Water Footprint and Climate Change Adaptation Strategies on Agriculture Development under One Belt One Road Initiative: An Overview

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Abstract. One Belt One Road (OBOR) is an initiative of collaboration and development that was put forward by China. Moreover, the agricultural production in most of the country members confronted Water scarcity and climate change. In current study it has been used Water Footprint (WF) as tool for measuring water consumption in China and participating country. Thus, this paper aims to understand OBOR from the perspective of WF of agricultural products. On the whole, the results showed that agriculture’s WF in China and OBOR countries increased steadily from about 6.84 trillion m³ in the initial period to about 9.54 trillion m³ in 2018. They also showed that China and India were the largest countries consumed WF which accounted for 76.12% of the total WF used in agricultural production. Furthermore, the WF that has been consumed for agriculture production in China and spanning countries was excessively concentrated on some products. As a whole, green the main water type used in producing agricultural products. Since announcing OBOR initiative in 2013 until now, there is not any remarkable change on GHG emissions that generated from agriculture due to the climate change impacts can be observed only on the long term. WF is a new perspective to explore OBOR. Agricultural trade with China certainly benefits both the countries along OBOR and China from the perspective of WF. The findings of this study is essential as references for better agriculture production structure, and is useful for managing water in China and the nations along the Silk Road, mitigating water scarcities, and wisely distributing the water resources in the various sectors.

Key words: agricultural production, China, climate change adaptation, OBOR, water footprint

1. Introduction
Climate changes, population growth pressure, and agricultural production significantly affect the amount of fresh water available for local and international people, which will passively reflect on agrarian development [1]. Regarding the ongoing population increase and overuse of water, the assessments show that the world is expected to face a 40% deficit in water by 2030. Currently, the world is consuming over 70% of universal water in agriculture. Consequently, by 2050, feeding nine billion people requires increasing food production and water withdraws in means of 60%,15% respectively [2]. Furthermore, agricultural products are responsible for a 90% WF in mankind water consumption. Improving water effectiveness and mitigating water pressure encouraged by agrarian practices is essential to enhance the sustainability of water usage and maintaining agriculture development [3].

The WF is a lens to examine critical issues in terms of agricultural production, food handling, processing, trading, and consumers’ awareness. It connects to how to use and manage WF. WF indicates to the freshwater quantity utilized for producing the commodities used by society. It points
out to water consume directly and indirectly in an operation, commodity, firm, or sector, comprising water consuming and polluting during the whole product cycle [4]. This concept transported to management science for demonstrating the consumption behaviours significance and the international measures in perfect water administration [5]. It consists of three components, a green WF, a blue WF, and a grey WF. The green WF generates from evaporated, or incorporated rains into products, the blue WF is the surface or underground water vaporized or integrated into a product, and the grey WF is the freshwater volume needed to digest contaminants to match particular quality measures [6].

WF has been widely introduced as a multidimensional index for water consumption about a decade ago. It was seeking a developed comprehension for production and consumption relation and also the evaluation of its linked stress on the water resource. It could discriminate the agricultural blue, green, and grey water consumption. Therefore, it may subsidize to assessing the water usage related to agriculture and compare the agricultural products through the water kind. It generally reflects the agricultural water productivity. [26]. Those strategic practices were successfully applied in different regions and gained positive result in the term of agricultural productivity. Thus, it is technically expected to be applicable and lead to the direct effect in OBOR countries as well.

Climate change now became broadly accepted as a real, urgent, and genuinely global problem. In facing droughts and water shortages induced by climate change, many countries have adopted strategies for preventing or minimizing possible negative impacts and boosting the chances [7]. Climate change shifts the water availability in all regions and influences community livelihoods, natural resources, ecosystems, and agriculture all over the world through rising water shortages, food insecurity, and environmental stress [8–10]. There are numerous studies about China which focus on climate change effect on water use in agriculture. These studies show that climate change decrease the productivity and raise the water consumption in the agricultural sector [11–14]. In addition, they show that the impacts of climate change on the agricultural WF has a great importance for guiding agricultural management to cope with climate change [15]. The hydrological change cycle induced by climate change [16], irregular distribution of precipitation patterns [16–17], and high temperatures [16–18] are significant concerns for the access, availability, and uses of water resources [16].

![Figure 1. The countries along the Belt and Road (Tian et al., 2017).](image)

The development of agricultural productivity in a country can be promoted by climate change and water footprint adaptation practices. Adaptive practices on climate change mitigation might boost agricultural productivity in OBOR countries. The impacts induced by the adaptation of climate change on productivity are urgent for sustainable growth in agricultural sector. There are two types of
adaptation, independent and organized adaptations. Independent adaptation is, for example, farmers' reactions to rainfall changes, such as changing crops or using various dates for planting and harvesting [23–24]. The organized adaptation is wise politics choices or feedback plans, frequently multi-sector, intend to change the ability of the agricultural organisation for adaptation or to facilitate particular adaptations. For instance, intentional crops are chosen then distributed strategically through different agricultural and climatic areas, replacing old crops by new ones as well as resources interchange generated from the shortage [21, 22].

One Belt One Road (OBOR) is an initiative from China for connecting markets of the whole world and promoting various opportunities for global trade. It involves two programs: 1) the ancient marine silk road that binds three main paths (the Indian Ocean path, the Mediterranean path, and the Persian Gulf path) between China and Europe; 2) the modern marine silk road based on water-paths amongst the member states of OBOR project (Sarker et al., 2018; Chen, Hou & Xiao, 2018; He, Huang & Zhang, 2016). This initiative is in line with China’s ‘Openness to World’ policy, and it is considered the most significant initiative of this type, encompassing more than 60 states (figure1) with a population nearly 4.4 billion, and about 40% of universal GDP [19]. This initiative has more than one dimension, as it encompasses several political and economic goals. The financial goals represent the sustainable development goals for all sectors in China, including the agriculture sector, which also benefits the participating countries. On OBOR studies, there were several circumstances, particularly on the agricultural trade. Therefore, when this project implements, reviews on the ecological effects should be improved, like biodiversity, water distribution and consumption, and climate change and carbon emit. Also, backing WF management for minimizing water usage, and providing a way that helps to adjust with climate change effects on the water by estimating and developing the WF consumption in agriculture sector is the big user of water [7].

Previous studies discussed OBOR mostly from political and economic aspects [24–27]. For OBOR, the reasons, scope, aims, strengths and difficulties, framework and evaluation have been analysed. There were also researches about the relations between the spanning countries or regions and the new silk road, such as Russia [28], Afghanistan [29], Turkey [30], Poland [31], India [32], Laos [33], Pakistan [34], Tajikistan [35], Singapore [36], Central Asia [37] and Europe [38]. Concerning the advantages or disadvantages of OBOR, there have also been several specific studies. OBOR is a new shot for the European Union (UN) and the countries in the Black Sea area [39]. Herrerd and Xu appreciated the trade obtains of UN states from the OBOR that they benefit greatly from participation. This is also applied on Central Asia and Southeast Asia [40]. Nevertheless, OBOR also confront the EU with a major political difficulties together with great economic chances [41]. Almost all Chinese activities in Central Asia has been developed under OBOR. The significanse of Chinese investments in Tajikistan has raised and Chinese agricultural companies in Tajikistan help them prosper [35]. So far, there has been a lack of studies on OBOR from an agricultural products WF perspective. Furthermore, as OBOR Initiative is applied, studies on the environmental influences need to be enhanced, including carbon emission, climate change [42, 43], and water distribution and consumption.

In this paper, we focused on climate change adaptation and WF management as strategies for maintaining development sustainability in agriculture production through an OBOR initiative framework. In addition to identifying how China via this initiative will contribute into developing a sustainable agricultural economy through strategies of the adaptation and mitigation, and how this initiative offers a positive impact on these strategies. The proposal of OBOR provides a favourable opportunity for the development of China’s agricultural products trade. By comparing the volume of bilateral trade values and observing the agricultural growth before and after this initiative, this paper analyzes the agricultural trading amongst China and those states. Therefore, we will conclude whether this initiative has fostered trade in this sector or not.

2. Methods & Data
2.1. Methods
On 28 March 2015, China government issued an action plan of OBOR. In that plan, 65 states had been identified along with the program that were participated in the Initiative. Support OBOR-Regions for...
implementing the economic policies and carrying out regional cooperation wider and deeper with high criteria. Also, establishing an open, comprehensive, and fair local economic collaboration that profits for all [44]. OBOR could play a considerable role in advancing infrastructure and economic development, which in turn, can assist in boosting the stabilization in the region politically and socially. OBOR assisted to closely connect the Asian and African markets with Chinese-made products which freely moved into these markets. Moreover, OBOR connected these markets with products manufactured by Chinese firms through its investment in these countries that could move to the western markets at lower price [45].

WF could be utilized as a monitoring index to value implemented agricultural plans. It also gauged potential adaptation at the agrarian countries along OBOR. The measurement correlated with the consumption of freshwater resource considering the climate change scenarios [27]. This agricultural WF analysis was based on a climate change scenario that has been developed to assess the influences of precipitation and temperature variability on agrarian products. It was also created to determine freshwater resource consumption in the OBOR countries [28]. The average of WF consumption within a product $p$ in a country is:

$$WF_{prod}^p = \frac{P[p] \times WF_{prod} + \sum_{ne} (TP[n, p] \times WF_{prod}[ne, p])}{P[p] + \sum_{ne} TP[n, p]}$$

$p$ indicates to the amount of consuming products in a country, (section produced from the same country and section imported from other countries), while $P[p]$ indicates to the production volume of product $p$ in the country. $Ti$ refers to the amount of imported product $p$ and $ne$ refers to exporting nation. $WF_{prod}[p]$ points out to the water footprint of product $p$ produced in the country itself and $WF_{prod}[ne, p]$ points to the water footprint of product $p$ as in the exporting country $ne$.

2.2. Data

The presumption is that the gross consumption amount came from local production and importations based on their proportional amounts. The average amount of WF for agricultural products were found in Mekonnen & Hoekstra (2011) report. The data of agricultural production for China and the participating states in OBOR initiative was taken from the statistic data of FAO (www.fao.org/faostat) and USDA (apps.fas.usda.gov/psdonline/app/index.html#/app/home). It provided international agricultural production data in some nations by 99 commodity collection which led agricultural and manufacturing goods. The data selected to perform a diachronic analysis is from 2001 to 2017. Agricultural bilateral trade data are provided from the UN Comtrade Database [29].

WF was a measurement of humankind’s’ requisition of freshwater, both consumed or polluted water. Practically, WF in terms of agricultural products in many countries has been obtained from Mekonnen & Hoekstra’s reports [30–32]. Those reports assessed the global WF of crop production and animal products. The WF was literarily related to water use in animal rearing, and it also provided in that report [33]. In reports, the product clusters mainly had six digits. We also selected the FAO’s data by six figures. According to WF of agricultural products in the aforementioned reports, CROPWAT 8.0 model and water balance model grid-based were hired to assess green and blue WF used by crop whilst consideration evapotranspiration of crops and harvest. Grey WF was measured according to nitrogen usage through consideration the nitrogen applied ratio, the utmost and normal absorption of nitrogen and actual crops[30].

The WF data beforehand mentioned is from1996 to 2005. Though there is a shortage of certainty, it is the most thorough and itemized data yet, that pointed to the agricultural products' WF in each nation. Due to the lack of data, we couldn't reach all the needed data for calculating the WF for all agricultural products later in 2005. Concerning the yearly seasonal varieties of the WF’s agricultural products, we continued researching. Though the WF data was limited, this study could be for policymakers as an outcome of the equivalent calculation of WF.

According to IPCC (2013), the weather is warming as a result of emissions of GHG, mainly from many sources. Emissions of non-CO2, such as CH4 and N2O, also share significantly to heating [34].
Therefore, the main effects of temperature alteration lead to the decrease of water for irrigation aims over all areas [35]. Also, increasing temperatures are the leading factors influencing the blue agricultural WF. The potential effects of temperature change are anticipated to change the demand and supply of water for agriculture purposes. Thence, the evaluation of climate change effects on water consuming in agriculture is fundamental.

CO2 and non-CO2 emissions data in OBOR countries were acquired from the Emission Database for Global Atmospheric Research (EDGAR) Emission Data and Maps. [36]. While CO2, CH4, and N2O emissions by the top three sources such as the agriculture sector, land use, and energy use, in addition to temperature change in OBOR regions, were acquired from the statistic data of FAO [37]. Regard to CO2, CH4, and N2O total emission data, which are the source from energy use, there was a limitation that data were available only until 2012.

3. Results & Discussion

To reduce water use on agriculture production, we identified the kinds of animal and crop production, which dominantly contributed to total WF of agriculture production. According to the data from Mekonnen & Hoekstra’s reports (2010 & 2011) and (USDA) United States Department of Agriculture, 92% of humankind’s WF came from crops and animal products is accountable for 29% of the agriculture's WF in the whole world. In the period (2001-2018), the gross WF of farm products manufactured in China and all OBOR-member states were approximately 89.3; 62.4 Trillion m3, respectively. In China, WF consumption concentrated in crop and animal production in the rate of 51%, 49% respectively of total WF used in agriculture particularly in cattle and swine meat which contributes to 89% of the animal production WF while wheat, corn, soybean, and rice provides to 66% of the crop production (Table 1). OBOR states WF consumption concentrated in the rate of 35% in animal production and 65% in crop production (i.e., water consumption on the crop in those countries is more than livestock).

The potential to reduce agriculture water footprints were in cattle, swine, chicken meat and fluid milk that contributes to 35% of the animal production, and were in wheat, corn, palm oil, and rice that provide to 65% from the crop production (Table 1). To reduce WF of meat, mainly in beef, depends on where the animal was reared. The livestock raised in grazing, and mixed places had lower WF on the exterior and groundwater flats than the industrial agricultural organizations. While as for decreasing the WF of crops producing could be though developing the irrigation policies and mechanisms; thus, farmers could minimize their WF with some extra cost. For example, in China, minimizing water in the irrigation process by means of 33.3% comparing to present practices was not causing a considerable yield fall [38]. Therefore, these strategies and techniques were applicable in all China and OBOR countries.

Figure 2 has been shown that agriculture WF consumption volume and agricultural production quantity in China moved in the same direction, which presented a growing trend. From 2014 to 2016, the agricultural production and WF consumption exhibited little decreasing trend. Based on the equation, the WF alteration is due to the quantity alterations of agricultural products, whether produced for local consumption or export to other countries (increased or decreased water-intensive outcomes). From 2000 to 2018, China’s annual average agricultural water footprint value was about 89.3 Trillion m3, of which the grey, green, and blue WF are 7, 74.1, and 8.2, trillion m3, respectively, while the grey, green and blue WF in OBOR countries were 4.74,50.78, and 6.85 trillion m3, respectively.

The water footprint of agriculture in China and OBOR countries increased steadily from about 6.84 trillion m3 (3 trillion m3 in China, 2.84 trillion m3 in OBOR countries) in the initial period to about 9.54 trillion m3 (5.42 trillion m3 in China, 4.12 trillion m3 in OBOR countries) in 2018. The ratio of green, blue and grey WF to total WF in China is shown in (figure 3). Owing the farm-output and irrigation-scale extension, the blue WF and green WF of agricultural products in China increased from 0.37 trillion m3 and 3.31 m3 to nearly 0.49 trillion m3 and 4.51 trillion m3, respectively. In OBOR regions they also increased from 0.32 trillion m3 and 2.31 m3 to almost 0.44 trillion m3 and 3.37 trillion m3, respectively. Although the net increase of green WF in China and OBOR states is higher
than that of blue WF and grey WF, the average annual in green and grey WF increase are same in China which accounts for 1.7%, which is little higher than that of the blue water footprint of 1.6%.

Concerning OBOR countries, the average annual in grey WF increase was 2.2%, which is little higher than green WF and higher than blue WF. The expansion of green WF is conducive to the regional optimization of water resources utilization structure. In contrast, the rise of blue water footprint puts forward higher requirements for the guarantee degree of irrigation facilities. The green water footprints more significant than blue WF in the past years and occupies the absolute dominant position in the agricultural production WF. For each country, from 2001 to 2018, the total WF in agrarian products of China (89.26 trillion m$^3$) mainly flowed to India (26.16 trillion m$^3$), Russia (6.76 trillion m$^3$), Indonesia (5.12 trillion m$^3$), Ukraine (3.4 trillion m$^3$), Vietnam (2.78 trillion m$^3$), Turkey (2.56 trillion m$^3$), Pakistan (2.48 trillion m$^3$), Thailand (1.83 trillion m$^3$), and Bangladesh (1.58 trillion m$^3$), while the fifty-five remaining countries of OBOR approximately (9.69 trillion m$^3$). From these values, we concluded that 93.61% of the total agricultural WF in OBOR regions comes from China and the mentioned countries above.

Table 1. Top products with the largest water footprint consumptions of China and OBOR countries from 2001 to 2018.

| Product         | China WF (trillion m$^3$) | China Percent (%) | OBOR WF (trillion m$^3$) | OBOR Percent (%) |
|-----------------|---------------------------|-------------------|---------------------------|------------------|
| Milled rice     | 6.44                       | 15%               | 12.24                     | 20%              |
| Wheat           | 3.74                       | 9%                | 8.65                      | 14%              |
| Corn            | 4.21                       | 10%               | 2.18                      | 4%               |
| Palm oil        |                            |                   | 3.83                      | 6%               |
| Soybean         | 2.85                       | 4%                |                           |                  |
| Other crop products | 5.10                     | 14%               | 13.83                     | 22%              |
| Cattle meat     | 8.03                       | 18%               | 11.51                     | 23%              |
| Swine meat      | 11.12                      | 25%               | 0.86                      | 2%               |
| Chicken meat    | 0.91                       | 2%                | 1.22                      | 2%               |
| Fluid milk      |                            |                   | 3.16                      | 5%               |
| Other animal products | 1.42                | 4%                | 4.88                      | 3%               |

It is also remarked that China and India have the largest WF through agricultural production, which accounts for 76.12% of the total agriculture WF. In terms of the remaining countries, they had less WF through agricultural production not because these countries adopt strategies for alleviating WF but because most of these countries suffer water scarcity. For instance, Because of water scarcity the one ton of water consumed in Saudi Arabia not like the one ton of water consumed in India or Indonesia. Namely, the WF mitigation strategy must be adopted in all countries along OBOR, not only the states had large WF through agricultural production.

The corporation through OBOR initiative may help all the countries along OBOR especially the lands which were in low WF and with severe water stress, they should urgently adopt WF mitigation strategies which may minimize the WF without negative impact on the productivity of agriculture [39–40]. Global collaboration is an excellent means for a sustainable water management in OBOR countries, however, this cooperation has to be according to the characteristics of geography, particularly the water profusion[39]. Based on the geographical features, Arab countries, most south and central Asian countries like India, Pakistan, Turkmenistan, Nepal, Afghanistan and Kirghizistan, and Mongolia, had extremely high water stress. Most of those countries, particularly in the Middle East, were using a high rate of water reserve for agriculture due to the naturalistic circumstances in these regions were limited and not helpful to agricultural situations.

China and all countries along OBOR exceptionally high water-stressed countries have to enhance its agricultural effectiveness, minimize its water consumption, and to recycle water waste. According
to H. Nouri, B. Stokvis, A. Galindo, M. Blatchford, and A.Y. Hoekstra the moving from an entire to deficit watering policy decreases WF consuming while having little impacts on crop-producing [41]. Chukalla, Krol & Hoekstra in their study concluded that using organic mulch can considerably diminish WF at a comparatively small cost. Also they have been argued that converting from sprinkling or furrowing watering for dripping or subsurface dripping watering decreased WF, but at a considerable cost [42].

Figure 2. Agricultural production quantity and agricultural WF volume in China

The import and export (bilateral trade) volume of agricultural products among China and the OBOR-countries path is unsteady, but as a whole, it didn’t have a significant effect on those countries during the five years after China proposed this initiative. From 2013 until 2018, the value of agricultural trade among China and nine out of ten sampling countries along the OBOR path hadn’t significantly increased. For instance, agricultural trade value in India and Malaysia were declined after 2013, while Indonesia and Russia were increasing slightly. Meanwhile, Turkey, Egypt, Saudi Arabia, Pakistan, and Kazakhstan were flat from 2011 until 2018. The agricultural bilateral trade volume between China and Brazil declined from 2013 until 2016, but after that, it increased significantly. On the other hand we found out that there are obvious increases in the agricultural trade growth between China and Indonesia, Egypt, Russia, Turkey, Malaysia, and Pakistan, which before 2013 accounted for (-1.56%, 19.02%, 3.87%, -0.45%, -4.80%, -11.02%, -14.12%) and after 2013 increased to (5.78%, 11.66%, 6.78%, 6.05%, -3.95%, -3.33%, 5.99%) respectively. The development of bilateral trading amongst China and India, Brazil, Kazakhstan, and Saudi Arabia declined from (5.05%, 19.02%, 4.76%, 2.94%) before 2013 to (-6.91%, 11.66%, 1.50%, 0.39%) respectively. Consequently, the OBOR initiative is likely to impact the agricultural trade in China-OBOR countries positively. Until now, there were only a few countries along the OBOR has been benefited from this initiative. Still, we expected in the long-term this initiative will be beneficial for other participating countries as well.

Due to climate change, the same agricultural product could have various WF in various nations and regions [8]. At present, the global climate is undergoing a process of change characterized by warming. The increase in temperature changes the environmental conditions of agricultural production, and affect water availability. The northward shift of accumulated heat will be beneficial to the growth of crops in high latitudes [43]. At the same time, this warming trend caused the three major food crops to reduce production trends, the scope of agricultural pests and diseases expanded, the degree of the harm increased, and farming costs and investment increased substantially. At the same time, meteorological disasters caused by climate change occur frequently, and the instability of agricultural production increases, which will have far-reaching effects on agricultural production conditions, agricultural natural resources, and agricultural natural disasters [44]. GHG emissions were a significant cause of climate warming, and greenhouse gases emitted by human activities were mainly
derived from gas emissions like CO2 generated from the combustion of coal, oil, and natural gas. Therefore, worldwide temperature is expected to raise between 1.6°C and 6°C by 2050. For each degree of global warming, 20% or more of the world's population reduced renewable water resources[45]. Recurrent and severe drought had an impact on agricultural production, while high temperatures were reflected in the increasing demand for crops water[46–47].

![Figure 3. Agricultural production quantity and agricultural WF proportion in China.](image)

Total GHG emissions in China and all spanning countries along OBOR persisted to grow slowly to around 21,424 megatons in 1990 in CO2 equivalent (Mt CO2 eq) at an average annual rate 3%. Emission increased in 2016 and 2017 was the slowest since 1990. From 1990 to 2017, the average total emission (not included land and forest use) for only CO2 approximately 42%, while 58% were distributed on all GHG emissions types. The emissions mostly (around 59%) involve CO2 alone, while CH4 contribute to 24% and N2O contribute to 17%. These proportions included only emission from the agriculture sector, land using, and energy using, which are usually accounted for separately due to their uncertainty and significant inter-annual differences. They mainly encompassed net CO2 emits from an alteration in land usage, energy use, and agriculture. In addition to that, little amounts in CH4 and N2O induced by land use and energy use, and part of the large number come from the agriculture sector.

The OBOR regions trend along with CO2 emissions had continued relatively stable during the past two years, as shown by the blue area in Figure5. During the last few years, total CO2 emissions have offered a slowdown in growth, reaching 21,424 megatons CO2eq during 2017, with counted raises 1% in 2016 and 1.87% in 2017 (figure 4). Non-CO2, emit from numerous various sources. It is more mysterious than CO2 emits [67]. From 2015 to 2017, the emissions of non-CO2 comparatively increased more rapidly than CO2 emissions, in means of 1.2% (2015), 1% (2016), and 0.8% (2017), whereas CO2 over the same period increased by -0.2%, 0.3%, and 0.5% respectively. Owning data limitations for 2016 and 2017 related to these sources, the yearly emission direction of CH4, N2O and F-gases aren’t exactly the same as those in CO2. In 2017, CH4 emissions remained at practically the same level as in 2016, with an assessed rise of 0.16%, to a total of 6787 Mt CO2 eq. CH4 is the most significant contributor to non-CO2 GHG emissions, mainly from agriculture. In 2017, in OBOR countries, 74% of GHG emissions came from CH4. Then, a total of 20% and 6% were generated from N2O and F-gas.

In 2017, China, Russia, Iran, Saudia Arabia, turkey, and Indonesia were the largest CO2 emitting countries that accounted for 69% of total CO2 emissions in OBOR-region. In other hand, the five accounted for about 68% of the total GHG emissions in OBOR region. The emissions of GHG generated from international transportation compose around 3% in means of total global GHG[49].
Figure 4 illustrates the 1990-2017 directions and portions for China and OBOR-regions. CO2 is the prevalent factor of GHG emissions in all OBOR-Countries.

The ratio of CO2 emissions in OBOR-region was frequently similar to the ratio of GHG emission in those countries. Except for China, the ratio of CO2 in 2017 was 51% against 46% in total GHG, because of the significant rate of coal. The five largest emitting countries in the mean of 18% of CO2 emissions and 22% of GHG emissions in OBOR-region while the rest countries accounted for 31% of CO2, and 32% of GHG in OBOR-region (figure 4).

![Figure 4. China and OBOR countries CO2 gas emissions](image)

Based on the results, CO2 emission from agriculture, land use, and energy use. Since 1995, emissions from agriculture have grown in China, followed by India, Indonesia, and Bangladesh. For Russia, the CO2 emission from this source started to decrease from 1990, but from 2005 until 2017, it became quite stablized. From 1990, the CO2 discharge from land use in China was negative emissions, which means China has reached the optimal status in reducing CO2 emission strategies from this resource. CO2 release from the same source in Indonesia was the most massive, but it was unstable, and it reached a high level in 2014 and 2015. As for other OBOR countries during the past two decades, it was stable in Pakistan and Myanmar, and it started to convert from negative to positive in India and Iran from 2011. Until 2012, India is the highest emitter of CO2 in terms of the CO2 emission from energy followed by China and Russia, then Indonesia.

CH4 and N2O emissions from agriculture were the largest in China and India, followed by Pakistan, Indonesia, Bangladesh, and Russia in terms of CH4. While in terms of N2O, the high emitters’ countries are Indonesia, Russia, Pakistan, and Bangladesh. As for land use source, CH4, and N2O in China was low and dominantly generated from Indonesia, Russia, followed by Myanmar and Lao. For energy use, the CH4 and N2O emissions in China were the highest and followed by India, Iran, Uzbekistan, Poland, and Turkey regard with CH4, followed by Egypt, Russia, Thailand, Turkey, and Iran in related to N2O. The F-gases made up the smallest source, but showed the most vigorous emission growth in non-CO2 emissions with an estimated global growth rate of 4.5% in 2016, extrapolated using on the annual average 2007-2010 trend.

The outcomes of the issue study above displayed that the WF average for agriculture productions in China and OBOR countries were approximately 89.3; 62.4 Trillion m3, respectively. A comparison between our assessments and preceding studies refer to the prior studies mostly were focusing on consumptive perspective at the local or universal scale[50]. The gross WF assessment for agricultural products, according to Mekonnen & Hoekstra (2010), was different from our estimation in OBOR countries. The differences in the results of both studies were possibly caused by a set of reasons, including crop types, locative resolve, soil, crops cultivating period, and weather situations. [32].

The meat's WF was specified via the animal feed. There were two prime determinants which drive WF from meat. The first determinant was food alteration efficiency (fodder amount is required for
meat-producing). The determinant contributes to a general decline for the total WF, including grey, green, and blue WF. The second determinant was the feeding component, in particular, the proportion of concentrating to brans, all grazing, mixed, and industrial systems, there was a rise in the part of concentrations of animal’s fodder. Generally, concentrate had more WF than bran. It contributed to the rise of the WF, mainly blue and grey WF. The full effect of the two determinants depends on the size of the two individual determinants [51–52].

The green-WF in all OBOR countries, including China, accounted for a more significant rate of the total WF (approximately 83%), but it had a more low opportunity cost than blue-WF [52–53]. The blue-water resource scarcer than green-water in most cases, so the usage of blue-water is limited because of scarcity and high opportunity cost, and its considerable environmental effect. Therefore, frequently, it is the determinant that restricts the development of the social economy in regions are suffering water scarcity. As a result, deciding the mechanism reducing blue-WF consumed by agricultural products, and the way to turn the blue-WF to another area is becoming the goal for all nations [54]. The optimization of rainfall as much as possible, which means rising crops, might decrease blue-water demand for agricultural production operations [50–55]. At the same time, the water supply would be converted because of climate changes, like changing rains styles and rising the evapotranspiration averages. As a consequence, agricultural production fed by rainfall would be more ambiguous because of climate changes. Therefore, creating inclusive exploitation system for water resource for facing the harmful influences for climate changes is reasonable.

WF for producing crops relies on two determinants: the gross green-WF and blue-WF consuming and the crops yield. The climate changes impacts on both crop-water consuming and crop yields, for instance, over the last three decades, temperatures in OBOR countries yearly increase (figure 5). Owning heat restricts crop development, the increase in temperature will led to increase the evapotranspiration, thus reducing the crop yield, which in turn reduced the agricultural production. The prospect influences on cattle contained alteration of producing and feed crop quality, forage animal growth, milk production, reproduction, and biodiversity.

These influencers were original because of increasing in weather heat and high CO2 concentricity, rainfalls variety. Weather heats effected many crucial determinants in livestock production, like water supply, animal production, and breeding. The amount and quality of forage were affected by a mixture of raises in heat, CO2 concentricity, and rainfall differences. The rise in heat and rainfall differences mostly influences cattle illnesses [56]. Some previous studies argued that the climate changes determinants were not the predominant determinants causing the WF decreasing of agriculture production. [57–59].

They showed that agricultural production does not only depend on climate changes impacts, but it also depended on technology developments and agriculture managing [60–61]. Cho et al., (2012) suggested that the planting dates could transfer in the frame of climate change scenarios for decreasing yield damages induced by a heat increasing. Hence, selection a more early date for crop plantation might be a suitable reaction for compensating the passive influence of a possible increase in heat [81]. Abeysingha et al., (2016) also referred to the irrigation water needs are not just affected by the climatic alteration but also the managerial activities, like crops planting timing, grown duration, cultivating ways [63]. Though the WF perspective supports an efficient scope to estimate WF consumption through the agricultural processes, however, there must be an interest for the quantification of green-WF and blue-WF of agricultural products [64]. Although product WF was a helpful operator for the sustainability of consuming and producing, for prospect encouraging OBOR regions for changing in connection with consuming the water resources, also another approach for ecological preservation and administration would be needed [84]. Because of that, the studies in future are necessary for conducting to progress the WF measurements frame.
Finding common ground between China and OBOR countries claims, regarding adapt to climatic changes and WF alleviation policies, is a severe defy for national territorial policies developing. Implementing the adaptation options could be a challenge for personal planters and water administrators. Communal obstructions may restrict from adopting the lower cost and the practical potential procedures in short-term [65]. However, in the long run, actions that needed technology and infrastructure changes will frequently be hard for justifying politically. Moreover, OBOR initiative is an excellent opportunity for all country-member to make cooperation together with China for establishing the targets regarding the climatic changes adaptation and WF alleviation policies.

In the frame of future climatic changes, the increase of the summer heat is probably to boost evaporation that will raise irrigating demand. Thus with the persistent dryness, this increased compression on the groundwater [66]. Concerning, the agricultural water, alteration in weather patterns, such as, severe precipitation events, dryness, and the increasing of deluge dangers were current challenges that could get worse (Yang, Chan & Scheffran, 2016; Tim Wheeler and Joachim von Braun, 2013) thus have to be adapted and mitigated. Therefore, timely adapting for climatic changes is a fundamental strategy and a crucial challenge for communities and the environment. [67–69]. The adapting to climate change required recognizing production and consumption patterns with lower water requirements, and the assessment of the water footprint is a powerful tool that could contribute towards this direction. The agricultural production is consumed for approximately 70% of the gross blue-WF withdrawn from groundwater, meres, and rivers [26]. Moreover, to add Green-WF and Grey-WF constituents to Blue-WF to produce food is very useful, owing over 90% of the universal rate of water footprint is linked to consuming food[7].

From the universal aspect, an increased contest for watery resource, together with climatic changes, might lead to considerable impacts on water availability for agriculture purposes. The potential effects of climatic changes were predictable for reshaping the demand and supply styles of fresh water for agricultural production all over the world[8–70]. The estimates of water resource utilization through producing processes of the agricultural products in light of climatic changes will share for improving managerial practices of agricultural water for dealing with changing of climate [71]. In this concept, the water footprint indicator could be used to evaluate applied agricultural schemes concerning the consumption of freshwater resources considering climate change scenarios [47]. It provides a new approach for agricultural production identified by one of the sectors where climate change adaptation is comparatively high importance [71].

4. Conclusion
Amongst OBOR states and the entire world, the outcomes showed that China and India were the largest country regarding WF consumption which account for 76.12% of the total agriculture WF. As
for the remaining countries, they have less WF through agricultural production not because these countries adopt strategies for alleviating WF but because most of these countries suffer water scarcity. Furthermore, the WF that has been consumed for agriculture production in China and spanning countries was excessively concentrated on some products. Most of WF was consumed in cattle, swine and chicken meat which were contributed to 89%, 35% of the animal production in China and OBOR countries respectively; and regarding to crop production, the majority of WF was concentrated on wheat, corn, soybean, palm oil and rice which were contributed to 66%, 65% of total crop production in China and OBOR states respectively. As a whole, green the main water type used in producing agricultural products. Since announcing OBOR initiative in 2013 until now, there is not any remarkable change on GHG emissions that generated from agriculture due to the climate change influences can be observed only on the long term. The findings of this study can be a reference for policymakers regarding to climatic changes adaptation policies and water management, so we recommend the decision-makers in China to pay more attention to agricultural trade in the context of this initiative and observe another factor that could support the initiative soon.

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