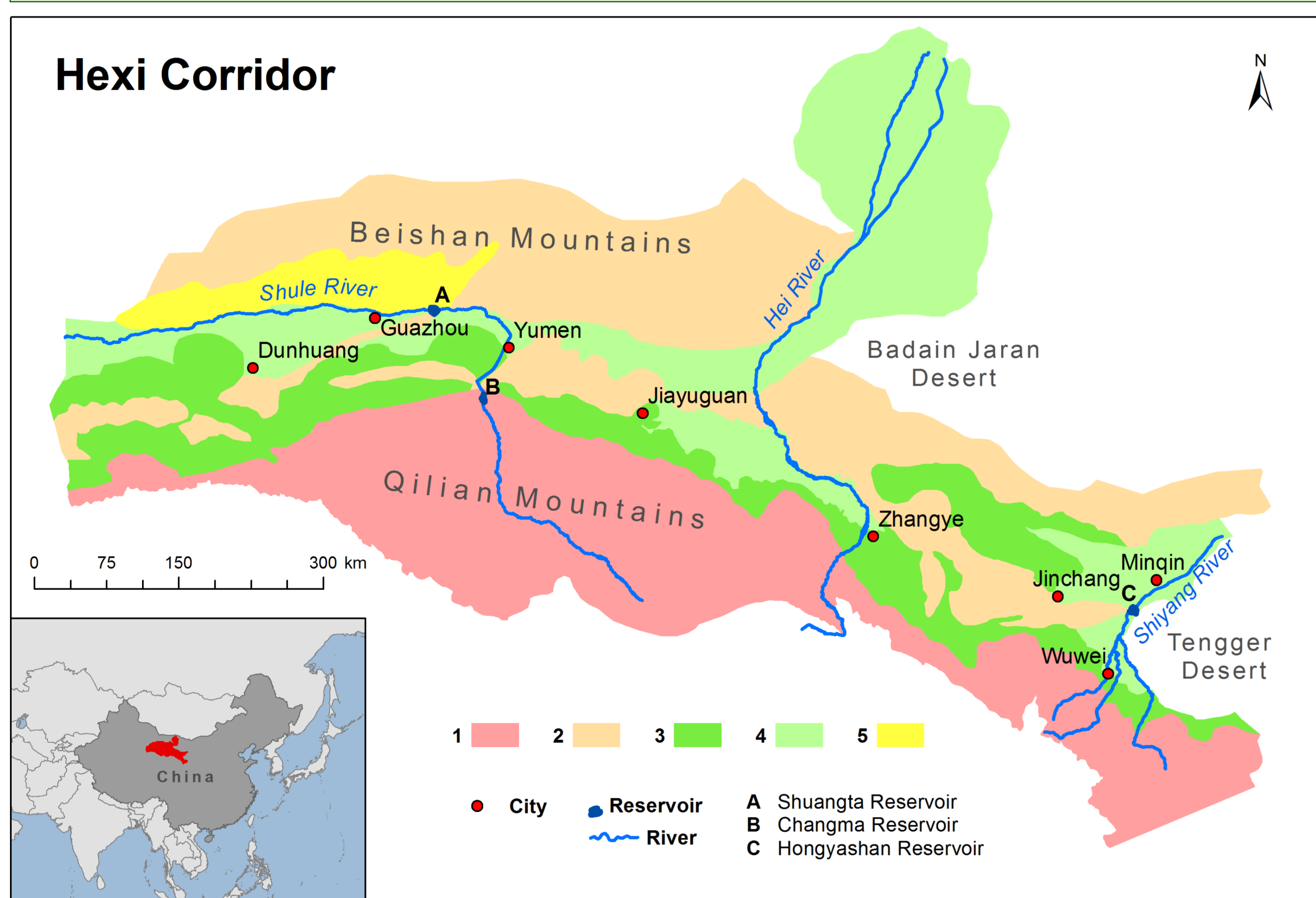


## Introduction

The plains of the Hexi Corridor are considered as the most productive agricultural region of Gansu Province in Northwest China. Rainfall is low (50-200mm), but water resources from glaciers and snowfall in the Qilian Mountains are abundant. Agriculture in the area relies on irrigation. Surface water from the rivers is supplied through large-scale canal irrigation systems. In addition farmers pump up groundwater from the easily accessible aquifers. Some localities suffer from falling groundwater tables which lead to alarming desertification rates.

In the Hei and Shule River Basin - two out of the three major inland river basins in the Hexi Corridor - farmers' groundwater use is largely unrestricted. Yet, 80% of the groundwater using farmers claim to voluntarily reduce their groundwater pumping when the surface water supply is increased. This raises the question whether improved surface water supply could avoid instances of groundwater over-use. To answer this question we 1) explore the relation between surface water supply and groundwater use; and 2) compare farming practices of groundwater users and non-groundwater users.

Map of Hexi Corridor. By Ronald Kraemer, adapted from Zhou et al. 2007  
1= high rock mountains, 2= low rock hills, 3= alluvial fans, 4= alluvial plains, 5= foothill plains



## Survey data

We base our research on survey data collected in 2014. Our sample contains 157 households spread over 15 villages in the Hei and Shule River Basin. All villages are located within canal irrigation systems and have good access to groundwater. We collected data on farmers' surface water and groundwater use for the year 2013. Access to surface water is assumed to be equal for all farmers per village. The number of surface water irrigation turns reported by the village leaders serves as measure of the surface water supply. As a measure of farmers' groundwater use, we calculated the average number of groundwater turns applied per unit of land.

## Results

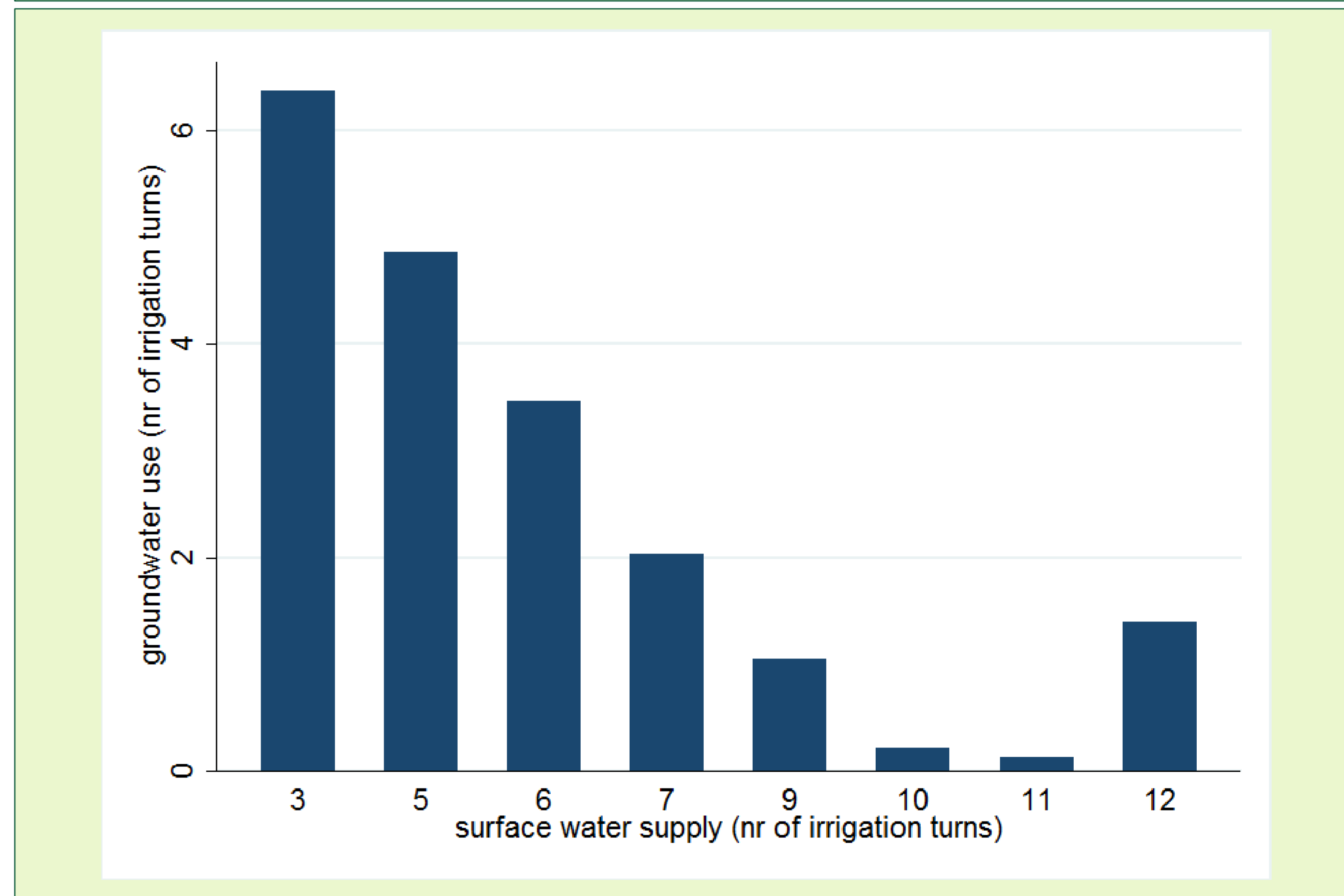
57% of the farmers in our sample used groundwater in 2013. Most of them applied groundwater in addition to surface water. We identified a strong relation between farmers' groundwater use decisions and the number of surface water turns supplied to their village (see graph). We estimated the effect of the surface water supply on farmers' groundwater use through a multivariate analysis accounting for other potential factors influencing farmers groundwater use (including household characteristics, groundwater use characteristic and land and market access). The model is defined as follows:

$$[\text{groundwater turns} = 12 - 1.4 \text{ surface water turns supplied} + \text{control variables}]$$

Our estimation shows that on average farmers substitute one surface water turn with more than one groundwater turn. This means that farmers do not only use groundwater to substitute a lack of surface water, but also to intensify their production.

In fact, the crop revenue of groundwater users is 20% higher and the cropping area is 30% higher compared to non-groundwater users. Moreover, the total number of irrigation turns applied to their fields (surface water + groundwater) is 30% higher for groundwater users. Accounting for the difference in cropping area, their total water use is even 90% higher than non-groundwater users.

Graph of farmers' mean groundwater use versus surface water supply. Source: own survey



## Conclusion

We could proof a strong dependency between farmers' groundwater use and the surface water supply in our study area. At the same time, we observe that farmers who pump groundwater are used to farming practices which require a lot more water than practices by farmers who rely on surface water only. This difference in farming practices makes it unlikely to achieve real water savings (accounting for both surface water and groundwater) by modifying the surface water supply only. Restrictions on land expansion and policies to propagate low water demanding, drought resistant crops may be necessary to avoid unsustainable (ground-) water use. Nevertheless, a more balanced distribution of surface water in the study area may have a soothing effect on farmers' excessive groundwater use in specific locations and could also increase farmers' acceptance regarding possible groundwater use restriction policies.

Groundwater pump next to surface water canal in Hei River Basin. Photo: Eefje Aarnoudse

