

Evaluation of unit design water supply amounts and characteristics of water consumption based on measured building use

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Introduction

In Japan, the discharge from an increasing number of buildings is being measured automatically by Building Energy Management System (BEMS), but there are few examples for which the measured data can be reflected in design standards.

This research investigates the real water consumption in a recently constructed building using measured data and estimates environmental performance based on unit design water supply standards and rainwater utilization.

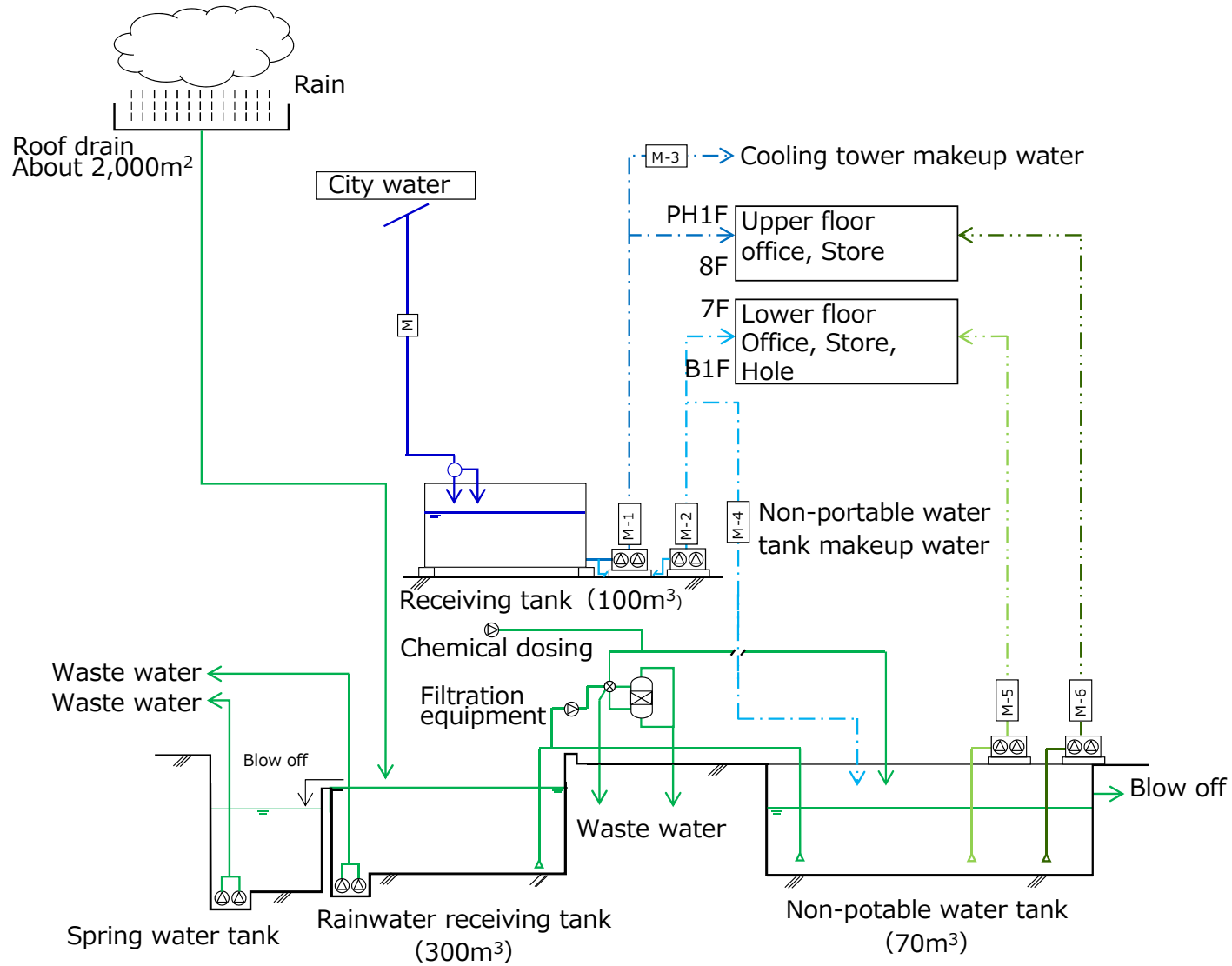
In this paper, we examine the interaction between the design water supply set using the unit water supply standards, rainwater utilization, and potable water replacement rates, based on actual measurements of water use in an existing building.

Overview of evaluation building (Table1)

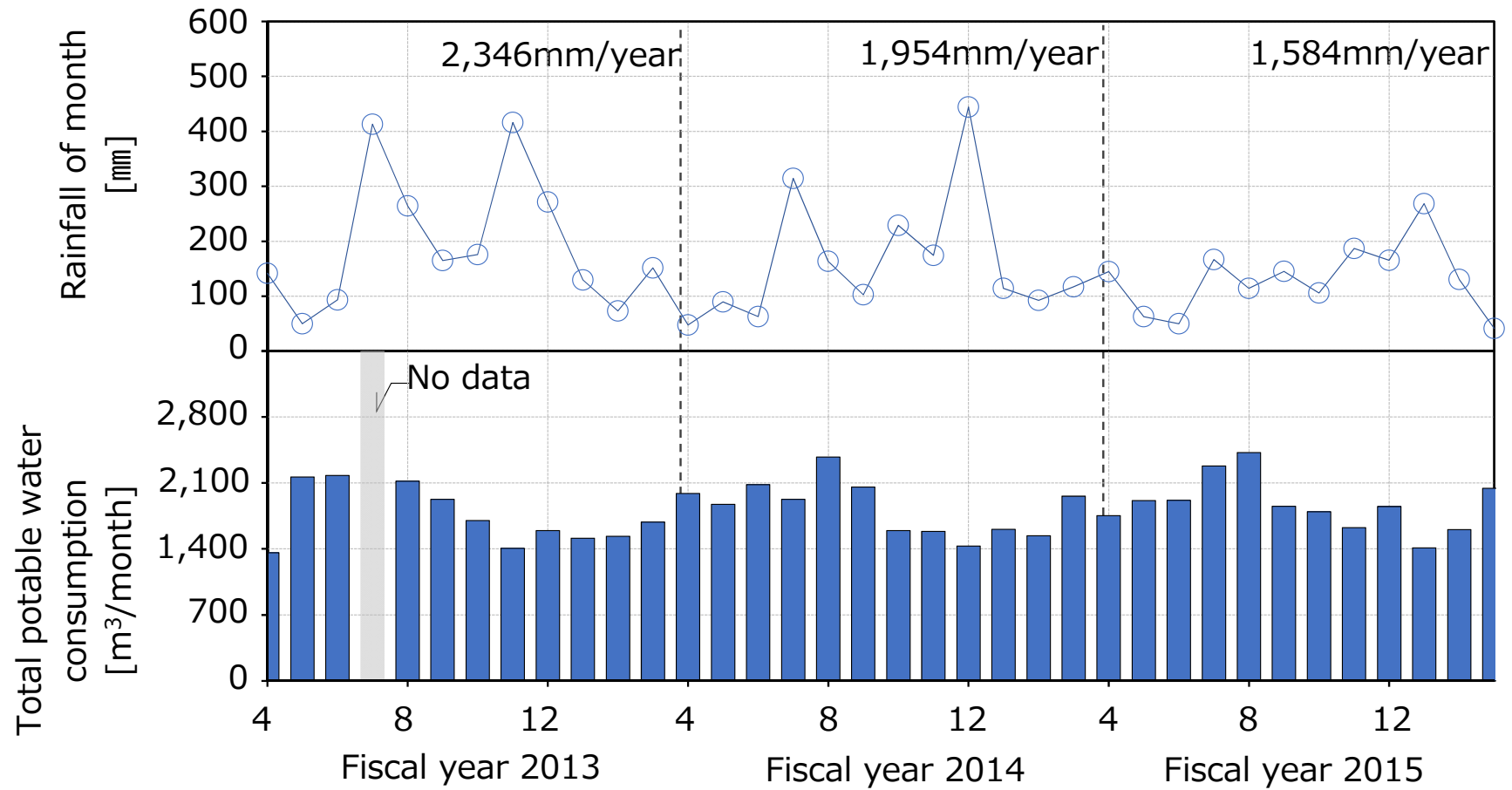


Building locations		Niigata
Building use		Office,Hall,Store
Gross floor area		About 30,000m ²
Water supply system		Direct pumping system (2 water supply system of upper floor and lower floor)
Water use	Potable water	Washbasin, Kitchen, taps
	Non-potable water	Toilet flush, Outdoor

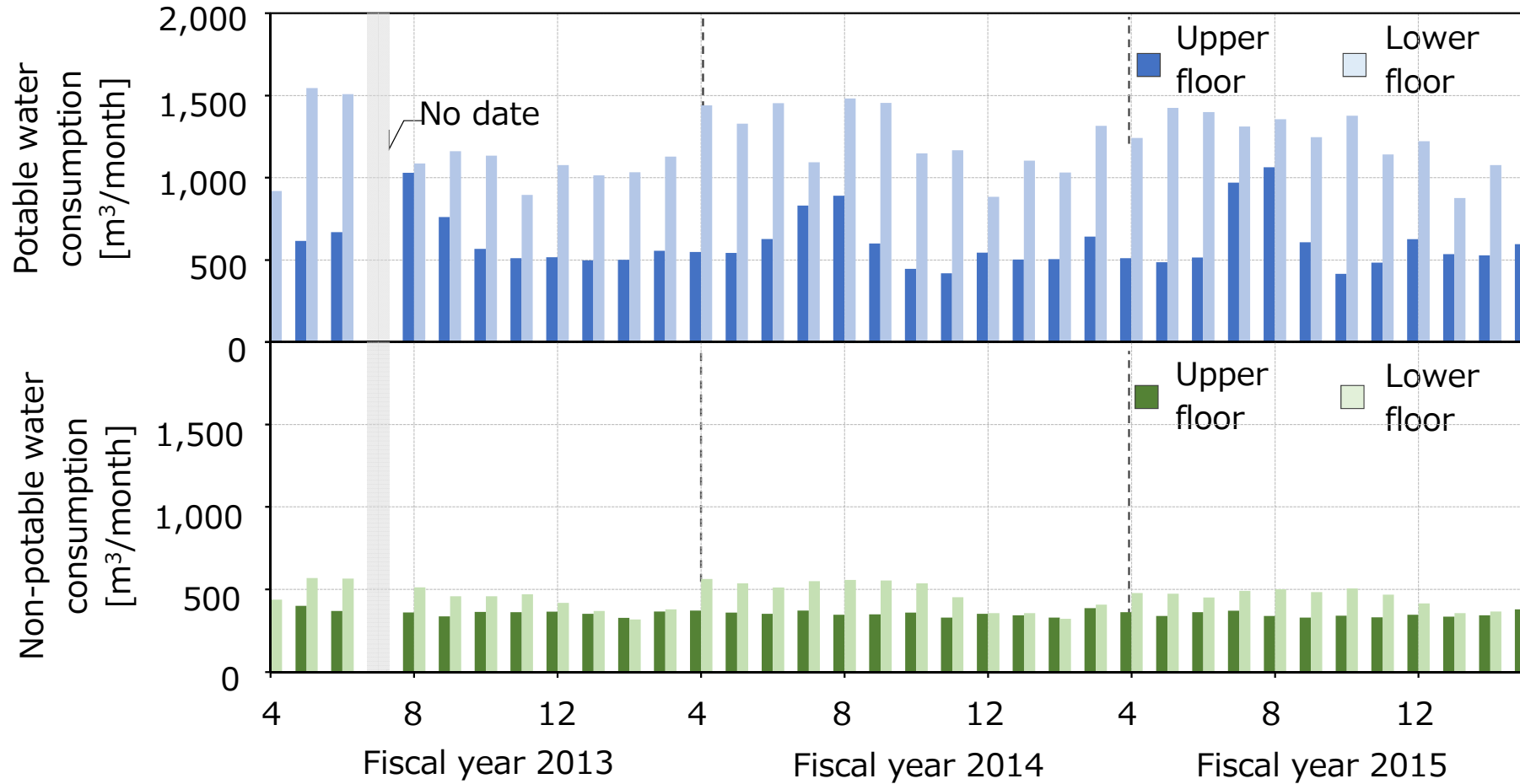
Water supply system schematic of Evaluation building(Figure1)



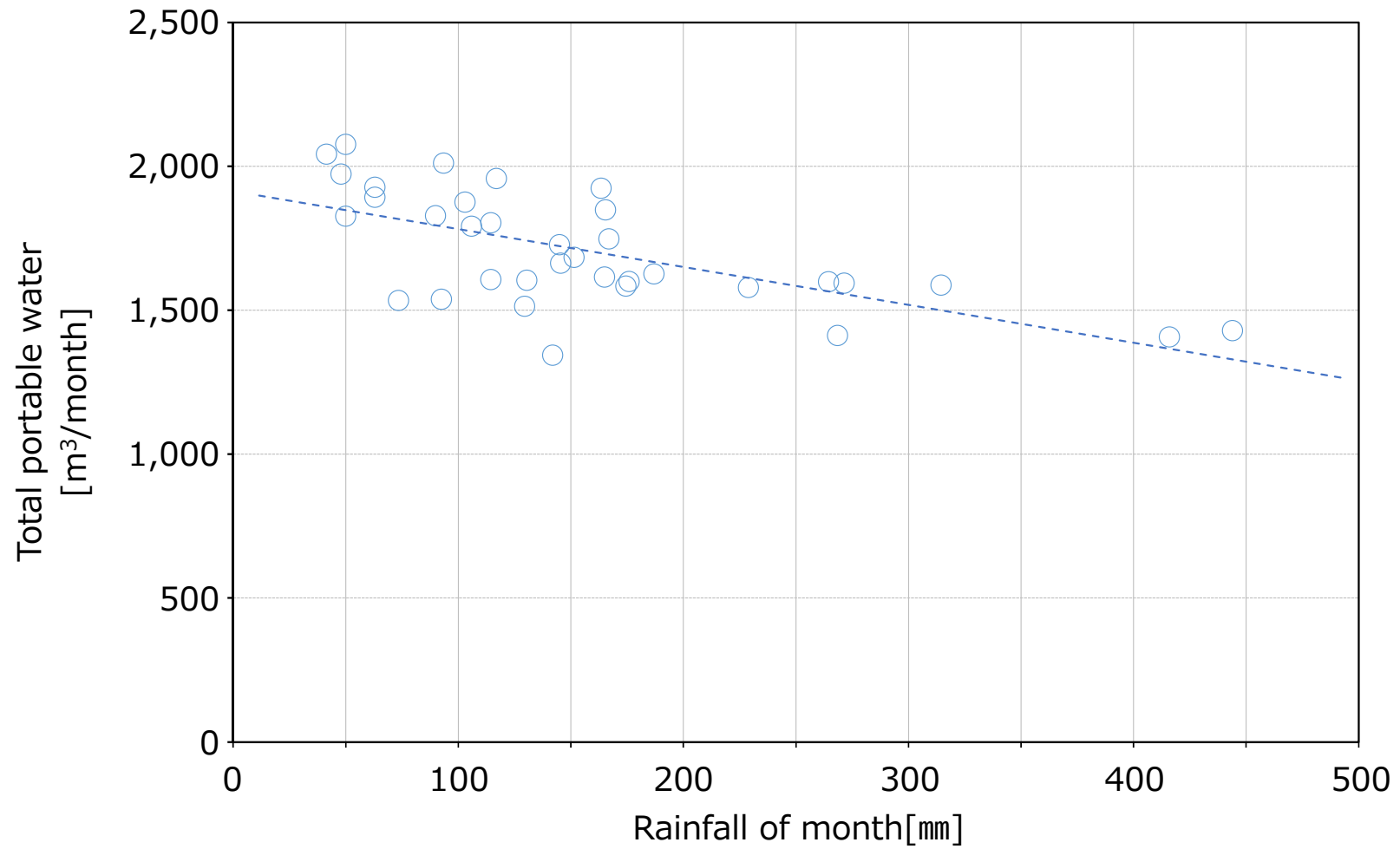
Rainfall of month and total portable water consumption(Figure2)



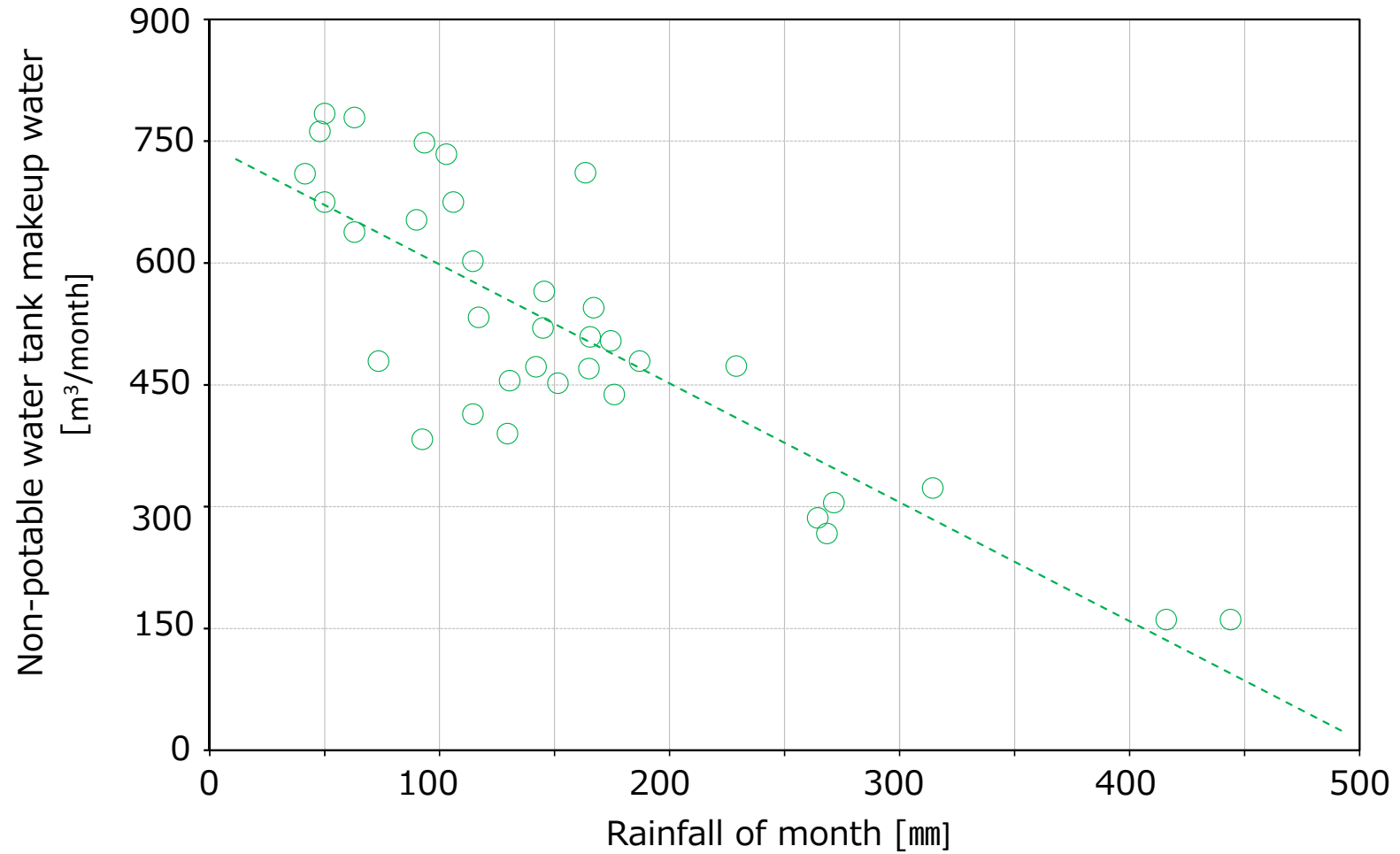
Consumption of Portable water and non-portable water(Figure3)



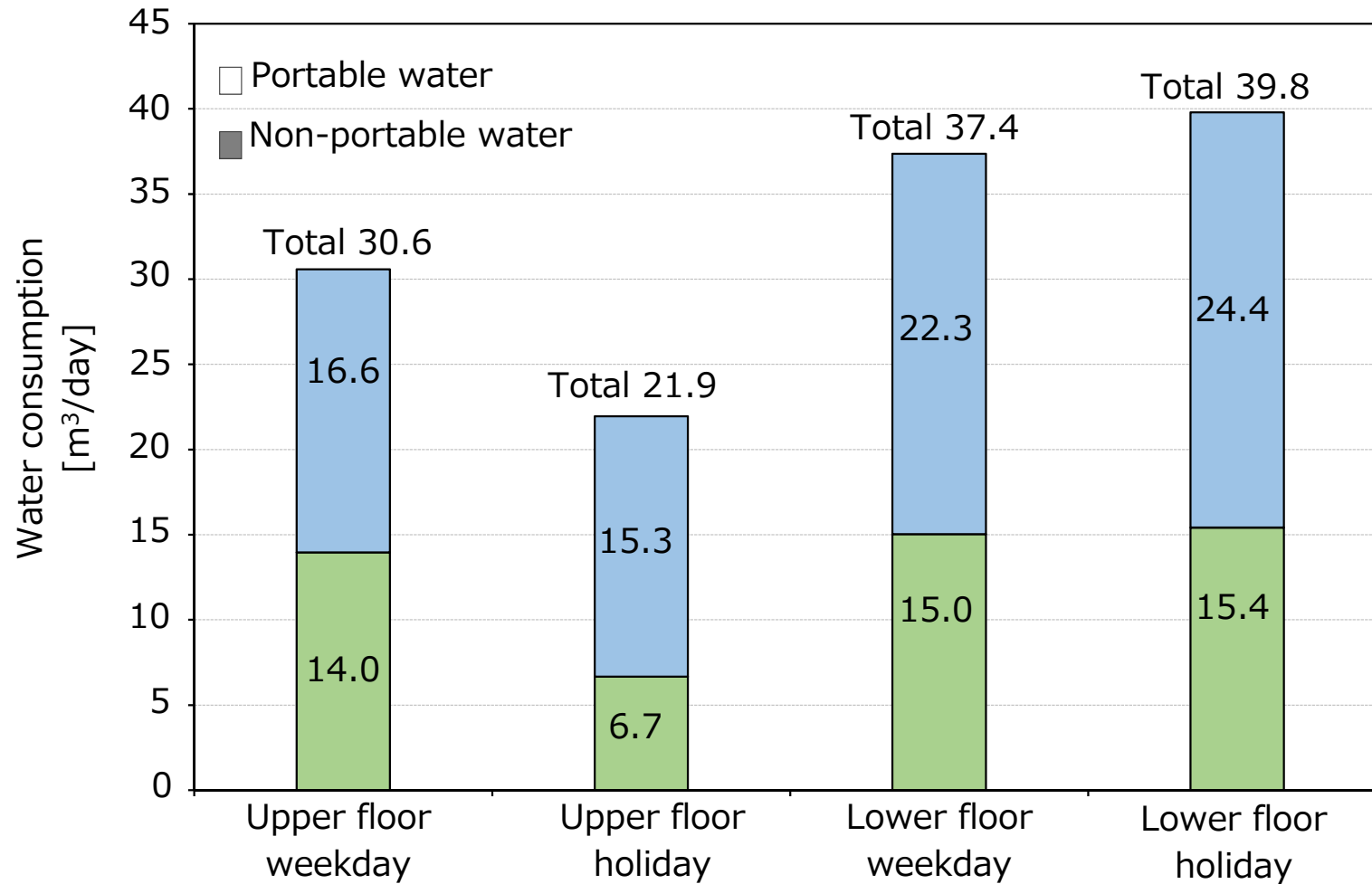
Comparison of Rainfall and total portable water consumption comparison(Figure4a)



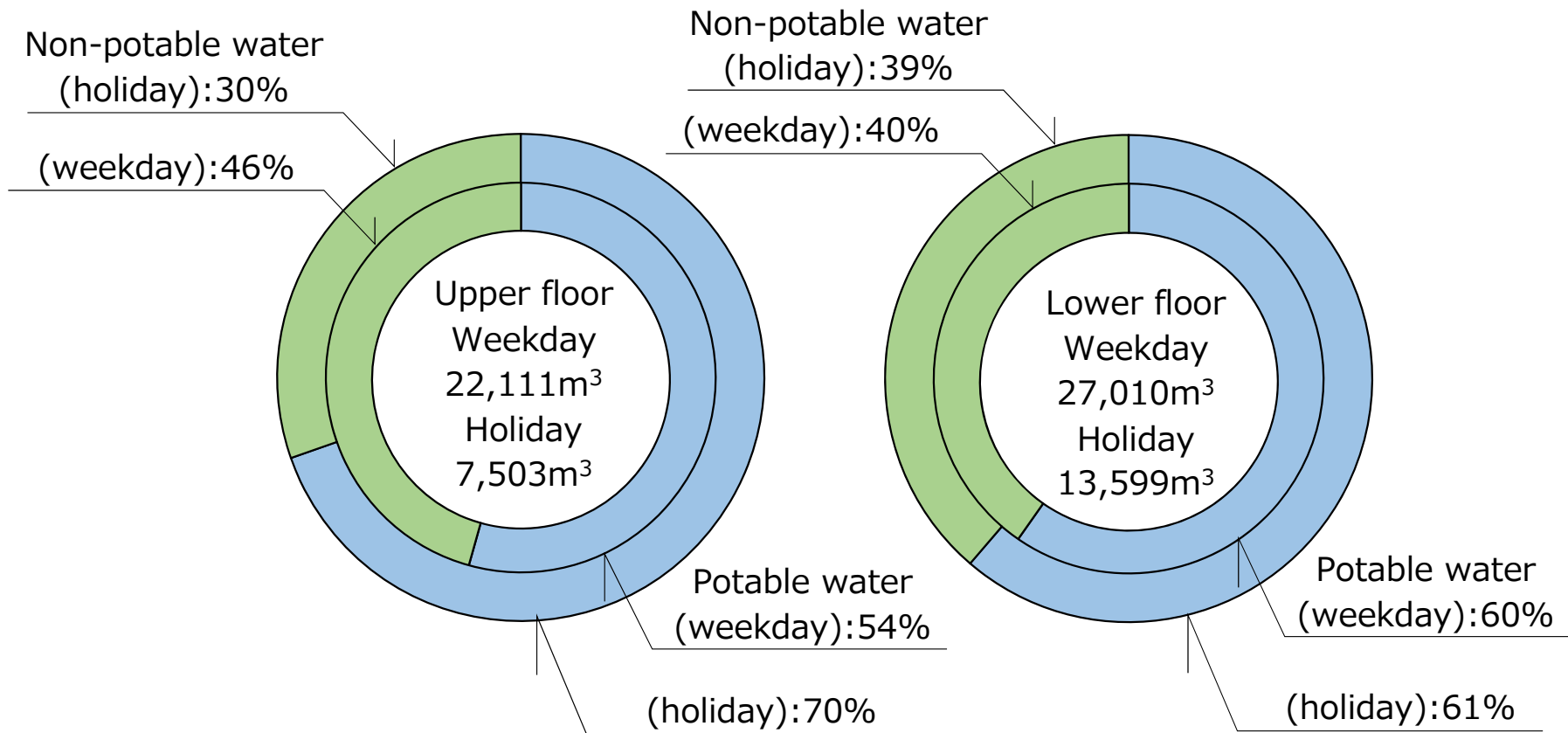
Comparison of rainfall and non-portable water tank makeup water consumption(Figure4b)



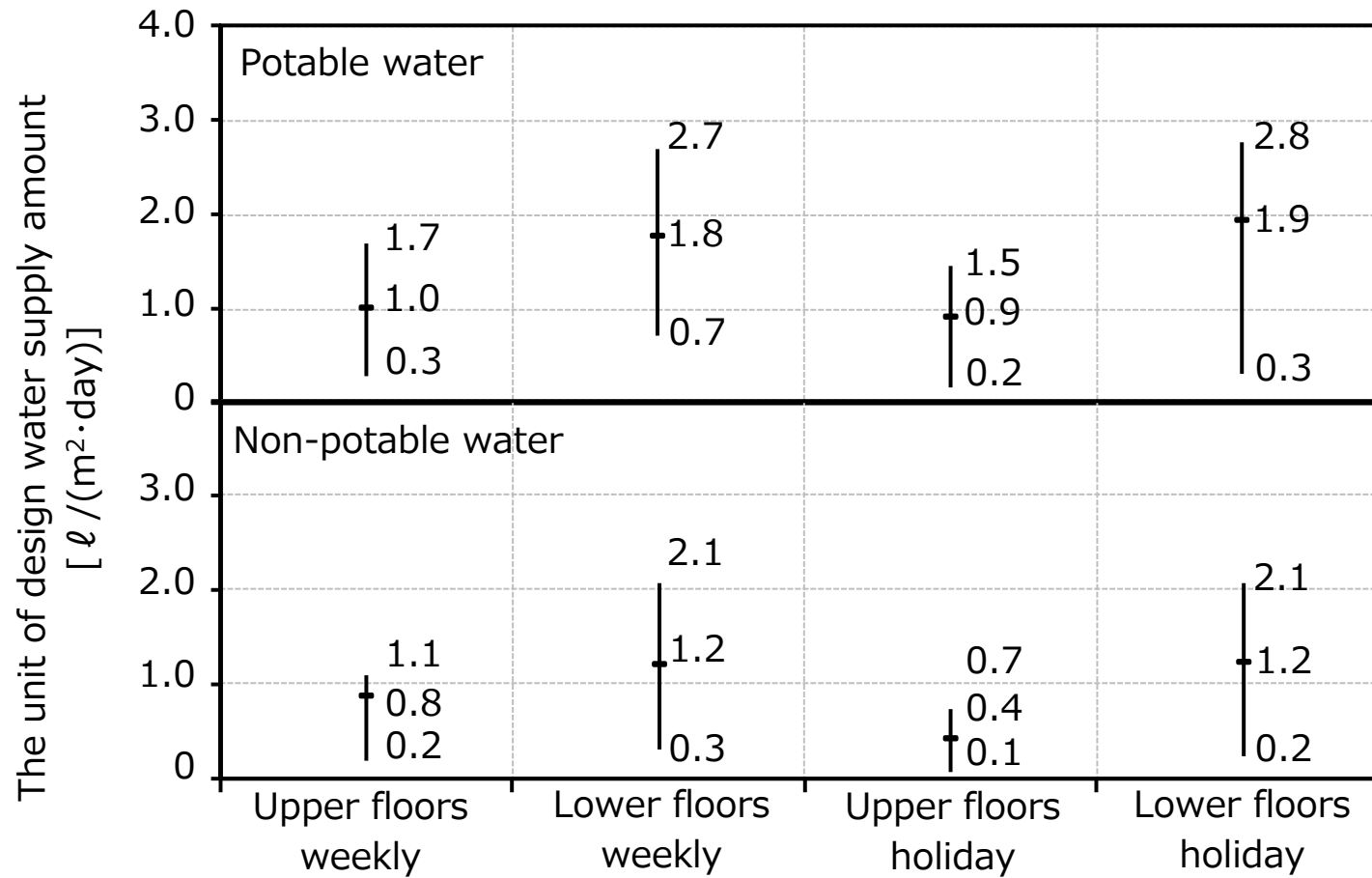
Weekday and holiday of daily water consumption by water use(Figure5)



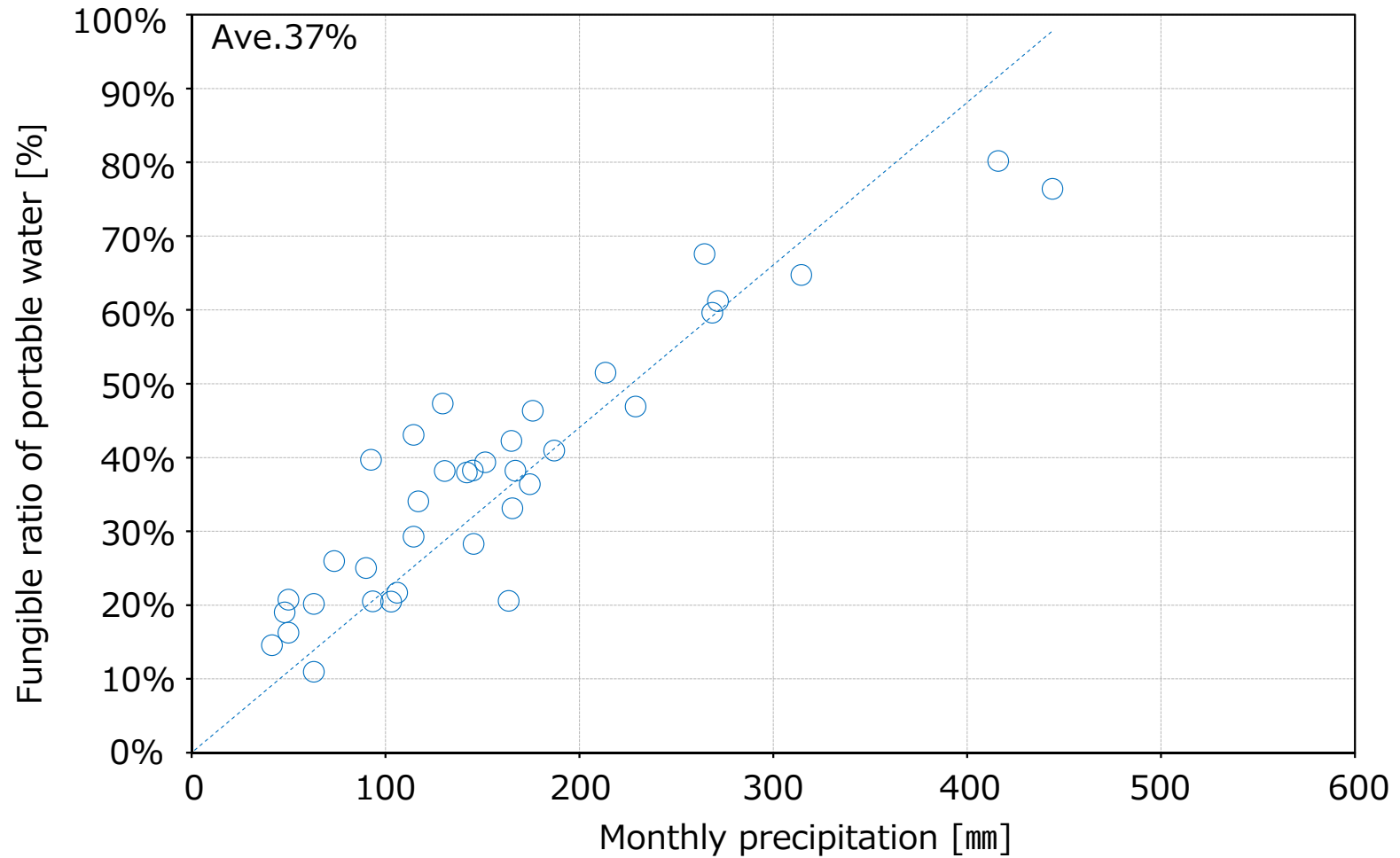
Water use rate of upper and lower floors in study building(Figure6)



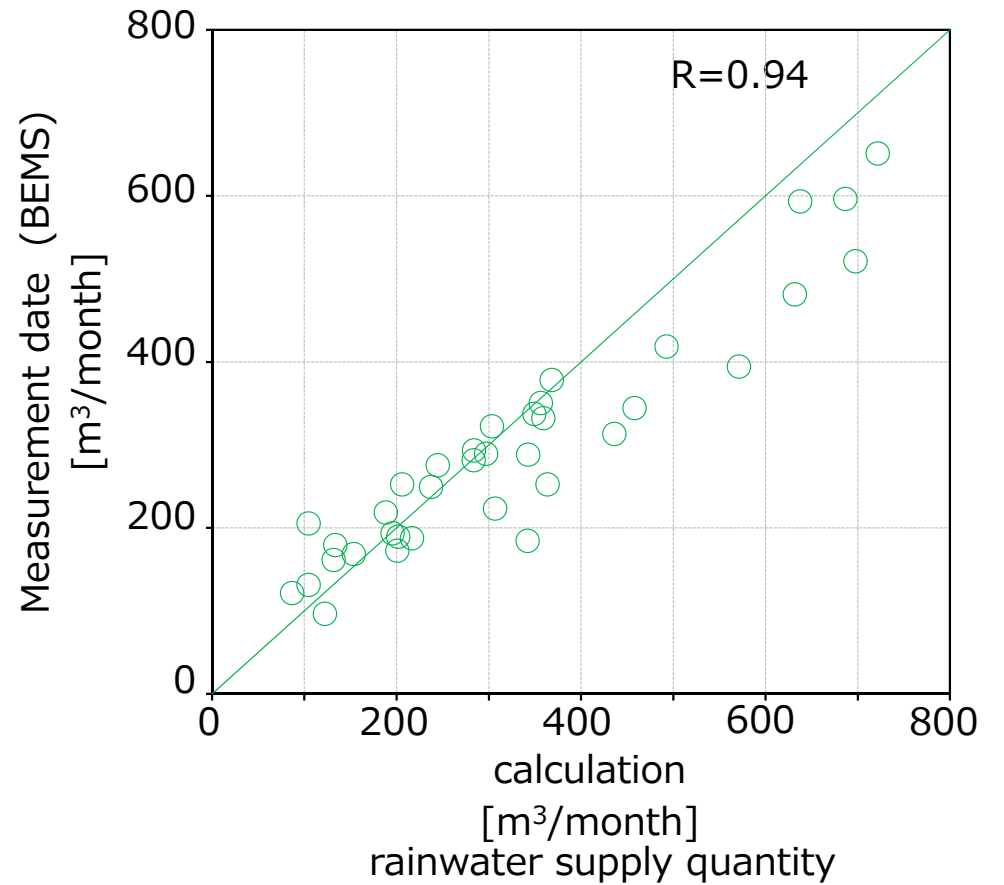
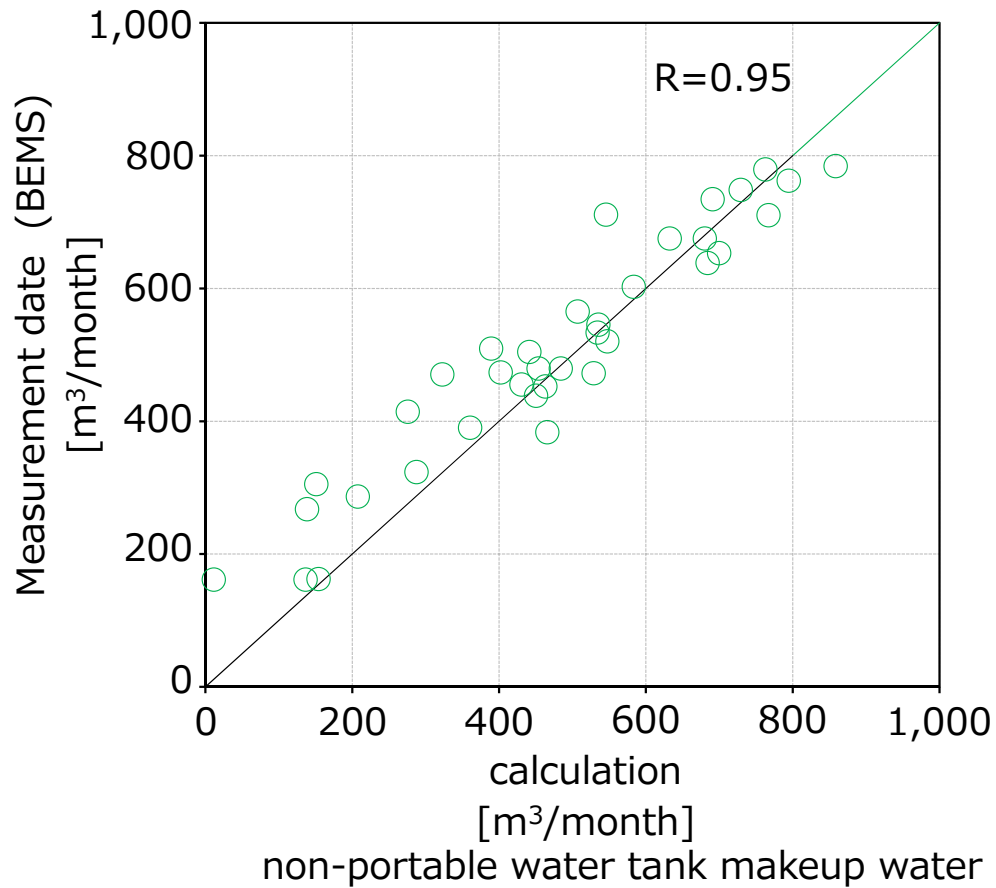
The unit of design water supply amount by water use(Figure7)



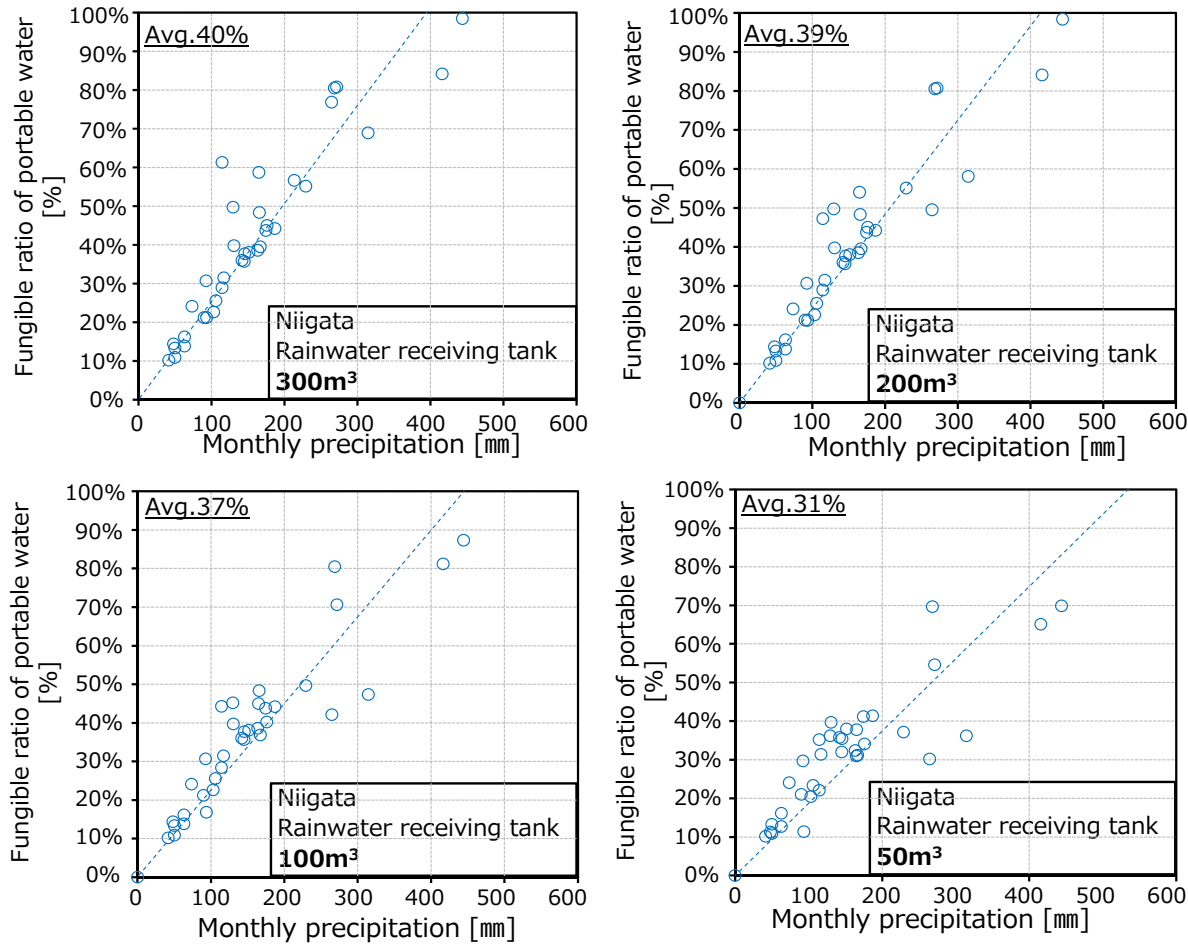
Fungible ratio of portable water and rainfall(Figure8)



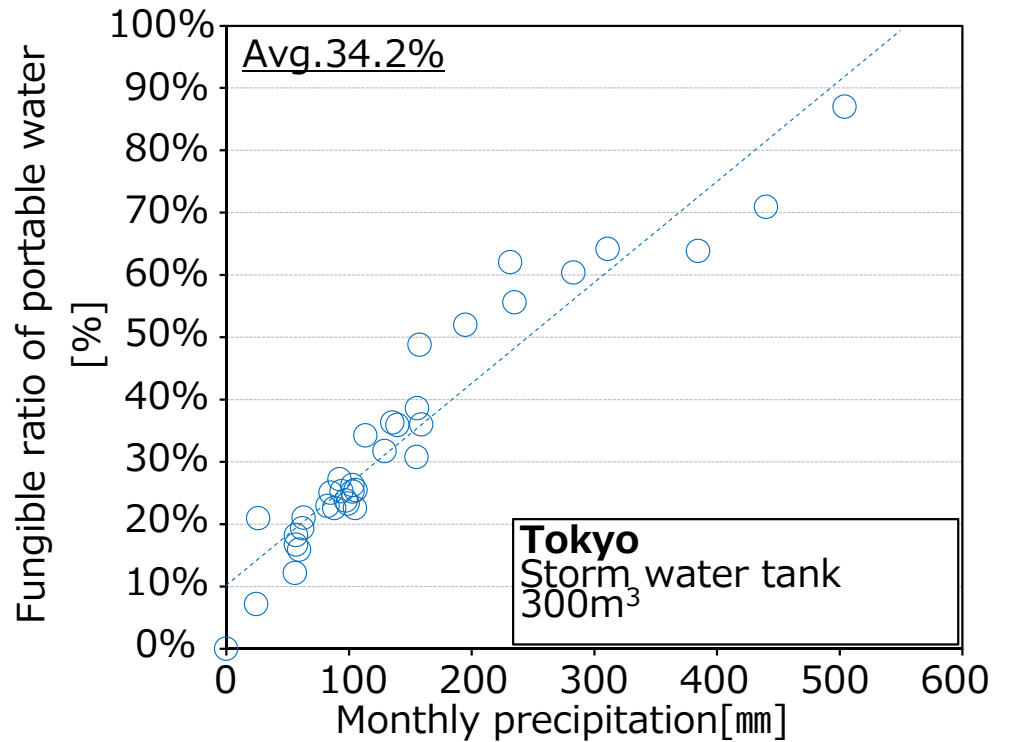
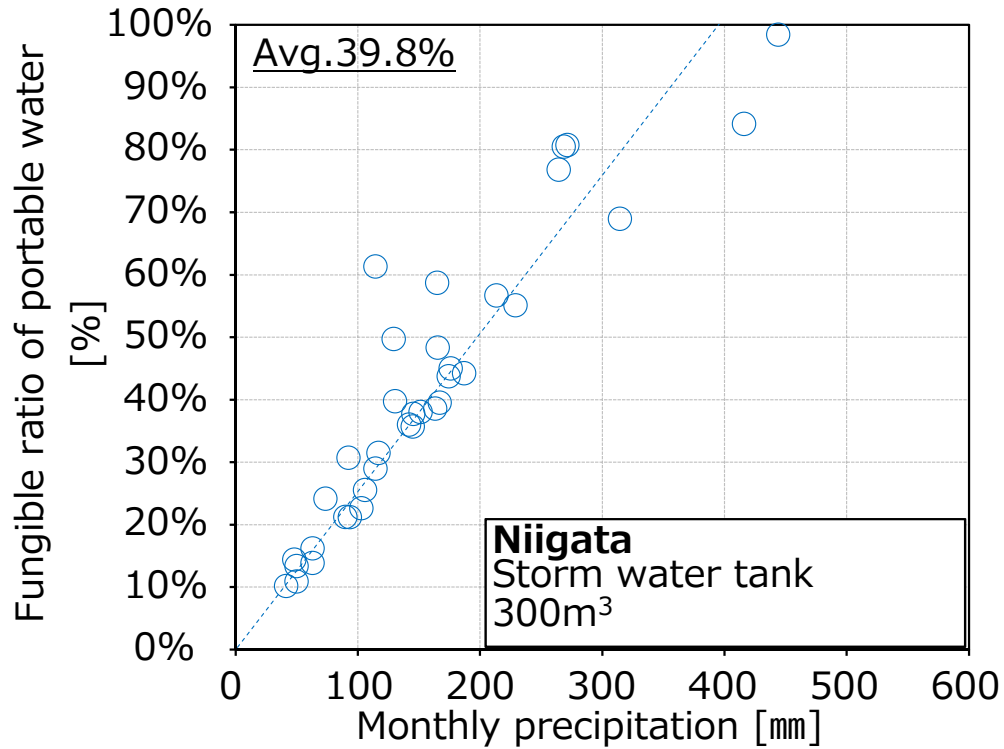
Comparison between measurement date and calculation(Figure9)



Comparison based on rainwater receiving tank capacity(Figure10)



Comparison by rainfall characteristics(for Niigata and Tokyo) (Figure11)



Location (Niigata and Tokyo)

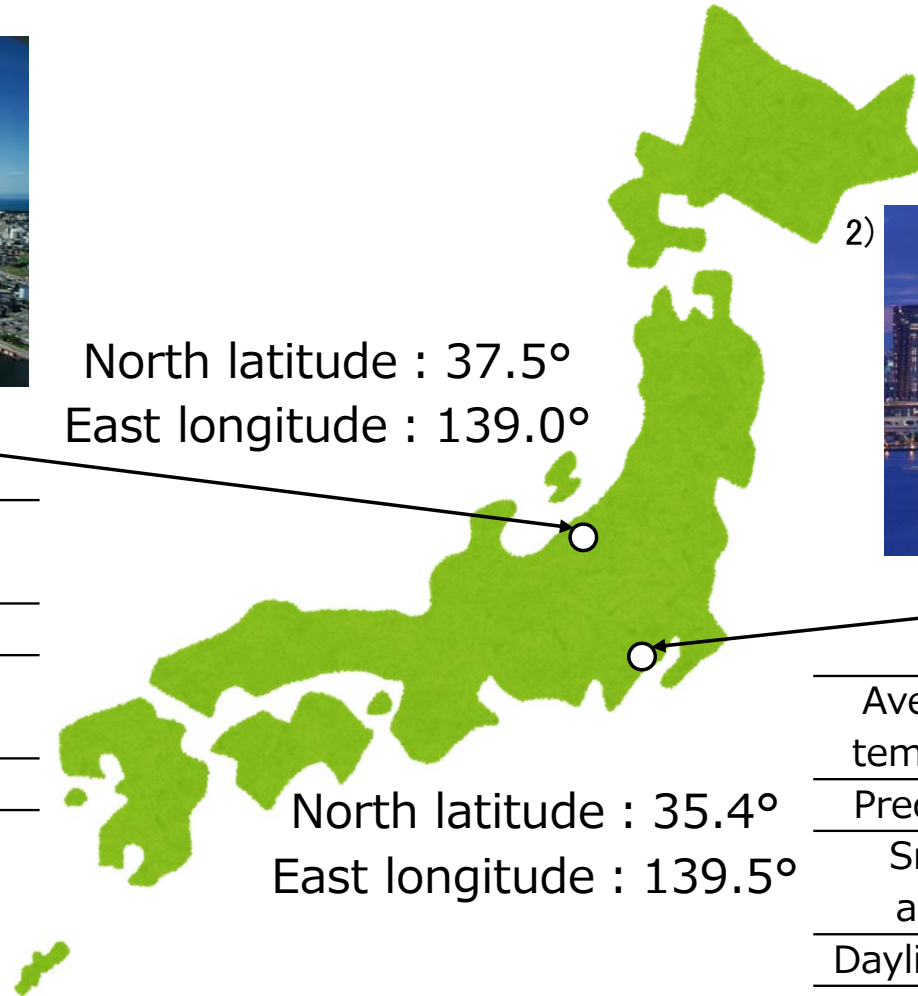
1)



Niigata(2015)

Average air temperature	14.4°C
Precipitation	1467.5mm
Snowfall amount	121cm
Daylight hours	1684.6h

North latitude : 37.5°
East longitude : 139.0°



2)



Tokyo(2015)

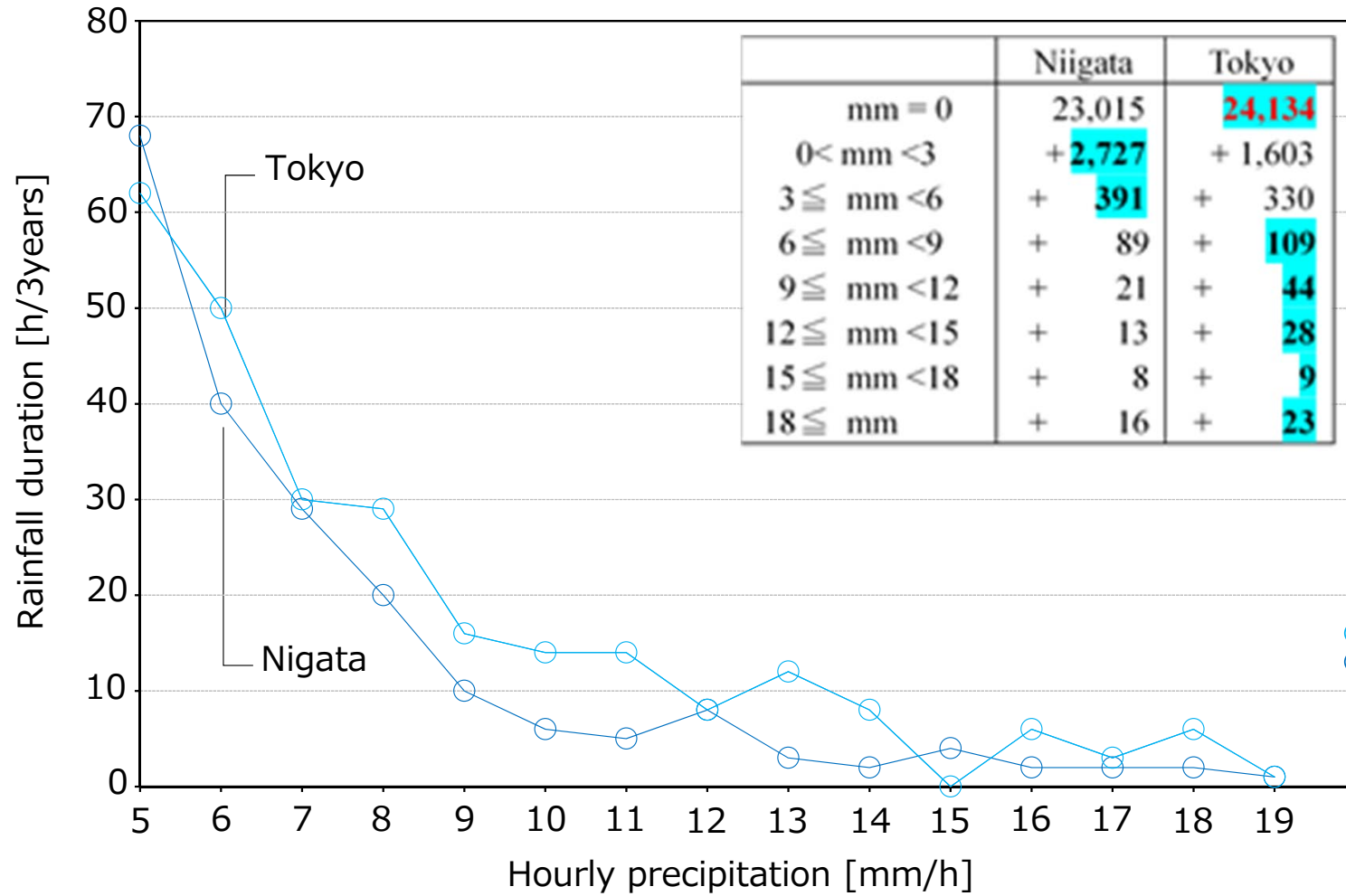
Average air temperature	16.4°C
Precipitation	1781.5mm
Snowfall amount	3cm
Daylight hours	1966.6h

North latitude : 35.4°
East longitude : 139.5°

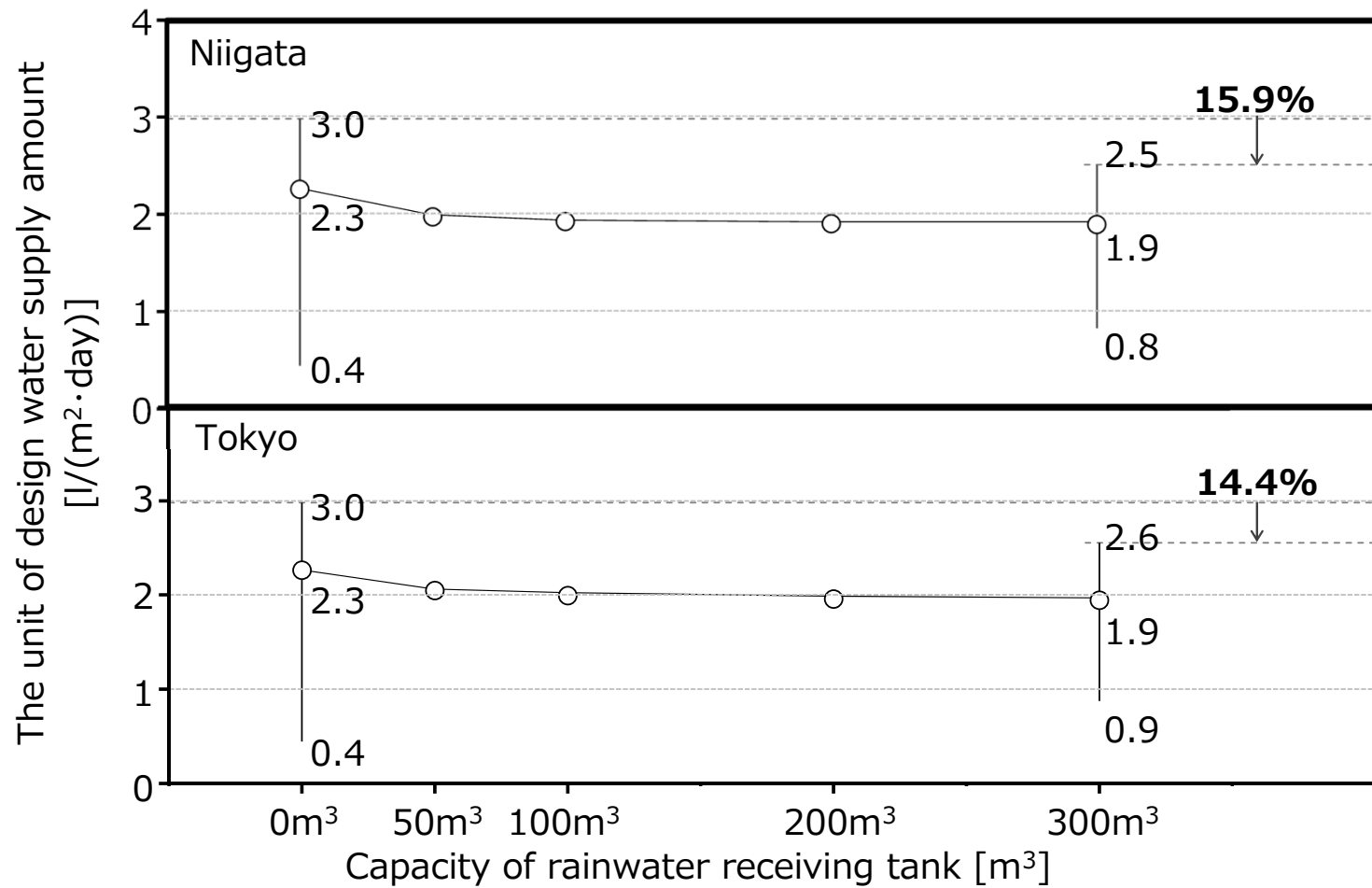
1) <http://culturecity-niigata.com/about/niigata.php>

2) <http://www.metro.tokyo.jp/>

Rainfall characteristic of Niigata and Tokyo in evaluation period(Figure12)



Reducing the design water supply standards to account for rainwater use(Figure13)



Conclusion

This study investigated the standard unit design water supply for an existing office building based on measured BEMS data and evaluated the water supply reduction that could be achieved by using rainwater.

In Japan, design water supply requirements can look forward to a downward trend thanks to the spread of water saving technologies.

In addition, changing precipitation characteristics brought about by recent climate changes has led to a need to change the criteria upon which domestic water systems are designed.

Thank you for your kind attention.

Our hope is that this paper, which is based on real-world data, will be useful in optimizing the capacity of domestic water systems in buildings where rainwater use facilities are installed.

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