The Characteristics of Soil Erosion Based on Runoff Plot

Zhang Jianqiang[1], ShenZhaowei[2]，Li Ruohua[2]，Li Gang[3]

[1]Bureau of panning land construction of Da Jiang Dong, Hangzhou, 311225, China

[2]Zhejiang Institute of Hydraulics & Estuary, Zhejiang Key Laboratory of Water Conservancy Disaster Prevention and Reduction, Hangzhou, 310020, China

[3]Zhejiang Guangchuan Engineering Consulting Co., Ltd., Hangzhou, 310020, China

corresponding author: Shen Zhaowei

corresponding author's e-mail address : 656375320@qq.com

Abstract: This paper studied 5 runoff plots of rainfall, runoff and soil erosion in Zhejiang province, China. The results showed that: (1) Annual rainfall was mainly concentrated in 4-9 months, accounting for 61%-67% of annual rainfall.(2) Annual runoff was mainly concentrated in 5-9 months, accounting for 67%-76% of annual runoff.(3) The amount of soil erosion was mainly concentrated in 5-9 months, accounting for 68%-87% of annual runoff. (4) Soil erosion was closely related to rainfall and runoff.

1. Introduction

Soil erosion is one of the important environmental problems that endangers the ecological security. it is one of the forms of ecological destruction, and is also one of the main environmental problems that the society pays close attention to at the same time [1].Rainfall is one of the important factors causing soil and water loss[2]. Study of the relationship between rainfall and soil erosion is one of the important contents of soil and water conservation science, and it can provide scientific basis for the development of soil and water conservation project[3-6].

In this study, five runoff plots in Anji, Yongkang, Changshan, Tiantai and Yuyao of Zhejiang Province were selected as research areas. The relationship between rainfall and runoff, runoff and soil erosion, rainfall and soil erosion were analysed using rainfall, runoff and sediment data in 5 regions in 2015. The research results can provide a scientific basis for preventing soil erosion.

2. General situation of study area

The basic situation of 5 regions in Anji, Yongkang, Changshan, Tiantai and Yuyao was as follows:
Hutang comprehensive observation field in Anji County is a small watershed of lake pond, which had become the national soil and water conservation science and technology demonstration park, with park area 57.88hm^2. According to the 1980~2009a daily rainfall statistics data of Xiaofeng meteorological station in Anji County, the annual rainfall was 1153~1864mm, and the erosive rainfall was more than1200mm accounting for 73.9% of rainfall. The soil in the basin was mainly red-yellow soil, and the land use types were mainly plantations.

Yongkang street was a small watershed runoff Qiantang River basin. According to 1980~2009a daily rainfall statistics data of Yongkang Municipal Meteorological Station in Yongkang County, the

annual rainfall was 983~2134mm, and the erosive rainfall was more than 1200mm accounting for 71.3% of rainfall.The soil was mainly red soil and yellow soil.

Changshan county was a small watershed of Qiantang River basin. According to 1980~2009a daily rainfall data statistics of the Fangcun meteorological station in Changshan county, the annual rainfall was 1319~2724mm, and the erosive rainfall was more than 1200mm accounting for 78.3% of rainfall. The soil was mainly red soil and limestone soil.

The Tai River field was also a small watershed of Qiantang River Basin. According to the 1980~2009a daily rainfall statistics data of Tiantai county meteorological station, the annual rainfall was 820~1728mm, and the erosive rainfall was more than 1200mm accounted for 72.2% of rainfall. The soil was mainly red soil and paddy soil.

Yuyao was also a small watershed of Qiantang River basin. According to 1980~2009a daily rainfall statistics data of Yuyao Municipal Meteorological Station, the annual rainfall was 921~1736mm, and the erosive rainfall was more than 12mm accounted for 73.3% of rainfall. The soil was mainly red soil and paddy soil.

3. Research method

The annual rainfall, runoff and sediment yield in 2015were collected. The rainfall collection device was measured using a simple artificial rainfall level measuring device which was installed in the open space, built-in water storage equipment, indoor with rain gauge. According to the design and construction of soil and water conservation monitoring sites in Zhejiang province, the runoff and sediment collected from the catchment area were set at the bottom of each runoff plot. The first grade runoff pool was provided with a "V" type flow weir, one of which connects the two stage runoff pool. The two grade runoff pool was provided with a "V" type flow weir, which was connected with the three grade runoff pool. When the runoff occurs, runoff was first collected to water tank, and then pooled into a tank through the aqueduct level runoff pool. When runoff pool was larger than that of the tank capacity, runoff began a diversion, and part of runoff was diverted to the two grade runoff pool. If runoff continued to increase, the runoff pool was larger than that of the tank capacity, the two grade runoff divided into three grade runoff pool.

4. Rainfall characteristics

The rainfall of 5 regional in 2015 in Anji, Yongkang, Zhejiang, Changshan, Yuyao was analysed, and the results were shown in Figure 1.

In 2015, the total amount of rainfall in 5 regions in Zhejiang province was between 1716.0-2834.5mm, and the amount of rainfall was abundant. In Figure 1, rainfall showed a significant wave trend, rainfall mainly concentrated in 4-9 month, accounting for 60.7%-66.6% of the annual rainfall, reaching the maximum value in June and July. There were significant differences in rainfall in 5 regions, and the total rainfall was the largest in Yuyao and Changshan. In addition, the rainfall in Changshan and Yuyao reached the maximum value in June and July, significantly higher than other regions.

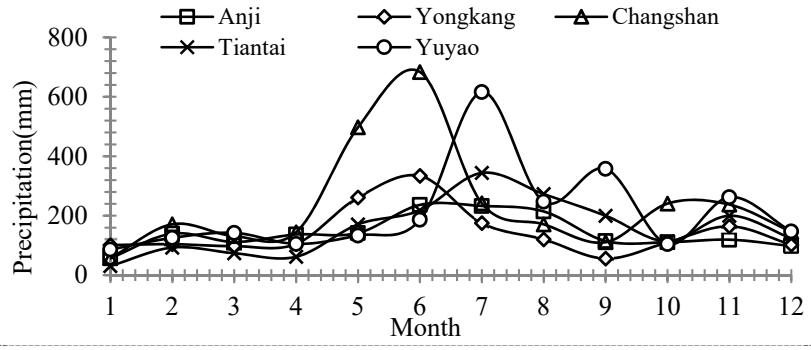

Figure 1. Monthly variation characteristics of rainfall in different regional.

The trend of seasonal rainfall was the same as that of the monthly rainfall, which showed a clear fluctuation trend. The precipitation in the second or third season was the largest, and the first and fourth season were relatively small (Figure 2).

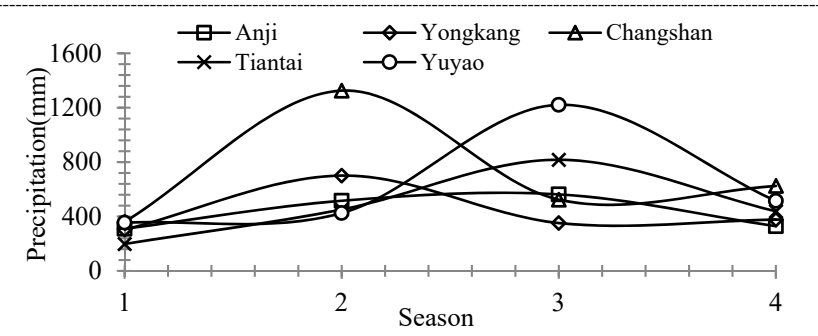

Figure 2. Seasonal variation characteristics of rainfall in different regions.

5. Characteristics of runoff and soil erosion

Runoff was mainly concentrated in 5-9 month(Figure 3), accounted for 67.4%-76.2% of the annual runoff. The monthly runoff in Yuyao and Yongkang was still the largest, especially in 5-9 month, and which was minimum in Anji and Tiantai. As can been seen that the amount of sediment losses showed obvious fluctuation trend in Figure 4. The amount of sediment loss was mainly concentrated in 5-9 months, which accounted for 68.3%-86.7% of the annual runoff. The monthly sediment loss in Yuyao and Yongkang was the largest, especially in 5-9 month which was the same with the runoff. The amount of sediment loss in autumn and winter seasons was larger, and which in spring was the smallest.

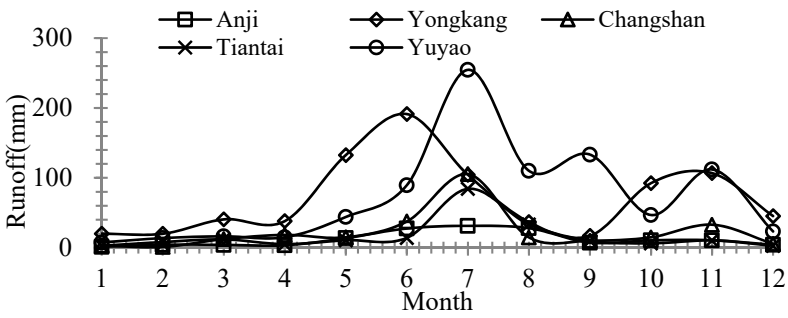

Figure 3. Monthly runoff depth in different regions.

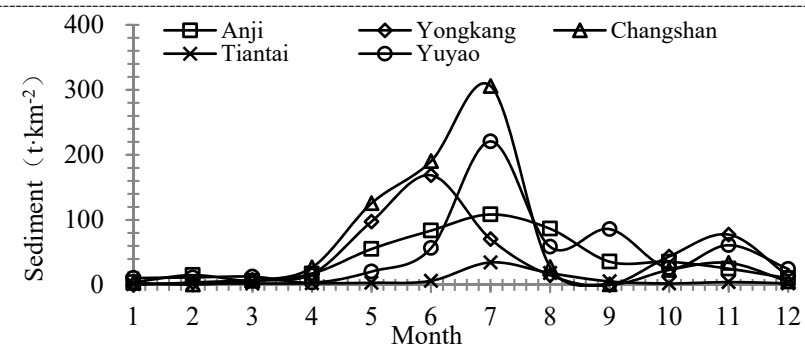

Figure 4. Monthly sediment yield characteristics in different regions.

6. Relationship between rainfall, runoff and sediment yield

Analysis of rainfall and runoff (Fig. 5) showed that runoff increased with the increase of rainfall, and decreased with the decrease of rainfall, which showed that there were some relationships between the two. This was mainly because the rainfall was the main source of runoff, if the rainfall was larger and the runoff would be relatively large. The same analysis to runoff and sediment yield (Fig. 6) showed that the fluctuation law of sediment loss amount with runoff fluctuation was consistent, and which showed that there was a certain relationship between the two. This was mainly because the surface soil was stripped by rainfall, and the runoff from rainfall migrated the stripped soil particles.

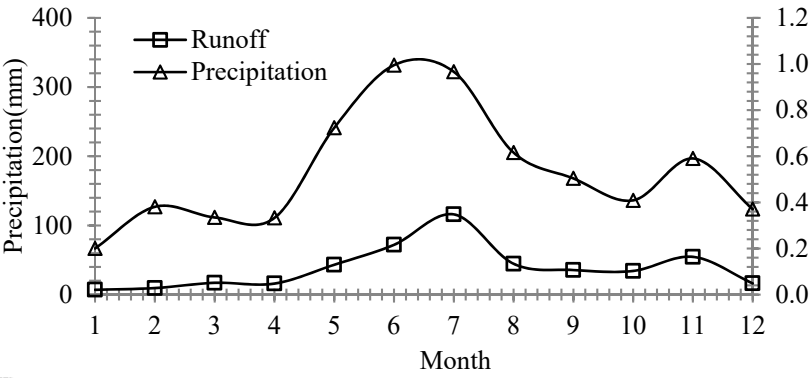

Figure 5. Relationship between runoff and rainfall.

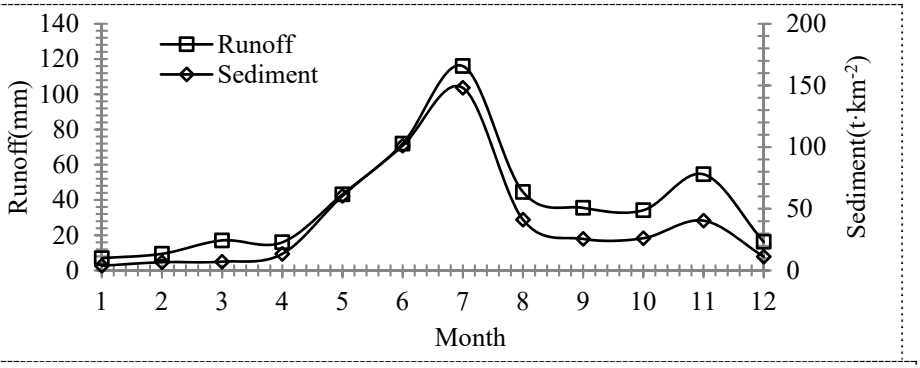

Figure 6. Relationship between runoff and Sedimentyield.

7. Conclusions

(1) In 2015, the total amount of rainfall in 5 regions of Zhejiang province was between 1716.0-2834.5mm, and rainfall was mainly concentrated in 4-9 month, accounting for 60.7%-66.6% of the annual rainfall. Total rainfall from large to small: Yuyao>Changshan>Anji>Yongkang>Tiantai. The rainfall in Summer and Autumn were larger, and which inSpring and Winter were relatively smaller.

(2) The total annual runoff from large to small: Yuyao>Yongkang>Changshan>Anji>Tiantai. Runoff mainly concentrated in 5-9 month, accounted for 67.4%-76.2% of the annual runoff. Runoff in autumn and winter had larger fluctuations, and which in the spring had a smaller fluctuation.

(3) Annual sediment loss from large to small: Yuyao>Changshan>Yongkang>Anji>Tiantai. The amount of sediment loss was mainly concentrated in 5-9 month, accounting for 68.3%-86.7% of the annual runoff.

(4) The trend of rainfall, runoff and sediment yield was consistent.The surface soil was stripped by rainfall, and the runoff from rainfall migrated the stripped soil particles.

Acknowledgments

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