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Dear Editor and reviewers

We appreciate your comments and tried to apply all comments to the revised manuscript. The main comments seemed to be related to the validation of methodology and contribution of this study.
First, we validated the methodology using observed data and added a new chapter ***"3.3 Validation of rice distribution simulation compared to 2016 observation".*** Second, we mentioned the application and contribution of this study in this chapter, for example, the importance of local distribution of food in the countries where produce large amount of domestic food products.
However, there were still limitations of validation in a scale issue and application of international trade issue, thus, we added more explanation of limitations in this study to the new chapter ***"4. Limitations, but possibilities"***. We also added more analysis of regional flows of rice and assessed the impacts of local food security on the regional dependency of rice in ***"3.2 Analysis of impacts of food security in prefectures on the entire rice distribution through various SSR scenarios"*** with additional Figure 2.
To sum up, we added 1) Validation of methodology using regional data, 2) Limitations and contribution, and 3) Addition analysis of regional dependency of rice flow in revision.
Please find the more details in revision notes.

All authors including myself have seen and approved this revised manuscript.
I am looking forward to your response.

Thanks.

Sincerely yours.

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Sang-Hyun Lee

Detailed review: Reviewer #1

1. Major Comments

Reviewer's comments		1.) The main focus of the paper is the national rice market of Japan and its regional redistribution flows, which are modelled using an economic approach. The only relation to water/hydrology is the water footprint calculation. I believe that the topic falls outside the core area that HESS usually covers. 2.) The paper has an almost exclusive focus on the Japanese market. I am not clear about the value/impact of the paper for an international audience such as HESS's. The authors do not clearly expose what they see as the main contributions / generic insights that are applicable elsewhere
Response		➔ We agreed with reviewer's comments, and realized the lack of explanation of contribution and application of this study. Accordingly. We tried to expose the main contributions in new chapter **"4. Limitations and possibilities". Please find the addition paragraph.** ➔ We also added more analysis of regional dependency on local food distribution in terms of resource governance management in order to expose the more application of this study to regional resource management based on local dependency. **Please find the addition paragraph.**
	Page 10 Line 388 – Page 10 Line 397	Although this study focused on Japanese cases, it could be universal with cases in the countries including large amounts of domestic transportation of food products. Various studies showed the influence of the international food trade on food security and resource management. However, it is hard to apply the international food or virtual water trade to national or local resource management. In addition, the domestic distribution of food products is more directly related to resource management, such as water, land, and energy. Concerning governance and integrated water-food management, it is important to analyze the local distribution of food among prefectures and assess the impacts of local food security in each prefecture on integrated water-food management. The methodology in this study assumed the potential situation of local distribution of rice and applied several scenarios related to local food security with potential impacts of distances using the gravity model. We believe it could show various possibilities, and the outcomes could be used as a guideline for integrated national-regional-local food and water management.
	Page 11 Line 433 – Page 12 Line 454	Regarding application and contribution, this study focused on the domestic distribution of rice in Japan, and it seems to be an exclusive case study with little application to international cases. Many studies relating to international food trade or water security focused more on the interlinkage between countries rather than downscaled impacts on local or regional areas. In particular, many studies targeted countries that have water-scarce but less food security or global area. However, Asian countries—such as Thailand, Taiwan, Vietnam, Japan, and S. Korea—are producing a lot of rice for domestic consumption with large amounts of irrigation water supply. They also have high levels of self-sufficiency of rice, thus local distribution of rice could be an important factor for managing local-regional-national food and irrigation water. In addition, resource governance or integrated resource management could be considered a way of sustainable management, and the distribution of domestic food could be more feasible than international trade concerning resource governance. Even if great deals of food products are traded between countries, it is difficult to apply integrated water-food management that include countries, because water-food are highly dependent upon spatial characteristics and boundaries of management, as well as local government. However, local policy of food security or water management could relate to

		production in other local areas. Accordingly, we need to analyze the food transportation between local areas and water-food dependency on other local areas. In addition, it is important to understand the gap between the national food policy and local situation, especially in the countries where domestic production occupies a large proportion of food security. This study analyzed internal virtual water trade through local distribution of rice to emphasize the impacts of food dependency to other prefectures on regional water resources. In this study, the flows of virtual water between prefectures and regions were mainly considered, rather than total water withdrawal or total production of rice. In other words, we focused more on how the local distribution of rice could affect regional water security through internal virtual water flows in Japan. In sum, the resource governance or integrated resource management would be more feasible on a local or regional scale, rather than international one, and local distribution of food and internal virtual water flows could be important factors for water-food management within an integrated local-regional boundary.
	Page 7 Line 256 – Page 7 Line 275	In addition, we focused on regional self-dependency—which indicated the proportion of consumption of rice produced in its own region to total consumption—and analyzed the impacts of increasing SSRs in prefectures. Figure 2 showed the regional dependency in each region through the weighted distribution under the 20 % SSR scenario. The Chubu, Hokkaido, and Kanto regions showed the high dependency of rice produced in the Tohoku region and Kanto region, especially, which imported 43 % of total rice consumption from the Tohoku region, under the 20 % SSR scenario. About 45 % of total rice consumption was provided from prefectures in the Chubu region, and 29 % came from prefectures in Tohoku regions. In spite of the 20 % SSR scenario, Kyushu and Tohoku regions had the higher levels of self-dependency in rice consumption than other regions. In particular, about 79 % of total consumption of rice in Kyushu was provided from prefectures within that region. Therefore, the local self-sufficient is higher than other regions, and allocation of local resources for rice production could be the main issue concerning trade-offs between local food security and resources usage. However, the Kansai region showed the distributed import of rice, for example, and only 30 % of total consumption was provided from its own region; 50 % of total consumption came from Chubu (21 %), Tohoku (18 %), and Chugoku regions (11 %). When the SSR increased to 60 % in weighted distribution, the entire regional dependency in all regions changed. For example, Chubu, Hokkaido, and Kanto regions still showed high levels of dependency on the Tohoku region, while simultaneously increasing regional self-dependency. In particular, in the Kanto region, the proportion of rice produced in the Tohoku region—in total consumption—slightly increased, because the increase in SSR in all prefectures derived the decrease in exports from Hokkaido to Kanto regions. Hence, the Kanto region needs more rice from the Tohoku region. On the contrary, in the Shikoku and Chugoku regions, the 60 % SSR scenario could largely increase regional self-dependency compared to other regions. The Kyushu and Tohoku regions had high levels of regional self-dependency in both the 20 % and 60 % SSR scenarios, because the prefectures on these regions produced much more than their consumption. Thus, the increase in SSR could hardly affect regional self-dependency.

Reviewer's comments		3.) The authors do not clearly explain/expose what they see as methodological/technical innovation in their article. To my knowledge, neither the gravity model used to simulate rice flows nor the water footprint calculations are new contributions.
Response		➔ We believe that this study could provide useful information and approach to analyze local distribution of food and its impacts on water management. In addition, we assessed the impacts of local food security on entire distribution of food in Japan. However, we agree there are several limitations and lacks of innovation in methodology. Accordingly, we revealed the limitations in new chapter **"4. Limitations and possibilities". Please find the addition paragraph.**
	Page 10 Line 398 - Page 11 Line 407	However, there are limitations in methodology, validation, and application. First, the gravity model is a traditional model in economic research, and its usage could not be regarded as the innovation of methodology. However, the approach, based on the gravity model in this study, could analyze the distribution of local food considering local food security policy and distance between prefectures. For example, we applied different self-supply in each prefecture as SSR scenarios, which represent local food security policy. In addition, international trade, population, and climate change could affect production and consumption at prefectures. Therefore, we could assess the impacts of them on local food distribution through the methodology in this study. However, the simulation included complex network of 47 prefectures, and the gravity model hardly derives accurate results from single simulation. Therefore, we set observed total production and consumption in each prefecture as the control factors, and several iterations shown in Eq. (6) were conducted until the simulated values were close to the control factors in order to reduce the bias and error of simulation.

2. Technical corrections

Reviewer's comments		1.) The gravity model that is used to simulate regional rice flows in the Japanese market is not validated against any observational datasets. I strongly believe that the predictive skill of models has to be tested. This is a highly simplified approach and in order to establish confidence in the model results, validation is essential
Response		➔ We added the validation process in the revised manuscript. However, still there was limitation of collecting observed data. We found the data about regional self-dependency of rice in 2016 provided from Japanese government. Thus, we simulated the same data and compared to observation in 2016. There processes and results were written in new chapter "3.3 Validation of simulation of rice distribution through comparing to observation in 2016".
	Page 8 Line 313 – Page 9 Line 334	3.3 Validation of rice distribution simulation compared to 2016 observation To validate the food distribution model, we compared simulated results to observed data. Regarding rice distribution, the Japanese government provided the regional self-dependency data in 2016, as shown in Figure 5. In the case of the Tohoku region, a representative rice paddy area, the 2016 observation data showed that 79.6 % of total rice consumed in the region was provided from prefectures in its own region. However, the regional self-dependency was calculated at 46.3% in the non-weighted distribution under the 20% SSR scenario. On the contrary, in cases of weighted distribution under the 20 % SSR scenario, regional self-dependency in the Tohoku region was 83.4%. This was only a 4% difference from the observation data in 2016. In most regions, except for Kansai, the simulation of regional self-dependency through the weighted distribution was closer to observation compared to non-weighed distribution. Therefore, the weighted distribution considering the distance between prefectures in gravity model could be more suitable for analyzing internal trade of rice among prefectures. However, the Shikoku region showed a large difference between simulation and observation under the 20% SSR scenarios. Even the regional self-dependency in the Shikoku region, through the weighted distribution under the 20% SSR, was calculated to 41.9%, but it was still largely different from the observation (77.3%). The Shikoku region is a big island, and it is quite limited regarding access to other regions. This is because only three bridges are connected to the Hiroshima, Okayama, and Hyogo prefectures. Therefore, we believe the regional self-dependency of rice was higher than simulation under 20% SSR scenarios. Accordingly, we compared the observation with simulation considering 4% and 60 % SSR scenarios, and we found that the increase of SSR from 20% to 40% in all prefectures could give a more accurate simulation, especially in the Shikoku and Chugoku regions. Despite only using the regional self-dependency as observation data to validate the model, we found that the weighted distribution could simulate results that are more feasible rather than a non-weighted one. In addition, it is hard to define the accurate SSR scenario, but the food distribution model in this study could assess the various situations relating to local food security through the adaptation of various SSR scenarios. Figure 5 The proportion of consumption of rice produced in own region in total consumption.

Reviewer's comments		2.) It is unclear what the exact purpose of the water footprint calculations is apart from being able to show virtual water flows. The water footprint concept disregards the variability of water scarcity in space and time. The impact of abstracting virtual water from a water-scarce basin is larger than for a water-abundant basin. Impact is also more severe during periods of drought. The true water availability shadow price will be highly variable in space and time and this could be captured with a spatio-temporally resolved model of the Japanese water-food nexus.
Response		➔ We totally agree with your comment. Thus we added some paragraph explaining the limitation of adapting temporal and spatial scales of water footprint in this study.
	Page 5 Line 196 - Page 6 Line 207	However, the WF depends on spatial and temporal changes, but this study adapted the average value of statics data of water withdrawal and productivity from 2000 to 2012. This is the limitation of this study; however, this study focused more on internal VWT through local distribution of food considering local food security. To consider local-regional resource governance, we need to analyze how much food (rice) is transported among prefectures and understand how much local water is used for other prefectures, as well as the impacts of local food security on water-food management in other local area. Therefore, the spatial scale of WF and VWT relates more to local food distribution rather than traditional water basin management. In terms of temporal scale, WF could be changed by drought or flood seasons, including natural disasters. In addition, WF is related to not only crop water requirement but also crop productivity. Therefore, the simulation of temporal WF needs enhanced efforts to analyze relationships among irrigation water requirement, climate change impacts, soil productivity, natural disaster, and artificial facilities such as irrigation and drainage systems. Accordingly, the analysis of temporal scale of WF could be limited in this study. However, the model in this study, analyzing local distribution of rice and internal VWT, could adapt the temporal changes of WF from future research.