Response to Anonymous Referee #3

Thank you very much for your excellent comments on our manuscript. We have carefully considered the comments and have modified the manuscript accordingly. The comments and detailed responses can be summarized as follows:

Comment 1**:** In the introduction section, the authors should descript the innovation of the VWC in detail of rice in China.

Response: We fully agree with the reviewer's opinion that the Introduction section should descript the innovation of the VWC in detail of rice in China.

We added the following sentences in the revised version.

There is not any research on the total VWC of rice and spatial distribution characteristics in China at provincial scale by the actual total water use. China is well-known for its massive land. The VWC of rice is largely different between regions. The VWC of rice of China should be assessed and the spatial characteristics should be also analyzed.

Comment 2**:** In the section of methodology, the authors should give an explanation of the indirect water even it was small in the total of VWC of rice.

Response: The total VWC of a crop is an indicator of freshwater use that looks at both direct and indirect water use during the crop production process. Indirect water use is an important component in the total VWC of a crop. Although the indirect water in the total VWC of rice is very less, we cannot ignore it. The indirect VWC is higher in the total VWC of some agricultural products including potatoes, cotton and fruits. For example, the proportion of indirect VWC of strawberry in 27 regions of China ranged from 0.8% to 38.0% with an average of 10.8%. The proportion of indirect VWC of strawberry is not so unimportant. We cannot ignore the indirect water.

Further, we added the following sentences to explain the importance of indirect VWC in *Discussion.*

For example, the proportion of $VWC_{indirect}$ in the VWC_{total} of strawberry in 27 regions of China in 2007 ranged from 0.8% to 38.0%, with an average of 10.8%. The proportion of $VWC_{indirect}$ of strawberry is higher in the VWC_{total}. We cannot ignore the $VWC_{indirect}$ in the calculation of VWC_{total} of some crops.

Comment 3**:** In the paragraph of discussion, the author should give more discussion because the calculation process had more uncertainty.

Response: We fully agree with the reviewer's comment. We made some assumptions and simplifications in the calculation of $VWC_{indirect}$, $VWC_{direct,\ blue}$ *and* $VWC_{direct,\ grey}$ of rice. And the uncertainty of the results should be discussed.

We used the Input–Output model to calculate the $VWC_{indirect}$ of rice supplied by each economic sector. Due to the data limitation, we made an assumption that the proportion of indirect water supplied between economic sectors is the same to each crops. Hence that made the uncertainty of $VWC_{indirect}$ of rice. If we can get the data that the input of rice from each economic sector, the calculation results of $VWC_{indirect}$ of rice will be more accurate.

We used the Sun's method to calculate the $VWC_{direct,\ blue}$ of rice. The direct blue water is calculated according to the proportion of irrigation water consumption of rice in the total irrigation water consumption of the irrigation district. That means the crop needs more irrigation requirement that the crop would consume more irrigation water. However, in many regions, the irrigation water was met to the need of rice irrigation requirement in the first place. Our calculated results of $VWC_{direct,\ blue}$ of rice maybe smaller than the actual $VWC_{direct,\ blue}$ of rice. If we can get the irrigation water consumption of rice, the results of $VWC_{indirect}$ of rice will be more accurate.

The $VWC_{direct,\ grey}$ is calculated by multiplying the fraction of nitrogen that leaches or runs off by the nitrogen application rate and dividing this by the difference between the maximum acceptable concentrations of nitrogen and the natural concentration of nitrogen in the receiving water body and by the actual crop yield. For the lack of data, the natural nitrogen concentrations were assumed to be zero. On

average, 10% of the applied nitrogen fertilizer is lost through leaching. The simplification of natural nitrogen concentrations made the $VWC_{direct,\ grey}$ of rice smaller. The simplification of applied nitrogen fertilizer lost through leaching made the $VWC_{direct,\ grey}$ of rice uncertainty. The natural nitrogen concentrations and applied nitrogen fertilizer lost through leaching should be studied further to reduce the uncertainty of the results. Because the $VWC_{direct,\ grey}$ of rice estimated only considers chemical fertilizer pollution, and not the effect of pesticides and herbicides on water quality, the result of $VWC_{direct,\ grey}$ of rice is a conservative estimate.

We added the following sentences to discuss the uncertainty of the results.

However, in our calculation framework of VWC of crops, we made some assumptions and simplifications in the calculation of $VWC_{indirect}$, $VWC_{direct,\ blue}$ *and* $VWC_{direct,\ grey}$, *which makes the uncertainty of the results. The uncertainty of the results cannot be completely eliminated. We could only make better assumptions and simplifications and use more accurately data to make our results more accurate.*