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Development and Application Of Integrated Catchment And Surface Water Quality Model In River Network Area: A Review

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ABSTRACT

Water is fundamental for life, and the effective use of water resources is a key cause of the issue. Water resources are being degraded and pollution is increasing because of anthropogenic operations, putting the basic human demand for water resources under strain. Urbanization has had a substantial impact on all sorts of ecosystems, resulting in increased pollution and other serious impacts on natural resources. Industrialization converts natural into residential and commercial zones; as a result, the area's increased impermeability and urban activities result in increased runoff and deterioration of water quality. Water quality degradation remains a concern in some cases, especially to the frequent discharge of non-point source pollutants into rivers. River systems are the principal means of disposal for industrial, agricultural, and household effluents. Sustainable pollution control requires the capacity to identify causes to consequences and predict the impact of control activities and changes to pollution sources. the significant rainfall in the river network region, Pollution from non-point sources has a frequent impact on water quality due to the considerable rainfall in the river network region. The Democratic Republic of the Congo (DRC) offers massive water reserves and is under stress. More than 50% of Africa's surface water reserves are located in the Democratic Republic of the Congo (DRC) and one-quarter of the continent's water resources. The overall amount of freshwater extracted by key economic sectors accounts for 0.2 % of total resource endowment, with total annual renewable water resources per person above the Water Stress Index threshold for water stress. The Congo Basin's huge resources contribute to year-round surface water flows. Approximately 30% of water supplies come from surrounding countries.

Keywords: hydrodynamic model, water quality model, water quality basement, Modeling development, River network area

1. INTRODUCTION

The urbanization has had a tremendous impact on all sorts of ecosystems, resulting in increased pollution and other negative consequences on natural resources. Water quality modeling is regarded as an essential component in assisting water quality management choices, not only in determining the requirements for satisfying water quality standards but also in evaluating the efficacy of actions in restricting pollutant sources for a defined use. The discharge from point sources of pollution (such as sewage treatment plants and direct household pollution) is often continuous; On the other hand, the temporal and spatial variation of the discharges of pollution from diffuse sources is obvious, which places higher demands on the mathematical modeling of the water environment. Water is the main resource that is important for the survival of all world's biodiversity. However, humans have access to just around 1% of the world's freshwater resources in the form of surface water or groundwater [1]. Accurate quantification of hydrological data at distinct spatial and cultural stages is necessary to provide sustainable wastewater treatment. [2]. Such data is generated using hydrological models [3]. However, in data-scarce regions, Conventional modeling accuracy assessment procedures are limited by the scarcity of accessible actual river discharge records., contributing to creating greater unpredictability in evaluating water resource availability. Several of the available streamflow gauging stations in large river basins are located downstream and represent combined stream flow parameters mostly from wide drainage regions. As a result, the data are also not particularly relevant for estimating regional patterns of reaction in headwaters areas [4]. Water is currently supplied for key activities including consumption, irrigation, on a global platform, both residential and industrial utilization is possible. but the regional distribution of water indicates that it is not sufficient where it is needed in many circumstances [5]. A large number of people live in water-stressed and water-limited regions around the world as a result of the inequitable distribution of freshwater resources. Water resources must be preserved, even though they are continually deteriorating and depleted in practice as a result of poor consumer-funded projects that result in inefficient water management, redundant and inefficient agricultural techniques, and urban expansion [5]. Understanding how climatic, freshwater, biochemical, and demographic perspectives are linked at various geographical levels, catchment sizes, local level, and global scales is critical for sustainable management of freshwater assets [6]. Average environments are significantly determined by a region's meteorological trends, which may be assessed by analyzing trends in hydro-meteorological variables such as temperature, precipitation, humidity, and wind. Point-source discharges are easily identifiable since they occur among a particular source. For example, pollutants emitted by sewage treatment plants or industries. Non-point source fluxes, on the other hand, may originate from spread sources/activities that do not have a single entry point [7]. Agricultural and livestock farms, as well as peri-urban activity, are instancing a pictorial representation illustration of the key activities that cause water deterioration on a watershed level relating to both point and non-point sources on a catchment scale. their efficacy must be evaluated using a sufficient amount of long-term data. As a result, It's obvious that maintaining nutrient and pollution inputs from various relevant variables at strategic points in a catchment is crucial for monitoring and mitigating water quality degradation and directing strategic planning. [8]. Water quality degradation is inextricably linked to changes in the habitats of many organisms. Concerns regarding water quality, especially from non-point pollutants, have been identified as a major factor in the decline of fish numbers in the British Isles Higher concentration levels in rivers may occur as a result of increased midsummer frequency, which may result in the progressive accumulation of fertilizers in soils that are discharged into rivers at the start of the rainy season [9]. Surface water quality models are useful for modeling and forecasting biochemical pollutant amounts, distributions, and risks in a given body of water [10]. Surface water quality models have progressed significantly from one factor to many factor water quality, from fairly stable to model parameters, from a contaminant to a combining model of pollutants sources, and from zero, one, two, and three-dimensional models. [11]. So far, more than 100 surface water quality models were developed. These models were categorized by Cao and Zhang depending on water system types, model-building methodologies, water quality coefficients, Components of water quality, model attribute, geographical scale, and reaction kinetics. On the other hand, almost every water quality model has a certain range of limitation criteria. [12]. As a result, further research into water quality models is required to overcome the inadequacies of the current models. These modeling results employing water quality models under various contamination scenarios are critical attributes of sustainable development. Furthermore, they serve as a critical foundation for environmental strategic choices because they not only provide statistics to environmental management authorities in order for building initiatives to be approved, and they still offer additional technical assistance to water environmental safety organizations. [13].

1.1 METHOD

1. Study Area

The Congo River's basin stretches from 09°15′ N to 13° 28′ N and 11°18′ E to 31° 100′ E, making it Africa's largest river basin. It covers nearly all of the DRC, as well as vast parts of Cameroon, the Central African Republic, Zambia, and Angola. The principal course of the river is 4,374 kilometers long. [14] and is subdivided into three sections.: Upper, medium, and bottom Lualaba. The Congo tailwaters are comprised of three major sections: the Luapula River, which flows from Lake Bangweulu to Lake Mweru in the Bangweulu-Mweru ecoregion of northeastern Zambia, and the Lufira and Lualaba rivers in the Upper Lualaba ecoregion of southeastern DRC. [15] [16]. The Bangweulu basin, which drains the Congo headwaters through the Luapula branch, is distinguished by multiple lakes, none of which are deeper than 10 meters, with Lake Bangweulu being the biggest (2,070 km^2). Lake Bangweulu is characterized by several unique sand ridges that span from southwest to northeast, generating long sandy mouths and beaches.

To the east, it is flanked by vast green wetlands and a riverbank. with a total combined size of at least 13,770 km^2. Several rivers pour into the Bangweulu marshes, the most prominent of which is the Chambeshi Stream. Lake Mweru is more profound (37 m) and bigger (4,413 km^2) than Lake Bangweulu, in spite of the fact that there are also gauges of over 5,000 km^2, and is depleted by the Luvua River [16]. The basin has a range of climatic regimes due to its tropical position. The northern and southern regions of the country have separate dry and rainy seasons, meanwhile, the equatorial area has a variable rainy season [17]. Both the north and south part of Congo Stream Basins gets the most of the rain between June–July–August, and December–January–February. The stormiest seasons within the central range are September–October–November, and March–April–May. The yearly precipitation averages roughly 1500 mm. Rain forests cover about half of the basin and are less damaged than Amazonian and Southeast Asian forests. [18] vegetation and Steppe environments, which are recognized by the nearness of grasses, closed-canopy forests, trees, and bushes. [19]. 2 % of the zone are covered by water bodies and predominantly located both in southeastern and western equatorial zones of the Congo River Basin, after the Amazon, is the world's second-largest drainage basin and has a large economic significance [20]. The Congo River serves as the primary transit corridor for products and services between the country's major cities, including Kinshasa, Kisangani, Bumba, Mbandaka, and Matadi, because of the destruction of the country's primary road system and the limited trains. Water transportation on the Congo River is highly frequent. In the proximity of large cities, the river system absorbs unclean manufacturing including medical toxic waste, rainwater. The Congo River Basin has a tropical monsoon climate with basically two monsoon seasons that alter depending on altitude towards the equator. [21]. The natural vegetation depends on many factors from a tropical rainforest in the middle regions with little seasonal change to grassland both in the north and south. [22]. With an area of 2.3 106 km^2, the forest is the dominant land cover, accounting for approximately 18% of the world's tropical forests [23].

Figure 1 Congo River basin Map. Source: Wikipedia

1.2 Geology and Soils

Since the Neoproterozoic period, deposit amassing and structural rearrangements have taken place in the Congo River Basin, a Central African intracratonic depression. [24]. The basin is a traditional spaceship basin beside a dough that seems to be dense in the center as well as spreads equally to the perimeter. It's in the middle of the African lithosphere. [25]. The Basin is assumed to become a situationally down thrust, with a flawed Proterozoic fissure at its center and topographic highs such as Proterozoic orogenic belts, its exhilarated East coast Margin, and the East African schism shoulder and central African shield basement highs forming its borders. [26]. The Cuvette and lower Kasai have mostly alluvial fan deposits, while the upper Kasai has mostly metasedimentary rocks and alkaline volcanic intrusions in the north and south-eastern regions of the basin. The Cuvette's sections bordering the river valley have the most beach strands (Fig. 2(a)). The 1978 World Soil Map of the Food and Agriculture Organization [27]. As a result, it provides the most comprehensive database on soils in the Congo River Basin (Fig. 2(b)). The Basin soils are dominated by relatively high-rate ferrosols, xanthic ferrosols, some other solid and liquid particles.

Other soil classifications exist, but with none of the visibility, The basin's soils are mostly sandy and sandy clay, with larger mud ratios in the basin's central and northern sections, specifically Ubangi, Sangha, and the Cuvette Centrale, as well as typical particle ratios in the basin's southern sections, notably Ubangi, Sangha, and Cuvette Centrale. namely Kasai, lower parts of Upper Congo, Lomami, and Lower Congo. The soils in the immediate river valley contain significantly more silt, which accounts for more than 20% of the total.

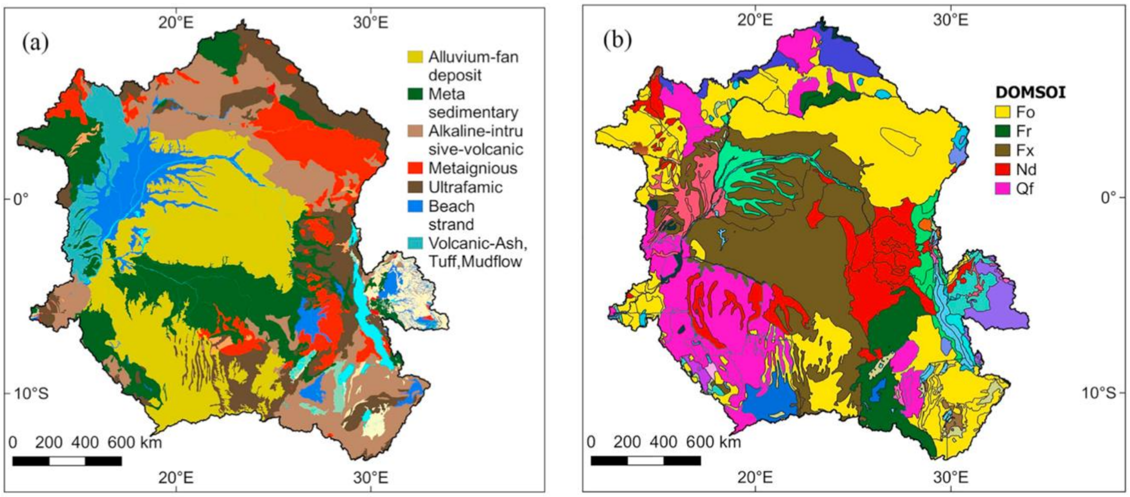

Figure 2 (a) Petrology of the Congo River Basin (Source: Bow et al., 2009); (b) Main soil types in the Congo River Basin. (Source: FAO//UNESCO, 1971-1978)

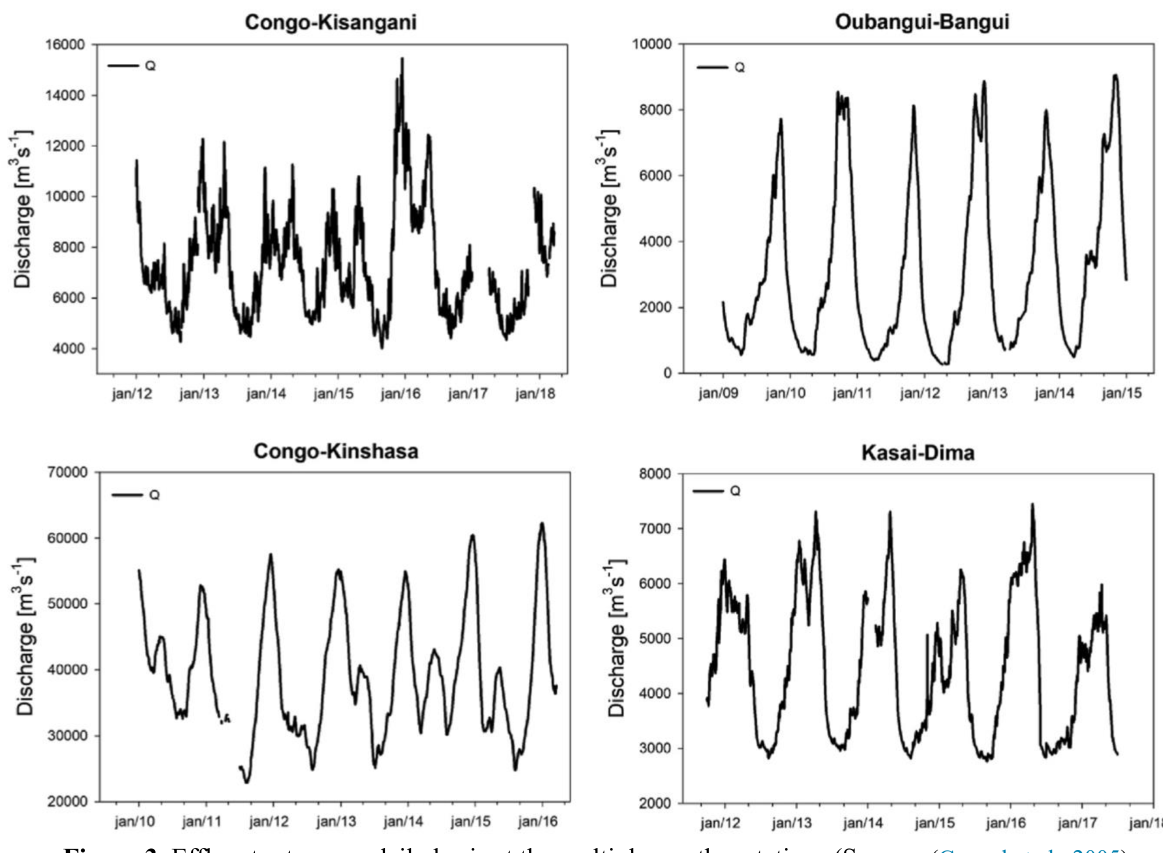

Figure 3. Effluent rates on a daily basis at the multiple weather stations (Source: (Coynel et al., 2005)

The main stem flow is impacted once the flow of water from southern channels rises [28]. The Central Congo region's consistent high rainfall leads to a moderate variation in flow throughout the year, with a low deposition interval in July and August. For the previous few decades, the intra-annual regime has been fairly stable: Qmax/Qmin = 2. From 1903 to 1996, the extreme monthly discharge ratio (24,700 – 75,500 m^3/s) was reported. The Congo hydrological management is among the most stringent in the world (occasional interannual proportion = 1.65) with little inter-annual variation in annual releases: Between 1903 and 1996, 33,300–55,200 m^3/s were measured. This is because of its geographical location on both sides of the equator, as well as its consistent rainfall [29]. The Congo

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River system is fractionally as frequent as the Amazon River system, which has a periodical average of 1.7 to 2.7 and annual and seasonal variability of less than 2.0 (1970–1990).In comparison, the monthly discharge ratio of the Orinoco River is 25. [30].

The Basin's land cover reveals that it is mostly composed of forests (more than 50%) and savannah grasslands (more than 35%). (Fig. 4). farmlands that are interlaced Biodiversity is also very important. The Congo River Basin has experienced a dramatic increase in human activity such as deforestation, as well as pressure from population expansion and urban development, during the last few decades [31]. According to Molinario et al., village communities grew by 10.2 % between 2000 and 2010. (2015). Researchers estimate a 74% upsurge in pierced forests, from 0.8 to 1.5 % of total surface area, and a 3.8 % reduction in core forests over the same time frame. Mining investment has increased as well, despite the fact that it is not categorized as a land category on the Geographical Cover map. [32].

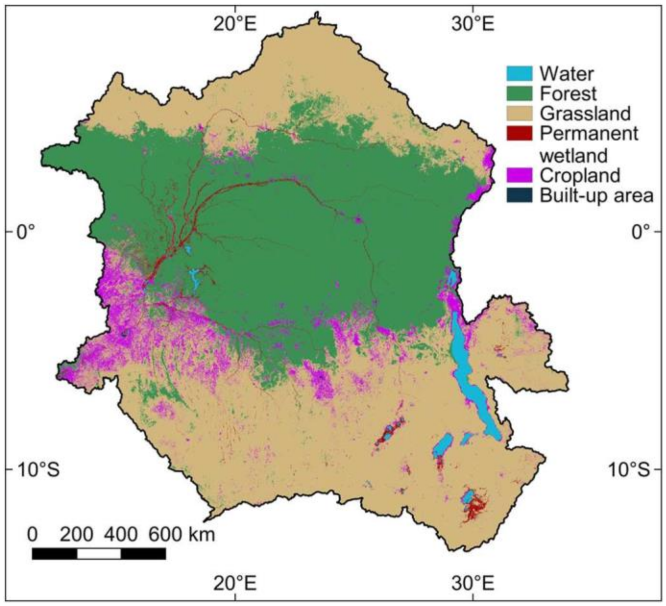

Figure 4. The Congo River Basin land use map
(Source: https://landcover.usgs.gov/landcoverdata.php#africa)

1.3 Congo River Basin Environmental Impacts

Two of the most serious challenges to freshwater ecosystems in the basin are the loss of riverside habitat due to deforestation and the degradation of water quality due to pollution and deposition [33]. Despite this, by the mid-1990s, the DRC had designated % of its entire usable forest for forestry concessions [34]. Conversion of land for mines, farming, and livelihoods settlement, as well as tree felling for fuel, notably and for creation of carbon for the transportable source of fuel, frequently over great distances, into towns and cities, are all sources of deforestation. Because of harvesting and farmland transformation, the Congo Basin has lost an estimated percent of its rainforest, and the rate of covered basin reduction is increasing significantly by 7% per year. [35]. The Lower Congo Rapids, Upper Congo, and Kasai ecoregions are seeing the greatest loss of biodiversity. [33], and riparian clearing for solid biomass, which typically denudes tributaries near population centers, are becoming a growing state and local concern. Timber harvesting to the palm oil industry is particularly noticeable in the Upper Congo ecological zones, and Chinese subsidies are projected to encourage substantial oil palm development near Lac Tumba. Substantially reduce Irrigation has become prevalent in many areas of the basin, and it has damaged riparian vegetation along large stretches of the Congo's principal stream. Substantially reduce Irrigation has become prevalent in many areas of the basin, and it has damaged riparian vegetation along large stretches of the Congo's principal stream. Deforestation makes room for other operations including gold, diamond, and other mineral mining. This happens all over the Congo Basin, but it's especially common in the uppermost Lualaba and Kasai ecoregions. [36]. Degradation from human habitation and industry is also a severe issue in portions of the Congo Basin. In the Democratic Republic of the Congo, 95% of enterprises deposit their junk straight towards rivers and other hydrological channels. Pollution is worse around big metropolitan areas such as Kisangani [16], as well as around Brazzaville and Kinshasa, where significant amounts of sewage are discharged into Malebo Pool and the Congo River. Lead and waste oil from industry, automobiles, and boat traffic contribute to this pollution. Heavy metal contamination, including lead and cadmium, has been observed as far downstream as 300 kilometers from Kinshasa [37]. The principal stream of the Ubangi is also impacted by pollutants from Bangui. [36].

1.4 Model

1.4.1 ArcGIS

the use of Geographical Information Systems (GIS), distantly detected information and various strategies for enhancing hydrological models [38]. has contributed to the development of models that can effectively address a variety of catchment parameters [39]. GIS, in particular its ability to analyze digital elevation models (DEMs), has provided modelers with new resource collection and image processing systems for the hydrological modeling [40]. More progress was made by integrating watershed models into GIS, which simplifies data entry and allows for a better understanding of model results [41].

1.4.2 HEC-RAS

HEC-RAS was developed by the United States Army Corps of Engineers and is frequently used in calculating the hydraulic parameters of rivers. It is a software that uses the energy equation to calculate water surface characteristics. [42]. The model describes terrain using computational cells in order to determine stream and direction along with a horizontal position from one computational cell to the next. Based on the hydraulic parameters of the cell and the water surface elevation of adjacent cells, HEC-RAS 2D computes flow rate at a cell boundary [43]. The HEC-RAS software is a computer program that is used to model river discharge through open natural channels and compute hydrological profiles [44]. Water pollution is entirely the result of pollutants sources. Estimates of Non-Point Source pollution must be accurate in order to handle pollutants load [45]. Observational assessment techniques and physics-based models are the most often used approaches for assessing NPS contamination loads [46]. The output component method, which is based on a range of data components, is used to measure pollutant sources, is the most commonly used empirical approach. [47]. The motivation for employing the outsource correlation model is straightforward; nevertheless, this technique is heavily reliant on the quality of observational statistics and does not illustrate the lively factors. that create pollutants loads. Furthermore, because statistics is employed rather than actual statistics, the conclusions reached using this method usually include a long planning phase. Tangible models, on the other hand, are commonly used to link rainfall-runoff pollution loads and to predict NPS contaminants throughout the temperature and precipitation cycle. [48]. All those models, in general, contain significant physical processes, and many can offer information regarding the geographical and chronological spatial aspects of contaminants. [49].

Table 1. Some commonly used Water Quality software

Model	Name	Applicability	Advantages	Disadvantages
AGNPS [50]	Farming pollutant source	Rainfalls events and ongoing drainage basin controlling	Strong water quality simulation mechanism; the various sources of pollutants are clearly described	Several characteristics must be defined, as well as large amounts of data.
HSPF [51]	Hydrological Simulation Program-Fortran	Rainfall activities and monitoring systems for river basins and urban areas	Better capture the detailed runoff and water quality processes	Lacking detailed spatial descriptions; limitations in urban areas
SWAT [52]	Soil and Water Assessment Tool	Watersheds are regularly checked.	Understand the short or medium impacts of land management strategies on water, sediment, and pollutants.	Not applicable to simulations finer than daily scale; parameters need to be adjusted in different regions
SWMM [53]	Storm Water Management Model	Rainfalls events and assessment process for urban areas and watersheds	few inputs require Full components with broad use; appropriate for water network simulations.	Highly demanding parameters; limitations in watersheds
STORM [46]	Storage, Treatment, Overflow, Runoff Model	Rainstorm events and continuous monitoring for urban areas	Easy to use	Contaminant transport and conversion cannot be modeled.

1.4.3 Basic principle of grid non-point source pollution model

DEM is used in the grid non-point source pollution model that was created independently. The water system is implemented after defining the sub watershed area threshold. As part of the extraction and sub watershed division algorithm, a single grid based on a sub watershed is used to calculate runoff and pollution yields. The algorithm includes three calculation modules: grid distribution of watershed rainfall, grid distribution of pollutant emission coefficients, and grid distribution of watershed runoff coefficients. Using the model, it is possible to calculate the total amount of pollutants emitted into the neighboring rivers under different land use patterns and rainfall conditions. The calculation idea is shown in Figure 5

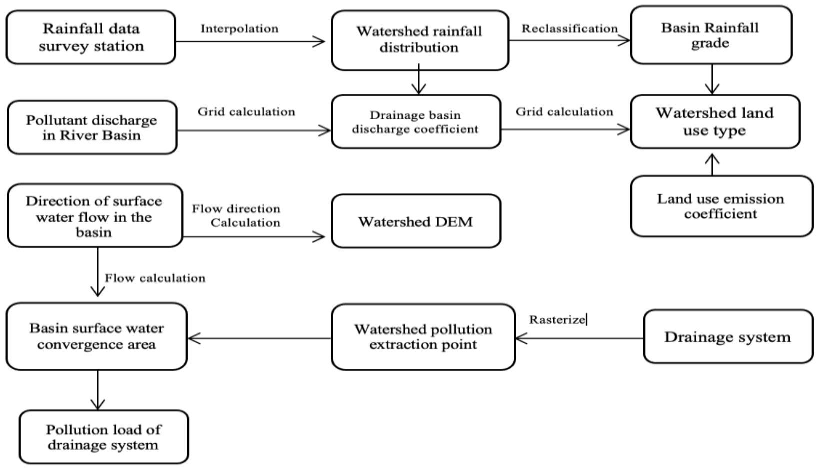

Figure 5. calculation principle of grid non-point source pollution model

Forecasting Basin Rainfall on a Grid: Rainfall drives all hydrological processes in the basin, and its major characteristic is its cyclical nature. In other words, the rainfall data obtained by the rainfall collecting site reflects exactly what has rained at that particular area, the rainfall data from the collection site must be interpolated. Interpolation is performed using the inverse distance weighting method (IDW). Grid distribution computation of watershed runoff coefficient: the runoff coefficient is calculated using the modified SCS curve value method. The SCS method is a rainfall-runoff relationship approach proposed by the United States Soil and Water Conservation Bureau. Grid distribution computation of watershed runoff coefficient: the modified SCS curve value method is used to determine the runoff coefficient. The SCS technique is a rainfall-runoff relationship approach established by the United States Department of Agriculture's Soil and Water Conservation Bureau. It can reflect the influence of various soil types, land use styles, and early soil moisture content on rainfall-runoff. It is distinguished by its few parameters and simplicity[54] The SCS curve value technique has the following equation:

$$\begin{cases} Q = \frac{(p-0.2S)^2}{p+0.8S} & P \geq I_\alpha \\ Q = 0 & P < I_\alpha \end{cases} \quad (1)$$

$$\begin{cases} S = \frac{25400}{CN} - 254 \\ I_\alpha = \lambda S \end{cases} \quad (2)$$

Where, S is the potential maximum infiltration, P is the total amount of one rainfall, q is the actual runoff depth, CN is the curve value of that day, and IA is the initial loss of surface runoff due to surface storage, interception and infiltration, which is in direct proportion to s λ Is 0.2. Combined with the grid pixel values of rainfall, pollutant emission coefficient and runoff coefficient, the grid pixel value of pollutant emission can be obtained by grid calculation. The calculation formula is as follows:

$$LD = P * R_{land} * C_{land} \quad (3)$$

LD is the grid pixel value of pollutant emission, P is the grid pixel value of rainfall, and r land is the grid pixel value of runoff coefficient Value, and Cland is the grid pixel value of pollutant discharge coefficient. Determining the outflow direction from each pixel in the grid is one of the keys to obtaining the hydrological properties of the surface. Application of the model the eight-direction (D8) flow direction method is used to calculate the flow direction of the basin's elevation data (DEM). The flow direction is determined by the steepest descent direction or the maximum descent direction from each pixel, and the output pixel is encoded with the value representing the direction to obtain the flow direction grid data representing the pollutant aggregation direction of the basin. The cumulative flow can be calculated as the sum of all pixels flowing into each downhill pixel in the output grid, the pixel with the highest cumulative flow can be selected by applying a threshold, and the flow data can be used to form a river network. The watershed is separated for distinct river sections based on the calculation results of flow direction and flow, and eventually the catchment areas of different river sections are generated.

1.4.4 basic principles of hydrodynamic model

The length of the river channel is substantially longer than its width and depth, hence the river network can be characterized as a one-dimensional issue. Energy and mass conservation principles allow one-dimensional Saint Venant equations to be constructed to describe the hydrodynamic process of river networks, as illustrated in formula (4). Saint Venant's equations are notoriously difficult to solve analytically, and numerical methods can only provide an approximate solution. In the module, the unsteady flow in the river network is calculated using the four-point implicit finite difference approach

$$\begin{cases} B_t \frac{\partial z}{\partial t} + \frac{\partial Q}{\partial x} - q_t = 0 \\ \frac{\partial z}{\partial t} + \frac{\partial (UQ)}{\partial x} + gA\left(\frac{\partial z}{\partial x} + S_f\right) = 0 \end{cases} \quad (4)$$

Where, Z is the river water level, X is the longitudinal distance of the channel, t is the time, q is the flow, a is the cross-sectional area, BT is the non-flow regulation and storage area of the river cross-section, QL is the side inflow per unit length, including the emission of point source and non-point source pollution, G is the gravitational acceleration, SF is the friction slope, and u is the water flow velocity.

1.4.5 basic principle of water quality model

The one-dimensional convection diffusion equation is the governing equation of the river network water quality model, as indicated in formula (5). Its fundamental premise is that matter exists. On the section, everything is completely jumbled; First-order reaction kinetics or matter conservation It follows Fick's law of diffusion, which states that diffusion is proportional to the concentration gradient. Under the effect of water flow and concentration, the convection diffusion model may mimic the distribution of dissolved or suspended compounds in time and space.

$$\frac{\partial}{\partial t}(A\emptyset) = -\frac{\partial z}{\partial x}(Q\emptyset) + \frac{\partial}{\partial x}\left(EA\frac{\partial \emptyset}{\partial x}\right) + (S_0 - S_f) \quad (5)$$

Organic pollution transport and change in rivers is a complex physical, chemical, and biological process. The mathematical model includes a dissolved oxygen balance subsystem and a nitrogen cycle subsystem for evaluating the decline of dissolved oxygen concentration induced by organic pollution discharge. Its biological process contains aerobic and anaerobic stages: the aerobic process involves the oxidative breakdown of carbon molecules and the anaerobic process includes denitrification reaction; the anaerobic process includes denitrification reaction. As a result, the model can be used for river hydraulic calculations, water-resistance impact evaluation of various wading structures, study on river sediment erosion and deposition, water quality simulations, watershed flooding management planning. The water quality module can simulate water temperature, nitrogen, phosphorus, algae, carbonated BOD, dissolved oxygen, and any other conservative and non-conservative components. In the module, the one-dimensional convection-diffusion issue is resolved using the best and fastest open mathematical equation. Simulating and forecasting contaminant transmission in the water environment can be done with the use of water quality models. [55], This can assist in lowering the cost of personnel and supplies for a wide variety of chemical tests. Additionally, due to particular environmental pollution difficulties, it is unavailable for on-site testing in some circumstances. As a result, water quality models have emerged as a significant tool for identifying water environmental contamination, as well as the final path and behaviors of contaminants in the water environment [56]. Following their completion, many tasks, such as petroleum refining, environmental, and paper-making operations, may have significant consequences for the aquatic system. [57]. Before any of these construction projects can begin, the environmental impacts are always analyzed, forecasted, and evaluated using a mathematical model. Through the advancement of framework and the timely software method [58], an increasing number of, water quality models using diverse model algorithms [57] have been produced. Hundreds of multiple water evaluation methods, there has moreover been the advancement of model software up now for diverse terrain, water bodies, and contaminants at various spatial and temporal scales. [59]. Furthermore, as these models' concepts and methodologies diverge, there are frequently massive variations between one's modeling results, which may also contribute to the diligence of projected results using different models, resulting in divergent environmental organizational processes because these modeling results can indeed be related to or evaluated. [60].

2. Conclusion

Water is required for agricultural, industrial, and domestic uses. As a result of demographic change, urban growth, and industrialization, pollutant loading into water bodies has increased, producing ecological distortions and affecting human health. Toxins that enter streams from defined sources are readily identified and assessed. Pollutants emitted from unknown sources referred to as non-point sources provide a significant issue. some software models can be used to assess changes in surface water quality for environmental sustainability purposes all over the world. Several surface water quality models have been created around the entire globe. Additionally, a few industrialized nations have enacted direction on water natural quality evaluation and given a few directed models for surface water quality modeling. As a result, it is necessary for the large percentage of emerging nations to harmonize several commonly used water quality models in order to conduct effective ecosystem impact assessments. Therefore, standardizing various frameworks related to real situations in different countries remains a substantial challenge. as many inquiries and scientists are still required. Surface water quality models have progressed significantly from a common component of water quality to specific parameters of water quality, from a constant to a simulation model, from a point source model to a linkage model of pollutants sources, and from zero- one-two and three-dimensional models.

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