# The Influence of Trade on Carbon Stocks in a Country's Wood Forest Products Based on the Comparison between China and 47 Countries along the “Belt and Road”

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**Abstract:** In this paper I select China's close trade with 47 timber forest products along the “Belt and Road”, using the reserves change formula to calculate carbon stocks, comparing China's carbon stocks from 47 countries along the route from 2013 to 2017. Analysis shows that China's total carbon stocks and growth are higher than these 47 countries. Calculate the impact of trade on carbon stocks of wood-based forest products and analyze the results. It is found that the “One Belt, One Road” initiative can not only continue to promote trade in wood-based forest products between countries, increase carbon stocks of wood-based forest products among countries, and achieve emission reduction targets.

## 1. Introduction

In recent years, cooperation between China and the countries along the “Belt and Road” has become increasingly close, showing new development trends and characteristics. In the “Belt and Road Initiative” initiative, the development policy on forestry has been formulated. It is proposed to create the “Belt and Road” forestry investment and trade promotion association. According to the nine provinces and municipalities in the west of China and Central Asia, West Asia and Eastern Europe, it is the core source. The "Green Great Wall" in the west. As of 2016, the trade volume of woody forest products between China and the countries along the route reached US$28.3 billion, accounting for 29% of the total trade volume of China's wood forest products, becoming the largest trading partner of wood forest products beyond the United States and the countries along the Belt and Road.

## 2. Research object

### 2.1 Regional definition

The research object of this paper is China and the countries along the “Belt and Road”. From the countries along the route, 47 countries with major long-term trade with China are selected. The specific scope is divided into six regions: Northeast Asia: Russia, Mongolia; Southeast Asia: Thailand, Vietnam, Myanmar, Brunei, Singapore, Philippines, Malaysia, Indonesia; South Asia: India, Bhutan, Nepal, Afghanistan, Pakistan, Bangladesh; West Asia: Egypt, Jordan, Iran, Saudi Arabia, Yemen, Oman, Israel, United Arab Emirates , Turkey, Kuwait, Qatar, Georgia, Armenia; Central Asia: Tajikistan, Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan; Central and Eastern Europe: Czech Republic, Poland, Montenegro, Slovakia, Hungary, Ukraine, Macedonia, Belarus,

Bulgaria, Croatia, Romania, Albania, Slovenia.

### 2.2 Product definition

In order to ensure the accuracy and comparability of the research data, this paper draws on the statistics of the classification and definition of forest products issued by FAO in 1982 and the China Forestry Development Report. According to FAO's definition of woody forest products, forest products obtained from forests should be regarded as categories, mainly divided into logs (wood fuels, industrial logs), sawn timber, wood-based panels (including veneers, plywood, particleboard, fiberboard), paper and cardboard, charcoal, wood chips, scraps and residues, wood pulp and recycled paper[1].

## 3. Measurement of carbon storage of woody forest products and its trade impact coefficient

### 3.1 Reserve change method

This paper chooses the reserve change method to calculate the carbon storage of wood forest products. The reserve change method takes into account the carbon flux at the national level and counts the carbon stock changes of wood forest products into the consumer countries. For importing countries, the import of wood-based forest products transfers the corresponding carbon content to the importing country. Since the product is consumed and used before final burning or decomposition, it should be included in the carbon emissions by the importing country (consumer country); For exporting countries, exporting wood forest products directly reduces their carbon stocks. The following is the formula for calculating the reserve change method [2]:

$$SCA = NEE + (IM - EX) - (E_M + E_X)$$

NEE refers to the Net Ecosystem Carbon Exchange, which is generally 0. IM refers to the carbon content in imported woody forest products, EX refers to the carbon content in exported wood forest products, and IM-EX refers to domestic The total carbon content of the wood forest products produced refers to the carbon emissions in the use of imported wood forest products, which refers to the carbon emissions in the use of exported wood forest products, and refers to the total carbon emissions of domestic wood forest products.

If $IM - EX \geq E_M + E_X$ , it means that the carbon sink is generated, that is, the carbon storage is increased; otherwise, $IM - EX \leq E_M + E_X$ , indicating that the carbon source is generated, that is, the carbon storage is reduced.

#### 3.1.1 Calculation of carbon content in woody forest products

The formula for calculating the carbon content of woody forest products [3]:

$$C = V * D * R$$

Among them, C is the carbon content of woody forest products, V is the volume (or weight) of woody forest products, D is the basic density of woody forest products, and R is the carbon content, which is the carbon occupancy rate of plant organic dry mass. The United Nations Intergovernmental Panel on Climate Change (IPCC) released data on parameters such as basic density and carbon content. The wood that is usually harvested from logs is made from bark from the cutting point. Therefore, when estimating the carbon flow of the logs, the bark must be considered. The ratio commonly used by scholars at home and abroad is 0.1. The carbon content parameters of woody forest products are shown in Table 1.

Table 1 Wood product carbon content parameters

| | Product | density（D） | Carbon Content Rate(R） | Bark Ratio |
|---|---|---|---|---|
| Log | Industrial logs (coniferous) | 0.450 | 0.500 | 0.100 |
| | Industrial logs (non-coniferous) | 0.590 | 0.500 | 0.100 |
| Paper and Paperboard | Newsprint | 0.900 | 0.500 | --- |
| | Paper and board (except newsprint) | 0.900 | 0.500 | --- |
| Wood-based Panel | Fiberboard | 0.628 | 0.468 | --- |
| | Plywood | 0.628 | 0.468 | --- |
| | Veneer | 0.628 | 0.468 | --- |
| Sawn Wood | Sawn wood (conifers) | 0.450 | 0.500 | --- |
| | Sawn wood (non-coniferous) | 0.590 | 0.500 | --- |

Source: United Nations Intergovernmental Panel on Climate Change (IPCC) data

### 3.1.2 Calculation of carbon emissions from woody forest products

The calculation formula for carbon emissions after x years in 2013[4]:

$$E_x = \sum_z^{x-1} \left[ aF_1C_z + (x-z)bF_1F_2C_z \right]$$

Among them, a and b refer to the ratio of direct combustion and natural decomposition of woody forest products, $F_1$ refers to the decomposition rate of woody forest products, and $F_2$ refers to the carbon rate of decay of woody forest products. When z = 0, $C_0$ represents the carbon content of the woody forest products in 2013; when z=1, $C_1$ represents the carbon content of the woody forest products in 2014, and so on. The carbon emission parameters of woody forest products are shown in Table 2.

Table 2 Wood forest product carbon emission parameters

| Forest species | Decaying carbon speed | Service life | Decomposition rate |
|---|---|---|---|
| Sawn Wood | 0.030 | 60 | 1/60 |
| Paper and cardboard | 0.260 | 10 | 1/10 |
| Wood-based panel | 0.030 | 40 | 1/40 |
| Log | 0.030 | 60 | 1/60 |

Source: IPCC data

### 3.2 Influence coefficient of trade on carbon storage of woody forest products

The impact of trade on the carbon storage of wood-based forest products can be tested by comparing the ratio of carbon storage generated by trade in wood-based forest products to total carbon storage in wood-based forest products (production and trade) [4].

$$R = \frac{S_m - S_x}{P_y + S_m - S_x}$$

R refers to the influence coefficient of import and export trade on the carbon storage of woody forest products, $S_m$ refers to the carbon storage of wood forest products imported each year, $S_x$ refers to the carbon storage of wood forest products exported annually, and $P_y$ refers to the annual production of Carbon storage of woody forest products. When a country imports more wood products than exports in a given year, R is positive, which means that trade has a positive impact on the carbon stock of a country's wood forest products. When R>0.1, the positive impact of trade is considered Stronger, when 0<R<0.1, the positive impact of trade is weak. On the contrary, when a country exports more wood products than imports in a certain year, R is negative, which means

trade is a country the carbon storage of forest products has a negative impact. When R<-0.1, the negative impact of trade is stronger. When -0.1<R<0, the negative impact of trade is weak.

## 4. Results and Discussion

According to the FAO database, calculate the impact coefficient of import and export trade on carbon stocks of wood-based forest products from 47 countries along the “Belt and Road” from 2013 to 2017[5], Since the production of wood forest products in Tajikistan and Turkmenistan is zero, the R values for each of the two countries are 1.0. The results are shown in Table 3.

Table 3 Impact of import and export trade along the “Belt and Road” countries on carbon storage of woody forest products

| Region | Positive influence | | Negative influence | |
|---|---|---|---|---|
| | Weak | Strong | Weak | Strong |
| North-east Asia | Mongolia | -- | -- | Russia |
| Southeast Asia | Singapore, Thailand, Brunei, Philippines, Indonesia | Vietnam | Myanmar | Malaysia |
| South Asia | Nepal, Pakistan | Bangladesh, India | Afghanistan, Bhutan | -- |
| West Asia | Armenia, Iran, Israel, Kuwait, Egypt, Jordan, Saudi Arabia, Turkey, Yemen | UAE, Oman, Qatar | -- | -- |
| Central Asia | Kyrgyzstan | Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan | -- | -- |
| Central and Eastern Europe | Georgian | Albania, Macedonia, Romania | Poland, Croatia | Belarus, Bulgaria, Slovenia, Slovakia, Czech Republic, Hungary, Montenegro, Ukraine |

Source: United Nations Food and Agriculture Organization (FAO) data, calculated results

### 4.1 Analysis of the positive impact of trade on carbon storage of woody forest products

As of 2017, China's R-mean value is 0.02. It can be considered that China's import and export trade of wood-based forest products has a positive impact on its carbon stocks, but the impact intensity is not large. By comparing the 2013 and 2017 forest carbon stocks, it is found that China's total carbon stocks have increased, and it can be considered that China's wood forest products trade will promote the increase of forest carbon stocks to some extent. Similar to China, there are Mongolia in Northeast Asia, Thailand, Indonesia and Brunei in Southeast Asia, Nepal, Bangladesh and Pakistan in South Asia, Iran, Qatar, Georgia and Armenia in West Asia.The import and export trade in these areas has a certain positive impact on the carbon storage of woody forest products (R range 0~0.1). Forest carbon stocks increased in 2017 compared to 2013, indicating that trade in wood forest products has contributed to the increase in forest carbon stocks in these countries. For the remaining countries with Positive influence, the forest carbon stocks in 2017 decreased compared with 2013, indicating that the trade in wood forest products has somewhat reduced the reduction of carbon stocks.

### 4.2 Analysis of the negative impact of trade on carbon storage of woody forest products

In countries where the import and export trade of woody forest products has a negative impact on carbon stocks, the Russian Federation, Malaysia and most countries in Central and Eastern Europe have an impact coefficient of R<-0.1, indicating that the impact is greater. Among all the negatively

affected countries, Myanmar and Malaysia in Southeast Asia, Afghanistan in South Asia, Poland and Czech in Central and Eastern Europe, forest carbon stocks decreased in 2017 compared to 2013.Among them, Myanmar is also the two countries with a high annual average net loss of forest area in the world. It can be explained that the trade in woody forest products has accelerated the reduction of forest carbon stocks in these countries to some extent. In Central and Eastern Europe, other negative impact countries except Poland and Czech, forest carbon stocks increased in 2017 compared to 2013. The increase in total carbon stocks of Russian Federation and Bhutan indicates that the trade in wood forest products has hindered the increase in carbon stocks. The increase in total carbon stocks of Russian Federation and Bhutan indicates that the trade in wood forest products has hindered the increase in carbon stocks.

### 4.3 Reasons for the differences in the impact of trade on carbon stocks in woody forest products

Among the countries with positive impacts, the wood-based panels in Northeast Asia and West Asia, the logs from Southeast Asia, and the cardboard trade in South Asia have contributed to the national carbon stocks; The trade in wood-based panels in Central Asia, wood-based panels and paperboard in West Asia, cardboard in Southeast Asia, and wood-based panels in South Asia have a weaker impact on carbon stocks. In countries with negative impacts, the trade in cardboard in Southeast Asia, sawn timber in South Asia, wood-based panels and sawn timber in Central and Eastern Europe will accelerate the reduction of national carbon stocks. The trade in logs from Northeast Asia, sawn timber from South Asia, and wood-based panels and cardboard from Central and Eastern Europe has hampered the increase in carbon stocks.

In summary, the development of wood-based panels in Northeast Asia, West Asia and Central Asia, logs from Southeast Asia and Central and Eastern Europe, and cardboard trade in South Asia will contribute to the increase in national carbon stocks.


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