



Study on Maritime Transportation and Logistics Systems of International Cargo —Focusing on the Global Wheat Transportation—

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【 学位論文題目 】

Study on Maritime Transportation and Logistics Systems of International Cargo
－Focusing on the Global Wheat Transportation－（国際貨物における海洋ロジスティクス
システムに関する研究 －地球規模の小麦輸送について－）

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ABSTRACT

1. Background

Wheat, the principal food of about half of the world's population, is grown in most areas of the world. Even people groups who eat mostly rice also eat some forms of wheat. It is well known that the trade volume of wheat occupies the half of that of grain.

The global population has increased since World War II, and it is anticipated that it will increase rapidly in the 21st century. Currently, about 4.4 billion of the world's 6.3 billion people live in developing countries. The population is increasing most rapidly in developing countries that attained political independence after World War II. In developing countries, about 800 million people do not get enough food or adequate nutrition for daily life. Meanwhile, developed countries are saturated with food. The food-shortage problem is becoming increasingly serious.

Shipping continues to be dominant mode of transportation, accounting for almost two thirds of world trade (metric tons). With the economic globalization, maritime transportation will become more and more important.

In recent years, many countries have been facing a number of pressing system-wide environmental issues related to the combustion of fossil fuels for mechanized applications, including air pollution, heavy reliance on the extraction and processing of petroleum, and emissions of greenhouse gases. The transportation sector is a leading contributor to these problems, and within this sector, freight transportation is a significant contributor especially to energy use and carbon emissions.

2. Purpose

In the 21st century, a steep increase in the global population is expected; mostly will happen in Asia and Africa. According to statistics of FAO, the growing population can be maintained by increased cereal production. But the unbalance between supply and production still exists in the world. The food problem is still serious for people. Firstly, the purpose of this research is to estimate the supply and import/export of wheat on the basis of the continental method. Using the continental method, we can obtain the volumes of wheat shortage and the trade features about the import/export. Secondly, by analyzing the trade flow data, we show a clear situation of wheat trade. Thirdly, we made an assessment to emissions of CO₂ in the wheat transportation. Finally, considering the cargo creation, we developed an analyzing system of wheat maritime transportation and logistics including transportation tons, ton-miles, value, number of bulk carriers needed and emissions of CO₂ in the transportation.

3. Summary

This dissertation is organized as follows.

Chapter 1 presents background of the research and purpose. Beside that, chapter 1 also describes the structure of this research.

Chapter 2 reviews the related research from the following viewpoint. They are global model, marketing of grain, time series analyses and mathematical programming. We also explore the positioning of this research from cargo creation and environmental problem.

In chapter 3, we analyze the population predictions, population changes and population growth rate according to the UN's data. The factor of population increasing is clearly shown.

Chapter 4 examines the production, supply of wheat on the basis of the continental method and analyzes the factors that affect the production and supply. Using the continental method, we can obtain the volumes of wheat surplus and shortage. After discussing the relations between the import, shortage and volume of maritime transportation, the requirements for maritime transportation of wheat are investigated and estimated in the future.

Chapter 5 proposes a trade flow analysis of wheat. First of all, we conduct the trade flow data of across section using programming. Secondly, we analyze the Asian wheat's import by panel data. Finally, the share analysis of the international wheat export market is discussed.

In chapter 6, the maritime transportation and logistics systems of wheat are analyzed for Asia. Firstly we analyze the Asian trade condition of wheat. Secondly from the import condition of Asia, we can make a decision which port can be used as importing ports and exporting ports based on investigating wheat exporting ports of others' countries and wheat importing ports of Asian countries. So the navigation distance between the exporting ports and importing ports can be calculated. Finally, we analyze the maritime transportation and logistics systems of wheat in Asia including maritime Ton, Ton-Miles, trade value, necessary number of bulk carriers and emissions of CO₂ in the transportation. In addition, the effect coming from the international price of wheat is analyzed by Cross-correlations.

In chapter 7, we analyze maritime transportation and logistics systems of wheat to Africa from maritime Ton, Ton-Miles, trade value, necessary number of bulk carriers and emissions of CO₂ in the transportation. After an analysis of the wheat transportation, we find that the agricultural policies greatly affect the wheat transportation to Africa. Then, using two scenarios, we predict how many ships are necessary for the maritime transportation of wheat to Africa in the future.

In chapter 8, a comparative study is undertaken on maritime trade of wheat and rice destined for Africa. For comparison, firstly, the feature of production and supply becomes clear. Secondly, trade feature is also discussed. Moreover, we show that agricultural policies significantly affect the transportation of wheat to Africa. On the other hand, we show that the export of rice to Africa is a

regular trend. Finally, based on the comparison of trade, we predict the number of maritime bulk carriers of wheat and rice for Africa. In addition, the effect coming from the international price of wheat and rice is also discussed.

Chapter 9 presents the conclusions of this dissertation. It includes a summary of important results and subject of future investigation.

4. Conclusions

In this study, from the viewpoints of cargo creation and environmental problem, we analyze the maritime transportation and logistics systems of wheat including maritime Ton, Ton-Miles, trade value, number of bulk carriers needed and emissions of CO₂ in the transportation using the trade flow data. We believe that this research is very useful for the maritime transportation of wheat in the future. The major findings obtained are summarized as follows.

In chapter 3, we found that:

- A steep increase in the global population is expected, mostly in Asia and Africa.
- An important point is that the change of population in Africa will exceed the change of Asia and become No.1 after 2030.
- The population growth rate will decrease in every region; the negative growth rate in Europe is significant.
- The cause of population explosion comes from the decline of death rate.

In chapter 4, we found that:

- Until now, although country-by-country predictions are often researched, they are hard to be estimated. In this chapter, we deal with the wheat problem by the continental method and good continent-by-continent results were obtained. The accuracy of the model and the reliability of the results were high.
- Using populations or years as a variable, a high correlation is obtained, especially in the shortage areas; therefore, it is possible to estimate wheat production and supply.
- A continental presumed model of wheat production and supply with food shortages was built.
- Sufficient wheat to support the growing population can be secured.
- We deduced a new method to estimate the maritime transportation of the future. In other words, we discovered a high correlation between the shortage and the import volume. Therefore, the shortage can be used to estimate the maritime transportation.

In chapter 5, we found that:

- A negative correlation among surplus areas was obtained for the market share of wheat.
- Using the program EXCEL VBA, we build the OD tables in the Asia and Africa.
- By the panel data analyses, we find that the import of wheat depends on the population and GDP of Asian countries.

In chapter 6, we found that:

- We analyzed the panel data of Asian trade and developed an analyzing system for maritime transportation and logistics of Asia including maritime Ton, Ton-Miles, trade value, number of bulk carriers needed and emissions of CO₂ in the maritime transportation.
- We find the coefficient of determination is high between the ports' depths and the DWT of bulk carriers.
- A strong correlation between the tons and ton-miles can be concluded. The information was valuable for predicting the appropriate number of required ships.
- The model was built to estimate the number of grain bulk carriers needed for wheat.
- The international price greatly effects the change of export share's residual by cross correlation.
- The speculation exists in the wheat marketing.

In chapter 7, we found that:

- We analyzed the panel data of African trade and developed an analyzing system of the maritime transportation of wheat, which includes the maritime tons, ton-miles, trade value, number of bulk carriers needed and emissions of CO₂ in the maritime transportation.
- We found that there was a competitive relationship among the EU, Canada, and the USA.
- We also found a strong correlation between the tons and ton-miles in Africa. The information was valuable for predicting the appropriate number of required ships.
- We created two scenarios for predicting the imports in Africa, but could not determine which scenario would actually happen in the future because the agricultural trade is greatly affected by various policies.

In chapter 8, we found that:

- The production and supply of wheat is worldwide; rice is the favored grain in Asia.
- The international market of rice is thin market.
- The import trend of wheat has suddenly changed; on the other hand, the import trend of rice is generally regular in Africa.
- We use a different method to predict the imports of wheat and rice for Africa because their trade features are different. In particular, regarding wheat, trade is greatly affected by various policies.
- A model is built to estimate the number of bulk carriers for wheat and rice in Africa.
- We find a strong correlation between the maritime transportation tons and ton-miles. Little change in the importers and exporters is seen.
- Since change of wheat trade significantly depends on agricultural policy, prediction of wheat trade is more difficult than rice. And the change of the number of bulk carriers for wheat is larger than that for rice.

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要 旨			
世界経済の発展とともに人口爆発や地球環境悪化は、深刻な食糧不足の問題を引き起こしている。本研究は、穀物のなかでも重要なひとつである小麦に関してグローバルなレベルでの生産・供給をベースに地球規模での輸送システムについて研究したものである。本研究論文の各章の概要は以下の通りである。 第1章は、研究の背景と目的、および本論文の構成について述べている。 第2章は、本研究に関する文献レビューをグローバルモデル、穀物のマーケティング、時系列分析および数学的プログラミングといった観点から行い、この研究を貨物創造と環境問題といった点に独自性を求めることとしている。 第3章は、人口予測、人口変化、人口成長率などについて国連データをもとに分析し、人口増加の要因を明確にしている。 第4章は、大陸毎に小麦の生産と供給を調べ、それらに影響する要因を分析している。この分析によって小麦の余剰と不足の量が得られる。そして、輸入量と不足量および海上輸送量との関係について分析した後、小麦輸送のための必要海上輸送量について予測している。 第5章は、小麦のひとつの貿易フローを提案している。まず、プログラムを利用してセクション間の貿易フローデータを作る。つぎに、パネルデータからアジアの小麦輸入を分析する。最後に、世界の穀物輸出市場での市場シェア分析について議論している。 第6章は、アジアでの小麦の海洋ロジスティクスシステムについて分析している。まず、アジアの小麦の貿易状況について明らかにし、アジアの輸入条件からどの港湾が小麦を輸出入するかを決め、輸出港と輸入港と航海距離を計算している。これらによって、アジアにおけるバルクキャリアによる小麦の海洋ロジスティクスシステムの特性、すなわち海上輸送量(トン、トンマイル)、貿易量、必要船腹量および輸送中のCO2排出量などが明らかにされている。 第7章は、前章のアジアでの海洋ロジスティクスシステムの特性をアフリカの小麦輸入について分析している。小麦輸送の分析結果、アフリカにとっては農業政策が小麦輸送に大きな影響を与えている。そこで、二つのシナリオを用いて将来アフリカへの小麦輸送にどの程度の海上輸送のための船舶が必要かを予測している。 第8章は、アフリカ向けの小麦と米の海上貿易に関する比較研究を行っている。比較のために、まず生産と供給の特性について明らかにする。つぎに、貿易特性について述べる。さらに、農業政策が小麦輸送に有効に影響していることを示す。一方、アフリカへのコメの輸出は一般的傾向がある。最後に、貿易を比較することによって、アフリカ向けの小麦と米のためのバルクキャリアの船舶数を予想する。さらに、小麦と米の国際価格の影響についても議論している。 第9章は、本研究の結論であり、重要な結果を要約するとともに将来の課題についても触れている。			

氏名	謝 京辞
海上輸送に関する研究は、バルク貨物部門とコンテナ貨物部門に大別されるが、これまでの研究は、その容易さといった点からコンテナ輸送に関するものが多くみられた。他方、バルク貨物輸送に関する研究は、世界市場を対象にしなければならず、またデータが不足していることなどから余り進んではこなかった。本研究は、そのような困難があるにもかかわらず、この課題を貨物創造といった問題意識を併せ持ちながら小麦の海上輸送に関する地道な研究を行いいくつかの有意義な知見を得ており、本研究がバルク貨物輸送の研究への端緒を開くものとして貴重なものであると考える。特に、小麦輸送を地域レベルではあるが、どの程度の海上輸送需要を創出するかを明らかにし、その方法を示している。また、小麦の生産・貿易・輸送が地球環境によって大きく影響を被ることの一端が示されており、今後の研究の方向を示唆している。このように本論文については、研究内容の新規性、先駆性、有用性ならびに博士論文としての体裁等の観点から博士(工学)の学位を得る資格があると認める。なお、本研究に関する有審査論文は5編(第1著者4編、英文4編)である。	

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試験科目	専門科目	輸送工学、交通経済	
		統計学	
判定	☒ 合 格 ・ ☐ 不合格		
要 旨			
申請学位論文を中心に、輸送工学、交通経済、統計学等の専門科目について口頭試問形式で試験を行った。			
・試験期日：平成 20 年 8 月 6 日 ・試験方法：口頭試問 ・担当者：審査委員；吉田、塩谷、磯貝、久保による口頭試問 評 価；専門科目に関連して、論文における専門用語、輸送および物流に関するシステムならびに経済性に関する専門的知識、分析に利用している統計的手法の適用上の問題、分析対象として取り上げている小麦の生産・貿易・輸送に関する現状と問題点、研究成果の意義と課題、最後に環境問題が小麦輸送に及ぼす影響などについて質疑を行い、適切に応じた。 以上の結果、学位申請者 謝 京辞は、試験に合格したと判定した。			