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REVIEW

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A historical overview of experimental hydrology in China

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Abstract

The history of experimental hydrology in China is important but poorly documented. Here we review 94 papers (86 of these in Chinese) from the CNKI and Web of Science websites to chronicle the history of experimental studies in China before 2000. Professor Wei-Zu Gu—the focus of this Special Issue—factors heavily into this history. Perhaps more than any country, the experimental hydrology history of China is influenced by socioeconomic development and political change. Our analysis shows 4 main periods of development associated with (1) an early development stage before 1949, the founding year of People's Republic of China (PRC), (2) an initial period of rapid transition in experimental studies in China (1949–1965), (3) a struggling and recovering stage for during and shortly after the Cultural Revolution, from 1965 to 1978, and (4) significant progress associated with new policies for reform and opening up in China from 1978 to 2000, that included contributions of Wei-Zu Gu and other scientists. In terms of experimental hydrological findings, two notable contributions are a mathematical description of saturation overland flow derived from streamflow and precipitation data and calculated water storage deficit in the unsaturated zone by Zhao and Zhuang (1963), several years before its process-based 'discovery' in the USA (and elsewhere) and the 'interface runoff generation law' of Yu (1985) which was ahead of its time in understanding linking the notion of the commonality of all runoff forms. In terms of model development stemming from experimental studies, the development of the Xinanjiang Model of Zhao (1980) was a significant achievement, later partly adopted into the VIC model in the USA and the ARNO model in Europe. Finally, the Hydrohill catchment developed by Wei-Zu Gu led the way for the rapid rise in process studies and internationalization of experimental hydrology in China. Overall, the experimental hydrological studies from 1949 to 2000 had a strong engineering focus, with many links to water conservation construction and management.

KEYWORDS
catchment hydrology, hydrological experiment, history of hydrology in China, hydrological processes

1 | INTRODUCTION

The history of hydrology is an area of growing interest in hydrology (Ataie-Ashtiani & Simmons, 2020; Beven, 2020; Beven et al., 2021). Recent papers have chronicled the development of hydrology in Africa (Hughes et al., 2015) and the UK (McCulloch, 2022) and built upon extensive early reviews of hydrology by Biswas (1970). The link between water and Chinese history is widely known, as noted by Ball (2017) where 'an intimate connection between hydraulic engineering, governance, moral rectitude and metaphysical speculation that has no parallel anywhere in the world.' As a result, China's development is inextricably linked to its hydrology (Janku, 2016). However, the English mainstream hydrological literature has not summarized the history of experimental hydrology studies in China. This is because much of literature is in Chinese and hitherto unknown outside of China. This paper aims to review the history of experimental hydrology in China before. This is especially timely as China now leads the world in papers published in this journal as of 2022 (McDonnell, 2023). A significant portion of the development of experimental hydrology in the late 1990s was driven by Professor Wei-Zu Gu—the focus of this Special Issue—and his colleagues at the Hydrohill catchment. Here we contextualize these contributions of Wei-Zu Gu in the long arc of development of experimental studies in China from the first papers dealing with process hydrology.

2 | METHODS

To conduct a comprehensive literature review, we utilized the three largest academic paper databases in China: CNKI (www.cnki.net), VIP (www.cqvip.com), and Wanfang (www.wanfangdata.com.cn). Our search used the Chinese keywords including 'hydrological experiment' ('水文实验' or '水文试验'), 'experimental hydrology' ('实验水文'), 'streamflow experiment' ('径流实验' or '径流试验'), 'runoff processes' ('径流过程'), 'hydrological processes' ('水文过程'), 'runoff generation mechanism' ('产流机理' or '产流机制'), and 'catchment hydrology' ('流域水文'). Since there are increasing number of English papers published by Chinese hydrologists which are relatively easy to access for international community, we focused exclusively on papers published before 2000. We also conducted the same process in Web of Science using the English words of these keywords to collect the English papers published by Chinese researchers up until 2000. It should be noted that we adopted several keywords such as 'runoff processes' to collect papers with no word 'experiment' in the title, considering that experimental hydrological studies are mostly concerned with processes and mechanisms. From the searched papers, we selected and grouped those with four themes: (1) case studies of hydrological experiments, (2) reviews or discussions of advances in hydrological process and experimental hydrology studies, (3) methods, formulas or models to describe the hydrological processes and characteristics found by hydrological experiments, and (4) analysis of specific questions using the data obtained by hydrological experiments. Although these collected papers go somewhat beyond what we might define as 'experimental hydrology,' they reflect the overall advances in the experimental hydrology and people's understanding on hydrological processes in China.

3 | RESULTS

A total of 94 papers were collected, 86 of which were in Chinese (Figure 1a) (a full list is provided in Supplementary Information S1). The earliest paper was published in 1957, and one or two paper was found each year for 1957, 1958, 1962, 1963, 1965 and 1966. After 1966, no papers were published for 14 years until 1980. The first English paper about experimental hydrology by Chinese researchers was published in 1980. We found many papers which applied hydrological models to analyse specific questions after 1990, but many of them were irrelevant to experimental hydrology and the hydrological processes or mechanisms. We therefore only collected some representative papers from them. Nonetheless, the number of publications increased progressively after 1980. We categorized the collected articles into four types based on the level of understanding on hydrological processes: (1) qualitatively understanding processes based on measurement data of basic elements in the water cycle; (2) quantitatively describing the processes by equations or models; (3) deep insight into the hydrological processes with hard data; (4) reviewing or discussing the advances in process understanding processes. The numbers of papers representing the four types were 31, 45, 6 and 12 respectively (Figure 1b). Based on the collected literature and its link to the national development in China, we now discuss the main development stages linked to these articles and their key advancements.

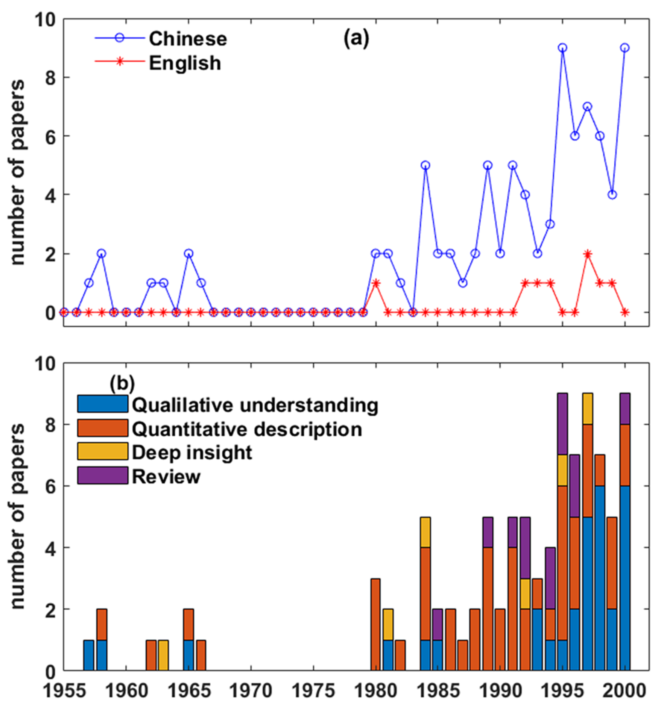

FIGURE 1 The number of collected papers published in each year categorized by (a) language and (b) level of process understanding.

3.1 | Development of hydrological sciences in China before the founding of PRC (before 1949)

Water management in China dates back at least 5000 years with the Liangzhu hydraulic system (Liu et al., 2017). The value of hydrological data on the development of human society in China can be traced to at least 4000 years ago when King Yu characterized river flow in relation to controlling floods. After the Second Opium War (1856), hydrological works in China were greatly affected by foreign knowledge and technology, and the government began to conduct hydrological measurements, hydrological data compilation and analysis. Before the war of Resistance Against Japan (1937), there were some 409 hydrological stations, 636 water level stations and 1592 precipitation measurement stations. Most of these were stopped or destroyed during the war, and only 353 stations including 148 hydrological stations remained in 1949, when the People's Republic of China (PRC) was founded (Bian, 2004).

During this period, colleges including Tsinghua University, Hohai Engineering College (the Predecessor of Hohai University), and National Central University established courses related to hydrology and began to train hydrologists, who formed original teams for hydrological research and works in China. Notably, Prof. Jiayang Shi's hydrological course at Tsinghua University played a pivotal role as the first of its kind in China during that era. The course successfully trained a number of pioneering hydrologists, including Guangwen Liu (Professor at Hohai University) and Jiaze Xie (Director of the Hydrology Bureau at the Ministry of Water Resources in 1950). Chinese hydrologists applied the methods developed in western countries to conduct hydrological analysis. For example, the unit hydrograph method was adopted to calculate the design flood when making the Ganjiang Basin Development Plan in 1948.

The earliest hydrological experiments in China can be traced back to 1924, when the first runoff observational areas were set up in Qinyuan, Fangshan and Ningwu counties in Shanxi Province by Demin Luo (W. C. Lowdermilk), an American professor in the former Jinling University. These experiments focused on the effect of vegetation cover on the amount of surface runoff and soil erosion under different rainstorm conditions. There are some anecdotal accounts that the first paper related to Prof. Luo's experimental studies was one titled 'Factors influencing the surface runoff of rain waters' published in the Proceedings of Third Pan Pacific Science Congress in Tokyo, Japan in 1926. However, the full text of this paper is not recorded. Despite this, no papers directly related to experimental hydrology, runoff processes or runoff generation mechanisms can be found in the Chinese journal literature until the 1950s.

3.2 | The period of rapid transition in experimental studies in China (1949∼1965)

After the founding of the PRC and with the development of hydraulic projects and hydrological science, experimental hydrology experienced a vigorous development period. During this period, the first Chinese experimental catchment, the Qinggou Catchment, was established by the pioneers including Professor Wei-Zu Gu in 1953, within which experiments were undertaken linked to streamflow, rainfall infiltration, soil evaporation and soil moisture measurements (Wang, 2011). The national hydrological conference in 1956 stressed the importance of hydrological experiments, and recommended that a plan for the construction of hydrological experimental stations be developed in China (Wang, 1956). During the Great Leap Forward (a nationwide economic and social plan in 1958∼1960 aimed at rapid development), many hydrological experiment stations were established, although some were of poor quality (Gu et al., 2003). The National Hydrology Conference in 1959 pointed out that the primary task of hydrological experiments was to serve the social production practice, but theoretical research on process mechanisms was also encouraged (Feng, 1959). As a result, the hydrological experiments during this period had a strong engineering focus.

Eight key papers in Chinese were published during the Great Leap Forward period, related to experimental hydrology and hydrological process understanding. Two of them explored the influence of precipitation, vegetation and slope gradient on streamflow and erosion, to guide the conservation of water and soil (Yellow River Conservancy Commission, 1957, 1958). Again, this reflected the engineering hydrological focus of the time. Three papers derived the calculation equations of discharge or flow velocity of streamflow and baseflow based on measurement data in hydrological experiments, to provide a basis for runoff design calculation and forecasting (Liu et al., 1965; Xu & Hu, 1962; Yellow River Conservancy Commission, 1966). Although these studies provided important practical guidance and methods, they contributed little to new knowledge of hydrological processes or runoff generation mechanisms. One notable exception during this period was Zhao and Zhuang (1963), who proposed that saturation excess runoff was the dominant runoff generation mechanism in humid regions, based on the discharge and precipitation data at 21 stations in southern China. They found that when precipitation amount exceeded a threshold value, the slope of the rainfall-runoff relation approximated a 1:1 line (Figure 2a). Zhao and Zhuang (1963) proposed a water storage curve to characterize the partial area contributing to storm runoff (Figure 2b). Interestingly, this paper was published earlier than the ground-based field studies of discovery of the saturation excess overland flow mechanism in the USA (Dunne & Black, 1970) and elsewhere. Zhao and Zhuang (1963) was perhaps the first paper proposing a quantitative curve to describe the relation between source area proportion and water shortage simultaneous with the work of Cappus (1960) in France.

Although experimental hydrology developed rapidly after the founding of the PRC, hydrological process studies at that time in China were conducted mainly by artificial runoff experiments (e.g., Liu et al., 1965) or analysis of streamflow data from hydrological stations (e.g., Xu & Hu, 1962). Systematic measurement of the individual components of the hydrological cycle was not a focus. Consequently, most studies conducted in China prior to the International Hydrological Decade (1965–1974) did not investigate hydrological processes. Even for Zhao and Zhuang (1963) who first proposed the saturation excess

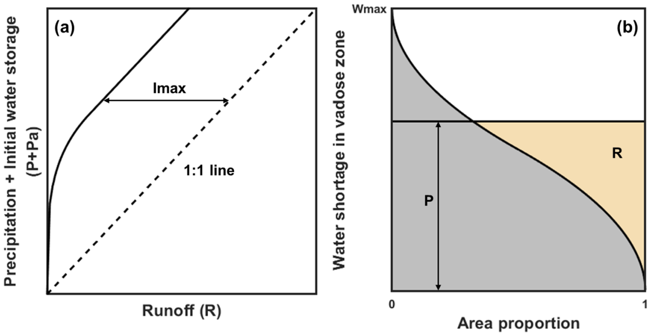

FIGURE 2 The rainfall-runoff relationship of saturation excess runoff and the water storage curve (from Zhao & Zhuang, 1963). (a) The relation between the sum of precipitation (P) and the initial water storage (Pa) and the runoff (R). The slope of relation when (P + Pa) excesses a threshold is close to 1. (b) The relation curve quantifying the area proportion with different vadose zone water shortage. The runoff generated by a given precipitation amount P can be calculated by: $R = \int_0^P (P - x)f(x)dx$ (the yellow shadow in Figure b). The grey shadow in (b) is the maximum water storage, equal to the difference between $P + Pa \sim R$ relation and 1:1 line in (a) (i.e., Imax).

runoff, the results were derived solely by statistical analysis of hydrological data and were not supported by any on-the-ground analysis or in-depth experimental investigation. Nonetheless, this period was the golden age of the hydrological experiments in China, including the development of both laboratory models and field catchment experiments. Despite few, if any papers actually describing these results pre-1966, the experimental catchments established in this period accumulated valuable data and laid the foundation for the later hydrological investigations some decades later.

3.3 | Challenges to progress in experimental hydrology in China (1965∼1978)

The first international hydrological decade (IHD) organized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) started in 1965, leading to a rapid development and modernization period of hydrological sciences. However, during this time, experimental hydrology in China was experiencing an 'extremely difficult period,' as noted by Gu et al. (2003). During the Great Cultural Revolution, the 'hydrographic office' of the Ministry of Water Resources in China was disbanded, and some provincial organizations related to hydrology were combined or eliminated. The management of many hydrological stations was then decentralized, and the standards for hydrological measurement were criticized, resulting in reduced measurement quality (Bian, 2004). Even more challenging was that some well-developed hydrological experimental stations such as Kaijiang (Liu, 1981) and Zizhou (Ma, 1981) were largely destroyed during this period. So, while the IHD was a boon to global experimental hydrology, the IHD in China coincided with exceptionally challenging times where even some hydrological academic journals, such as the Journal of China Hydrology, founded in 1956, stopped publication in 1966. As a result, no papers were found in our literature search for 1967–1979. Even the China Institute of Water Resources and Hydropower Research was eliminated in 1969. Despite these challenges, most workers at hydrological stations kept on with the measurement work, accumulating streamflow data for later research (Bian, 2004).

Things began to get better at the end of the Great Cultural Revolution in 1976. The hydrological governmental organizations, research institutions, and academic journals were reconstituted gradually. Lessons learned from the difficult periods about the hydrological station management also provided important guidance to later work. Meanwhile, hydrologists began to attend international conferences held by the World Meteorological Organization (WMO) and the International Association of Hydrological Sciences (IAHS), establishing international academic exchange and cooperation with developed countries. These provided the foundation for the rapid development of experimental hydrology that started ∼1978.

3.4 | Reform, opening up and the contributions of Wei-Zu Gu and others (1978∼2000)

The Reform and Opening-up Policy was carried out in 1978, after which a quick development period of experimental hydrology in China followed. In total, 86 published papers (including 8 in English) were found for this period in our literature search. Benefiting from previous efforts in international exchange, education, and research on hydrology, as well as the opening-up policy, Chinese hydrologists had already acquired fundamental knowledge and theories regarding the basic runoff generation mechanisms proposed by western developed countries. Specifically, the main hydrological processes and mechanisms, such as infiltration excess runoff processes (Zhao & Wang, 1980), saturation overland flow runoff processes (He, 1984), subsurface stormflow runoff processes (Liu, 1981) and groundwater runoff processes (Zhuang et al., 1980), had already been recognized in the papers published in the early stage of this period.

This period could be further divided into two stages, roughly with 1990 as the dividing point. In the first stage, researchers were more interested in hydrological processes, and attempted to establish models or equations to describe these processes. For example, Liu and Wang (1980), the first English paper collected in this review, developed a small-watershed model to estimate the peak flow in China based on the streamflow data in 9 watersheds. Ma (1981) conducted a detailed analysis on the runoff generation characteristics in loess regions based on the 11-year measurement data of streamflow, soil moisture and precipitation in the Zizhou catchment, and developed equations to calculate the streamflow. Li (1984) adopted a two-level discharge measurement weir to measure the interflow runoff, and established a model to simulate the runoff process with multiple components.

The 'interface runoff generation law' and the 'Xinanjiang Model' are two of the most important achievements from 1980 to 1990. Yu (1985) discussed the point-scale runoff generation mechanisms based on the theories of water movement in porous media. He found that the five major runoff generation mechanisms (infiltration excess runoff, subsurface interflow runoff, groundwater runoff, saturation surface runoff, and returning runoff) shared common characteristics: they all occurred at interfaces where the infiltration capacity changed, and the water input intensity from the layer above was larger than the infiltration intensity of the layer below. The 'interface runoff generation law' was then proposed to summarize the combination patterns, generation conditions, and conventional relations of different mechanisms. This provided important theoretical foundations for a better understanding of the runoff generation processes. Yu (1985) was one of the most highly cited Chinese papers published during this period (cited 143 times on the CNKI website). Follow-on papers getting to this same observation (e.g. McDonnell, 2013) and how all runoff processes share common response characteristics linked to interfaces, were unaware of this important paper published in Chinese.

Another important achievement in this 1980–1990 period was the development of the Xinanjiang Model. It was based on the theoretical study of Zhao and Zhuang (1963) in the previous rapid development stage. It was applied in 1973 for the first time when formulating the streamflow forecasting scheme for the Xinanjiang reservoir (Zhao, 1992), and published in 1980 (Zhao & Wang, 1980). The Xinanjiang Model was a semi-distributed rainfall-runoff model applicable to humid and semi-humid regions. The surface runoff generation was assumed to occur on partial areas, which was calculated according to the tension water capacity curve. The soil was divided into three vertical layers to calculate the evapotranspiration. The original, two source version of the Xinanjiang Model separated the runoff into surface and groundwater components, while the most widely used three source version developed after 1980 introduced the additional component, subsurface interflow runoff (Figure 3a). The four source version was subsequently developed by further dividing groundwater runoff into quick and slow components (Zhao, 1989). The runoff confluence process within each subbasin was represented by the unit hydrograph method, and the routing process among subbasins was calculated via Muskingum routing method. The most significant innovation of the Xinanjiang Model was the tension water capacity curve (Figure 3b), which represented the proportion of the pervious area whose tension water capacity was less than a given value. This method provided a non-uniform distribution of tension water capacity throughout the subbasin, which was adopted in several hydrological models developed by

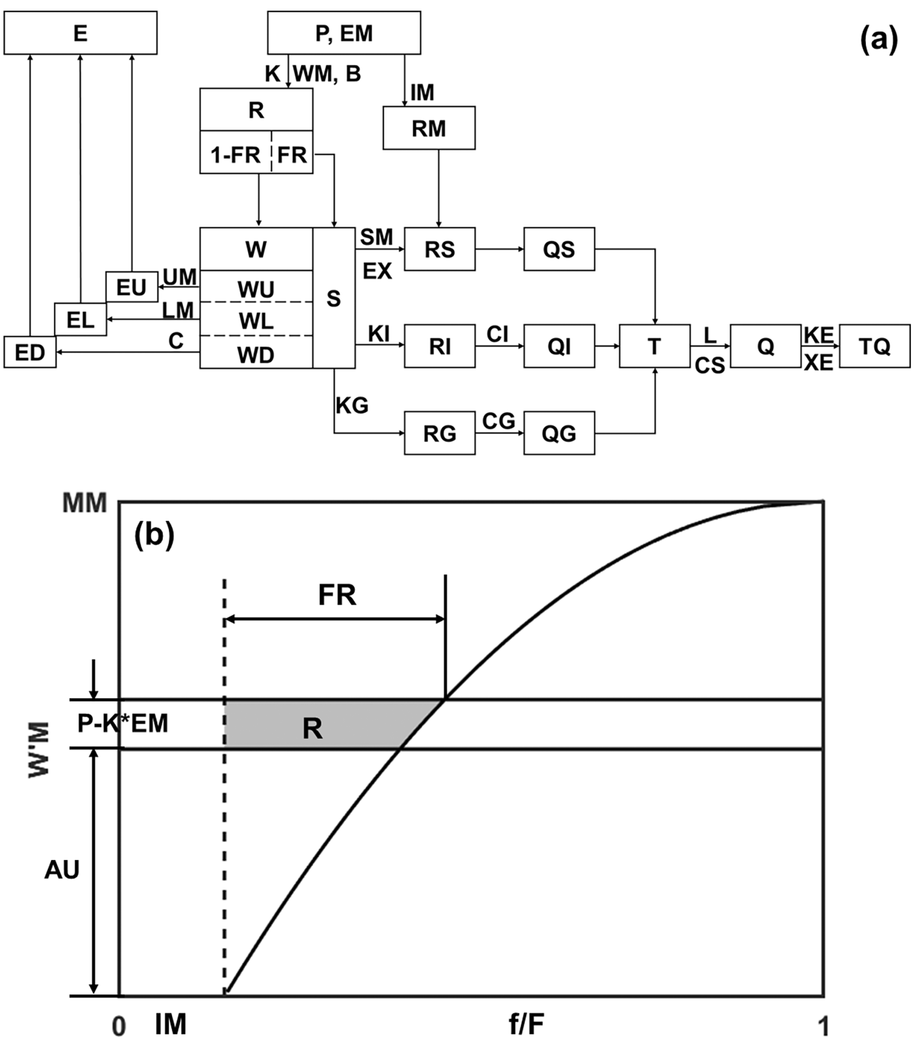

FIGURE 3 Important figures of the Xinanjiang Model. *Source*: Adapted from Zhao (1992). (a) The flow chart of three source version Xinanjiang Model. The meanings of all the symbols could be found in Zhao (1992). (b) The distribution curve of tension water capacity. f/F is the proportion of the previous area whose tension water capacity is less than a given value of tension water capacity W'M. MM is the maximum W'M. IM is the impervious area. AU represents the tension water storage state. P, EM and K are the rainfall, pan evaporation and ratio of potential evapotranspiration to pan evaporation. R (the grey shadow) is the runoff generated by the input of (P-K*EM).

western researchers, such as VIC model (Liang et al., 1996) and ARNO model (Todini, 1996).

In the second stage of this period (1990~2000), the number of experimental stations significantly decreased as China transitioned from a planned economy to a market economy system, posing challenges to the management of experimental stations. However, the publication of articles continued to increase, partly due to the increasing number of studies adopting emerging tools to analyse the data obtained in the hydrological experiments during previous periods, despite a decline in field-based experimental research. A significant characteristic in this stage was the increasing number of studies analysing specific process questions (e.g., examining the influence of a certain factor on hydrological processes). The proportion of such studies in this period (24 of the 63 we identified) was much higher than in previous periods. Meanwhile, with the development of computer technologies, hydrological models stemming from experimental catchments were developed more frequently. For example, Ou et al. (1995) built a hydrological model to quantify the effect of forests on streamflow and soil water storage. Zhou et al. (1995) adopted the Grey System model GM (2, 1) to compare the hydrographs for three types of vegetation based on 10-year streamflow data at Xiaoliang experimental station. Fan and Han (1991) conducted an artificial indoor experiment to analyse the influence of land surface slope on the runoff amount, peak flow volume and runoff confluence process. A large number of studies also focused on specific aspects of the catchment water cycle, and contributed to the development of hydrological models by improving the simulation modules of a certain process. For example, Bao and Wang (1997) developed a vertical mixing runoff generation model to consider both infiltration excess and saturation excess overland flow runoff.

Groundwater runoff processes were increasingly studied by Chinese hydrologists by the end of the 1990s. Several studies attempted to develop methods to simulate groundwater and to separate the groundwater runoff component (e.g., Luo & Song, 1990, 1991; Rui &

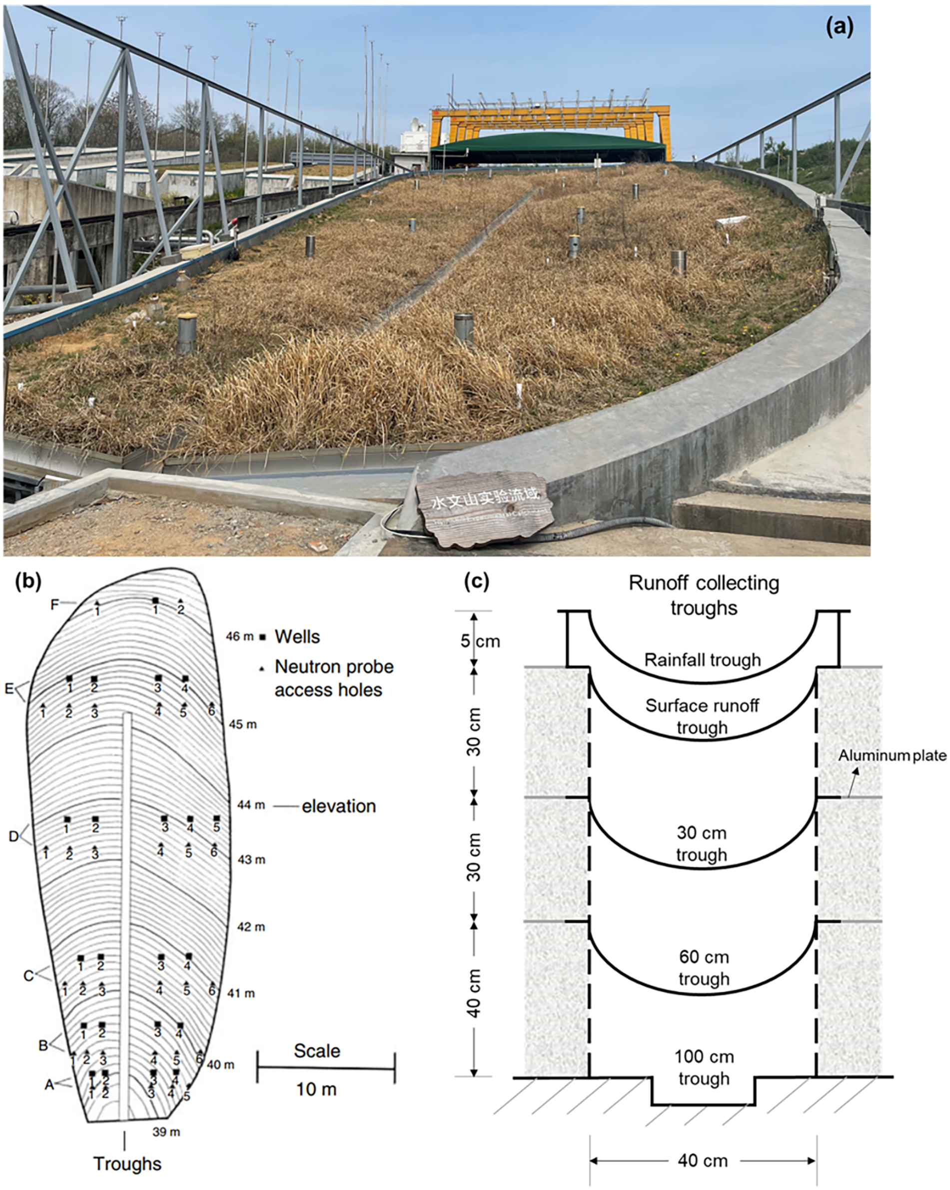

FIGURE 4 The recent photo and topography map of Hydrohill catchment and the schematic cross-section of runoff collectors. (a) Recent photo of Hydrohill catchment (taken by Yi Nan in March 2023). (b) Plan view of the surface topography of the Hydrohill catchment showing the locations of sampling wells and the runoff collecting troughs in 1980s. (c) Schematic cross-section of rain, surface runoff, and subsurface flow collectors at the Hydrohill catchment. (b) *Source*: Adapted from Kendall et al. (2001). (c) Adapted from Kendall et al. (2001).

Zhu, 1989; Xie, 1988). During this period, the study regions in China for experimental hydrology started to exhibit a remarkable geographical diversity. Hydrological experiments were conducted across various climate regions in China, including the arid region of northwest China (Shen et al., 1995), the wet region in southeast China (Gu, 1992), the cold mountainous region in southwest China (Yang et al., 1992) and cold, wet region in northeast China (Fan et al., 1993). Additionally, researchers conducted experiments in a wide range of underlying surface types, such as karst areas (Liang, 1995), deserts (Wang & Gao, 1998), glaciers (Kang et al., 1997) and urbanized catchments (Cen et al., 1997).

Lastly, and perhaps most importantly for this Special Issue and linked to the second stage of this period (1990∼2000) is the work of Professor Weizu Gu. Even when facing the challenges brought by economic transition to hydrological experiments, Professor Gu set up the Chuzhou Hydrology Laboratory and the Hydrohill catchment in 1981 (Figure 4a), described as 'the greatest public works project in experimental hydrology' (Kendall et al., 2001). The Hydrohill was designed as 'an intermediate catchment scale between the complexities of natural catchments and the ideal qualities of soil columns.' The Hydrohill catchment was equipped with a large number of sampling wells and suction lysimeters, making it a suitable location for testing mixing assumptions and closing a water and tracer mass balance (Figure 4b). The runoff components draining from different layers could be measured separately by the weirs at the outlet of the catchment (Figure 4c). Gu was also the first Chinese researcher to adopt an isotope tracer approach to gain insight into the runoff generation mechanism. Gu (1992) was the first Chinese paper that quantified the contribution of pre-event water in runoff generation based on solid evidence from isotope data, thus posing questions about the concepts related to the widely used rainfall-runoff relationships and the unit hydrograph. Gu (1995) proposed the perceptual model of runoff generation processes in the Hydrohill catchment (Figure 5a) where 11 different patterns of surface and subsurface runoff (Figure 5b) were identified by analysing the isotopic composition of varying runoff components collected from precipitation events during 1979∼1992. In addition to establishing the Hydrohill catchment and introducing the isotope tracer approach to hydrological experiments in China, Prof. Gu also had significant contributions to the hydrological measurement methods and technologies. These contributions included developing methods of measuring water flow in small river gauging structures (Gu, 1982), and exploring the utilizability of neutron scattering method in soil water content measurement (Gu & Lv, 1983). These achievements ushered a new area of experimental hydrological research in China, indicating the flourishing of modern hydrology as described by McDonnell (2023, this issue).

4 | SUMMARY AND CONCLUSIONS

Our review showed that the development of experimental hydrology in China could be divided into four stages, which were highly related to national development. In particular, the foundation of the PRC and the great leap forward led to a rapid growth of experimental hydrology, while the great cultural revolution caused a setback in its progress. The implementation of the Reform and Opening-up policy in

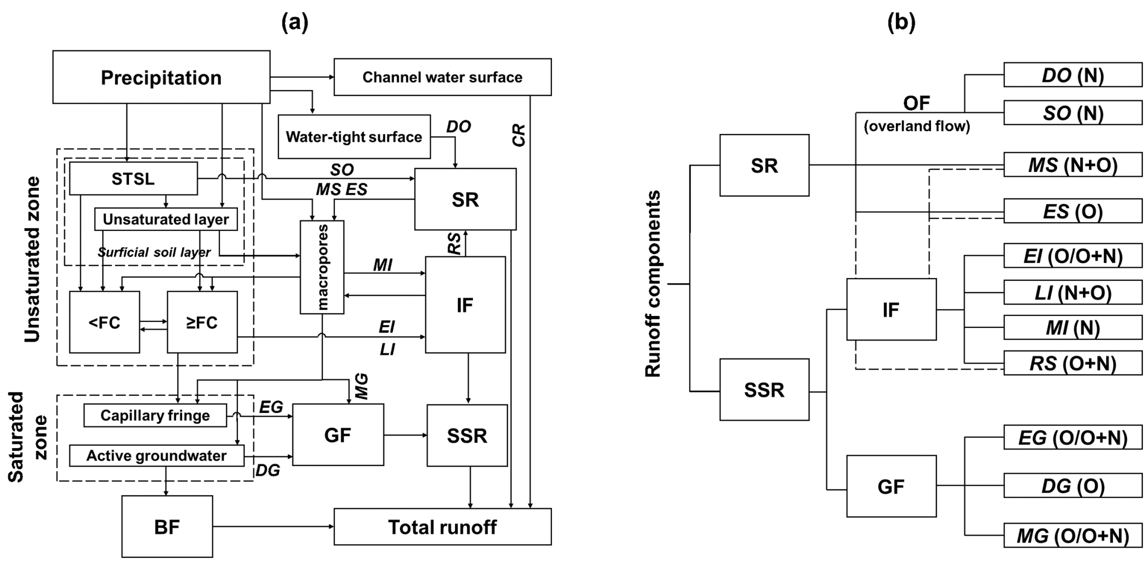

FIGURE 5 (a) Diagram of runoff generation processes in Hydrohill and (b) classification of 11 runoff generation mechanisms. *Source*: Adapted from Gu (1995) and Gu et al. (2018). The meanings of symbols are: BF, baseflow; CR, channel runoff; DG, darcy groundwater flow; DO, direct overland flow; EG, expelled-saturated groundwater flow; EI, piston-like expellant interflow; ES, saturated expellant surface runoff; FC, field capacity; GF, groundwater flow; IF, interflow; LI, lateral saturated interflow; MG, macropore groundwater flow; MI, macropore interflow; MS, mixed-saturated surface runoff; RS, return flow; SO, saturated overland flow; SR, surface runoff; SSR, subsurface runoff; STSL, saturated thin soil layer. O and N in Figure b represent old water and new water, respectively.

1978 ushered in another period of rapid development of experimental hydrology. Gu et al. (2003) also summarized the general process of hydrological experimental study in China. The number of experimental stations significantly decreased after 1990 as China transitioned from a planned economy to a market economy system, posing challenges to the management of experimental stations. However, the publication of articles continued to increase, partly due to the increasing number of model-based studies, despite a decline in field-based experimental research. The Chinese experimental hydrological studies before 2000 had a strong engineering characteristic, with most studies aiming to serve the production and practice of watershed management. These included such things as the influence of artificial measures such as water and soil conservation (Tang & Chen, 1995), rainwater harvesting (Tian, 1996), drainage engineering (Yang et al., 2000) and water storage projects (Wang, 1996) designed to guide the construction and management.

Lastly, ours is by no means the definitive review of hydrology in China. We hope this analysis will spur others to delve into the Chinese literature to uncover more hidden contributions to the field of hydrology. We inevitably missed certain papers in our literature search as it can be challenging to determine whether specific articles should be categorized as experimental studies. Besides, considering the increasing English papers published by Chinese hydrologists after 2000, this study only focused on the advances before 2000, and some important achievements in the 21st century such as hydrological experimental system (HES), critical zone experimental block (CZEB), and hydrological mazes (Gu et al., 2018) will no doubt be summarized in future review papers.

Nonetheless, from the perspective of the influence on modern hydrological sciences, we believe that the papers collected in this review are the most comprehensive review to date on the history of experimental hydrology in China before 2000. Perhaps four significant advances can be highlighted as the most important achievements in Chinese experimental hydrology in the 20th Century: the discovery of the mathematical saturation excess runoff generation relation by Zhao and Zhuang (1963), the Xinanjiang Model of Zhao (1989), the interface runoff generation law of Yu (1985), and the insights from the Hydrohill catchment led by Professor Wei-Zu Gu. The first three achievements before 1990 were realized under exceptionally challenging circumstances characterized by limited measurement equipment and a scarcity of data. In contrast, the last achievement was based on creative and innovative experimental designs and practices.

5 | DEDICATION

We dedicate this small review to Wei-Zu Gu, for whom the special issue is devoted. Prof Gu was an inspiration to all of us. His legacy of experimental hydrology and indomitable spirit lives on in the generations of Chinese hydrologists to come. We thank the two anonymous reviewers of the paper for their useful comments.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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