, with 92 publications, the part of South Asia has carried out the most unit hydrograph studies. Particularly India, which mainly occurs in South Asia. Following Southeast Asia, it comes in second place with 87 publications on the unit hydrograph method. Indonesia dominates Southeast Asia in unit hydrograph study, particularly a study case in flood discharge in watershed areas.

Table 1. Region Occurrence Amount

Region Relevance	Amount
Southeast Asia	87
US	59
Europe	60
UK	6
China	50
Japan	28
Turkey	21
Mexico	27
South Asia	92
Africa	4
Middle East	28
Korea	31
Canada	6
Rusia	8

Africa, alongside four publications in the cluster, was the least represented. Other regions that are designated include the Middle East (28 publications), the UK (6 publications), Korea (31 publications), North America (six publications), China (average of 50 journals), Japan (28 publications), Turkey (21 publications), Mexico (27 publications), Korea (59 publications), and the United States (59 publications). Most studies conducted in regions like China, the US, Japan, Korea, and Europe concentrate on evaluating urban flood design and flood risk. Certain areas, which include the Middle East, Mexico, Turkey, Canada, Africa, Russia, and the UK, are primarily known for publishing studies on the unit hydrograph method.

Type of Publication

Various publishing types, including journal articles, books, components, posted material, proceedings articles, reference entries, and reports, were included in a compilation of bibliometric data gathered and subsequently subjected to clustering analysis. The clustering results clarify the occurrence patterns for each publication type and draw attention to the predominance of formats in the global academic discourse.

Table 2. Publication Type Result

Type of Publication	Amount
Book	44
Component	2
Journal Article	355
Other	2
Posted Content	41

Proceedings Article	58
Reference Entry	1
Report	4

Journal articles are the primary publishing type prevalent in unit hydrograph studies. Most studies on the unit hydrograph approach are usually presented as study case articles. Two publications under the category "other" are among the other types of journals found in the result data. This "other" denotes that both publications are based on a published Encyclopedia from an online library. At the same time, a component type of publication contains a book chapter available through the online library Access. Following with the least number of occurrences in the result, that is a reference entry containing only one publication.

Exhibit the HSS and SCS Method's Hypothesis

A new set of keywords is used to extrapolate the findings of the unit hydrograph methods to examine the most widely used process in unit hydrograph studies. To cluster the data from a Crossref reference, two general keywords are used: "flood discharge" and "the unit hydrograph method." A density map illustrating the occurrence type of method often used in unit hydrograph study is created using VOSviewer for the cluster data result.

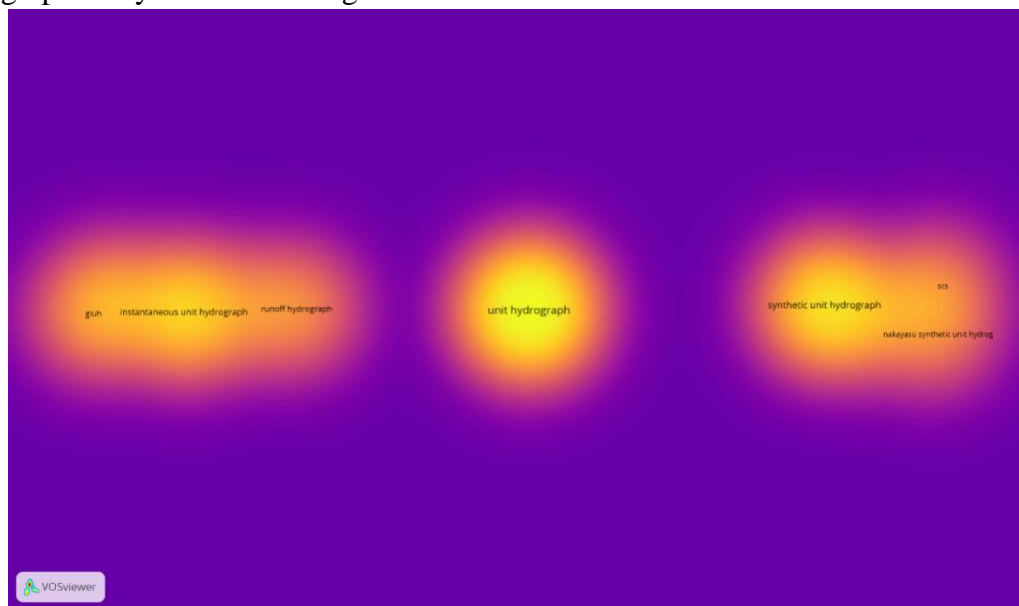


Figure 5. Methods Range Density

The VOSviewer software's density map (Figure 3) illustrates how the SCS unit hydrograph method is a prominent approach for the unit hydrograph method studies. The SCS occurrences number is 11 with a relevance point of 0.34, and with the Nakayasu method, the occurrences number is 11 with a relevance point of 0.31. Using the second clustering, identify a highly concentrated area of research on the prominent unit hydrograph approach.

The density VOSviewer map displays the outcome of the occurrence amount. It is demonstrated that in unit hydrograph studies, one of the methods mainly used is the SCS method, followed by the Nakayasu method, which is the least on the list. However, applying the Nakayasu Unit Hydrograph Method to this strategy is limited. From the first data cluster of 507 publications, only below 30 studies primarily use the Nakayasu Unit Hydrograph method; in contrast, the SCS method is most often adopted.

CONCLUSION

This study integrates mapping visualization analysis utilizing VOSviewer software with Publish or Perish to carry out bibliometric research in the unit hydrograph method. The topic area of the data collection included titles, abstracts, and keywords derived from the term "unit hydrograph." Five hundred-seven pertinent publications published between 2000 and 2023 were located based on the search results. Subsequently, VOSviewer separates the visualization process into three categories: network visualization, overlay visualization, and density visualization.

Based on the mapping results, significant growth research was conducted in the unit hydrograph between 2000 and 2023. The most prevalent type of publication, the article journal, indicates an intense emphasis on case studies on this topic. This bibliometric analysis offers an in-depth comprehension of the disparities in research output and impact between various countries and regions, emphasizing Asia as the region with the most publications in the unit hydrograph method.

As a result of an overall used method, the Nakayasu approach is only used in a few studies; the SCS method's dominance highlights how well accepted and used it is. To utilize the best hydrological approaches in various watershed scenarios, researchers, practitioners, and policymakers must thoroughly understand the elements that influence method selection. This research aims to assist future researchers in conducting relevant research and serve as a reference for them.

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