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Introduction

Droughts are one of critical issues for water resources risk assessment due to global warming. It is important to understand and explain how drought occur and where is the high-risk area of drought for natural hazard mitigation.

Objective

This study aims to assess the frequency of drought occurrence by method using statistical analysis and water resources data at Shikoku region in Seto Inland Sea Climate where has relatively frequent drought occurrence in Japan.

Methods

Target Area and Data

Shikoku region in Seto Inland Sea Climate

Red dots shows 26 locations of observed precipitation data obtained from AMeDAS which is used in this study

Drought in this study is defined as the record of reduction of water intake in the web archives (https://www.shikoku-saigai.com/).



Fig.1 target area map and observed precipitation data locations

Collected observed data

- Precipitation, Population data

Statistical Data Analysis

- Precipitation
Population
Water resources and water usages estimates

Assumption: Water resources = (Precipitation - Evapotranspiration) x area is adopted in this study as following estimation assumption from the web link.

Assumption: Evapotranspiration = Precipitation x 2/3 is adopted in this study as following the book

Water usages = domestic water use + agricultural water use + Industrial water use

Results and Discussions

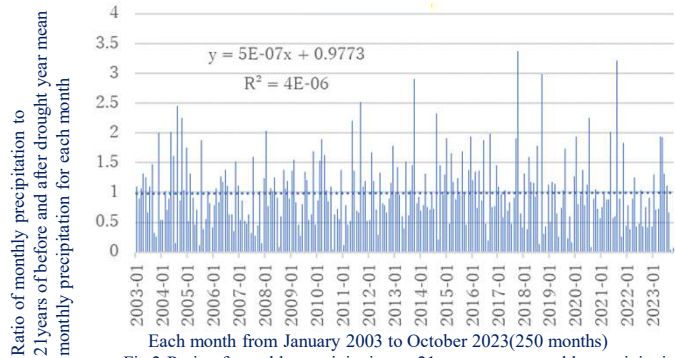


Fig.2 Ratio of monthly precipitation to 21 years mean monthly precipitation for 250 months at Matsuyama City

The drought occurrence year at Matsuyama City is 2013. The ratio of monthly precipitation in drought occurrence year 2013 are similar values to the ratio of monthly precipitation during 2003 to 2023. Although there is not extreme characteristic of precipitation in drought occurrence year 2013, the ratio of monthly precipitation in 2011 and 2012 tend to be below 1 in several months, and it suggest that drought occurred in 2013 due to less monthly precipitation in 2011 and 2012 compared to each month climate normal precipitation.

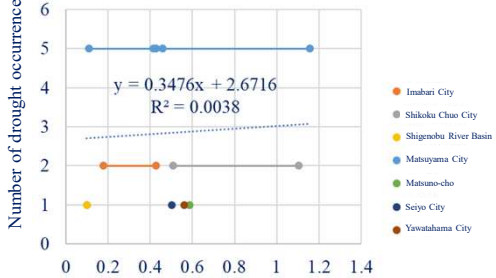


Fig.3 Scatter plots of ratio of monthly precipitation to 21 years climate normal monthly precipitation on drought occurrence month and number of drought occurrence in Ehime Prefecture

The ratio in Fig.3 is below 1 mean that monthly precipitation in drought occurrence month is less than climate normal monthly precipitation during 21 years between before 10 years and after 10 years from drought occurrence year. Although clear relationship between the ratio of monthly precipitation on drought occurrence month and number of drought occurrence were not shown in Fig.3, it was confirmed that drought occur mostly in the case that ratio of monthly precipitation to climate normal precipitation on drought occurrence month is below 1 in Fig.3.

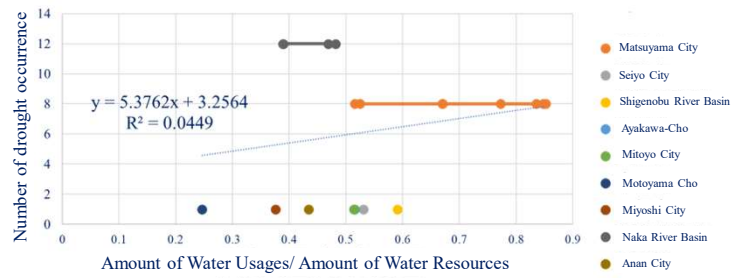


Fig.5 Scatter plots of Number of drought occurrence and the ratio of amount of water usages to water resources at Shikoku Region

In Fig.5, at Matsuyama City, the ratio of amount of water usages to amount of water resources are from 0.5 to 0.8 and relatively higher than another locations in Shikoku Region. It is considered that since population at Matsuyama City is larger than another locations, the ratio of amount of water usages to amount of water resources are larger than another locations. At Matsuyama City, number of drought occurrence is relatively larger than another locations. It suggests that there is possibility that Matsuyama City has high risk of drought.

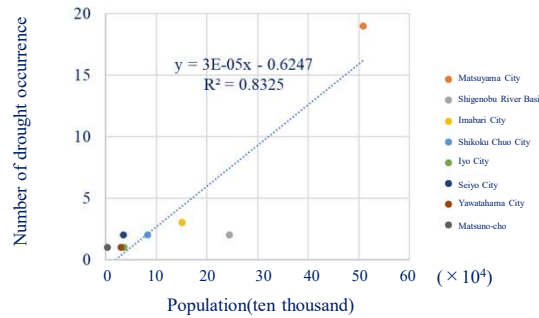


Fig.4 Scatter plots of population and number of drought occurrence in Ehime Prefecture

In Fig.4, at Matsuyama city, number of drought occurrence is larger compared to another locations in Ehime prefecture, and population is also larger compared to another locations in Ehime prefecture. In Fig.4, at the locations where less number of drought occurrence in Ehime prefecture, population tend to be below 100000. It suggests that due to large population at Matsuyama City, water usages tend to be larger among locations, as the result, number of drought occurrence tend to be larger at Matsuyama City among locations.

Conclusion

In this study, statistical analysis for number of drought occurrence, observed precipitation, population, water resources and water usages were conducted in Shikoku Region. The results suggest that characteristic of population is more explain about differences of number of drought occurrence than characteristic of precipitation among locations in Shikoku Region in this study. It is considered differences of population among locations within Shikoku Region more influence on differences of drought occurrence by increasing water usages than similar characteristics of precipitation among locations within Shikoku Region on Seto Inland Sea Climate where is known for temperate climate and light rain. In this study, it is indicated that Matsuyama City where has large population among Shikoku Region has high risk of drought.

Acknowledgement

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Reference

Itaru Teragawa, Study on drought in the Shikoku region by statistical analysis using AMeDAS observed precipitation data and population data, Bachelor Thesis, Yamaguchi University, January 2024 (Principal Supervisor Dr. Natsuki Yoshida; Co-Supervisor Prof. Koji Asai)