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研究課題名(和文) The Effects of Climate Change and Agricultural Management Practices on Rainfed Rice Crop Yield in Rural Vietnam and India

研究課題名(英文) The Effects of Climate Change and Agricultural Management Practices on Rainfed Rice Crop Yield in Rural Vietnam and India

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研究成果の概要(和文)：本研究は、ベトナムとインド農村の天水農業地域における稲作生産に対して、気候変動が与える経済的影響を明らかにするとともに、これらの地域の天水稲作の単収を向上させる農業管理方法を提示することを目的とする。世帯調査から明らかとなった主なこととして、農家は干ばつ、洪水、低地(塩水遡上)など状況の変化による単収の変動を減少させるための新しい管理技術や方法を取り入れたい意向を持っていることがあげられる。本研究では、農家の圃場で試験栽培を実施し、稲作生産の単収を向上させる潜在的な農業管理方式を示した。社会に対しても直接的な影響を持つ。

研究成果の学術的意義や社会的意義

農地で実施した稲作実験は、農民たちに農作物増産のための管理方式を理解する機会を与えた。本研究で画期的な農業管理戦略が確認されれば、農民の生計向上に大きく貢献し、生計の大半を米作に依存する人々の飢えや貧困削減に寄与し、社会に対しても直接的な影響を持つ。また、能力研修や国際会議での発信を通して、学术界・市民社会にも広く成果が共有・普及される。

研究成果の概要(英文)：This study emphasis the economic impacts of climate change on rice production in rainfed agriculture regions of rural Vietnam and India. Further, it is also explore the potential agricultural management practices to enhance rice yields in rainfed areas. The key outcomes from household surveys recognized that the farmers are prefer to adopt new management techniques/practices to reduce yield gaps under different situations such as drought, flooding and lowlands (salt intrusion). Our conducted rice crop experiments in the farmers' field, remarkably provides an opportunity to understand the potential management practices for increasing their crop yields and have a direct impact on society.

研究分野：Agricultural and Environmental Economics

キーワード：Rice crop climate change management practices fertilizer applications

1. 研究開始当初の背景

Rice farming is the main economic activity for hundreds of millions of rural poor in Asia, which produce about 90 per cent of the world's rice. Nevertheless, 40 per cent of the total rice area is under rainfed (particularly, lowland or upland), while about 3.5 million ha of rice-land are still being classified as deep-water or flood-prone (Maclean et al. 2002). Even though, rainfed lowland areas are generally face several biophysical constraints such as adverse soil conditions, pest and weeds. These situations cause low productivity in rainfed areas.

Furthermore, previous recent studies specified that production of rice in the past few decades have been decline in many parts of Asian countries due to increasing temperature and reducing number of rainy days. A limited increase in temperatures could lead to reduce crop yields for poor people living at lower latitudes, especially in tropical and seasonally dry regions. Rice crop is grown in a vast low-lying deltas and coastal areas in Asia. More frequent and extreme events, such as droughts and floods are directly effects on low productivity of rice production.

2. 研究の目的

The purpose of considering Vietnam and India as our case study is primarily due to these two countries are top rice exporters contributing significant role in the international food security (*Figure-1*). In case of Vietnam, about 80 per cent of the farmers are cultivating rice crop and the production of rice crops plays an important role in the Vietnamese rural economy (Thanh and Singh, 2006). For instance, more than half of Vietnam's rice crop grow in the Mekong River delta but all of which would be affecting by sea-level rise make rice production very vulnerable to climate change. On the other side, rainfed rice in India constitutes up to 55 per cent of the total rice area, within this the area of 15 per cent is covered by uplands and 33 per cent is low lands and the remaining 7 per cent is flood prone.

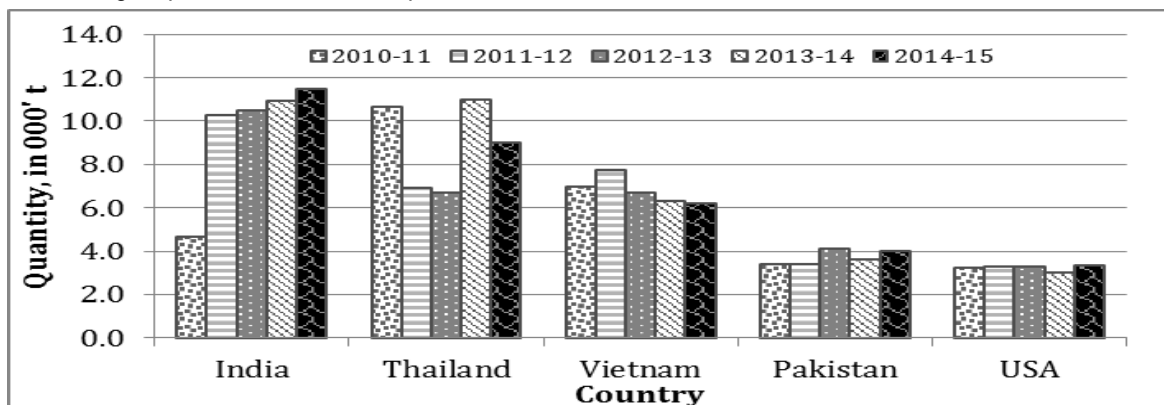


Figure-1: Major rice exporting countries, 2010-11 to 2014-15 (Source: IRRI, World Rice Statistics)

The productivity under rainfed conditions are not exceeded more than one ton per hectare both countries in India and Vietnam. Considering, the pressure of increasing growth of population and urbanization, the risk of hunger is expect to remain extremely high in

India and Vietnam. Besides that, the rice production impacts may threaten not only food security, but also national economic productivity. In view of fact that the improving growth of rice productivity is much necessary, not only to achieve an overall GDP and it is essential to meet the rising demand of food and incomes of those who dependent on rice farming. Therefore, management practices for rice production in Vietnam and India must target for increasing rice yields, particularly for rainfed rice. However, agricultural management strategies are restricted due to the limited resources in developing countries (Mendelsohn and Dinar, 1999).

The expansion of new strategies and farm level management options need to be improving farmer's livelihood in rainfed farms (Hafele, 2004). This study investigated the significant factors through conducting household survey and rice crop experimental plots for rainfed rice yields in lowland, drought and flood prone areas. The major objectives of this study is to evaluate the economics of climate change impacts on rainfed rice production in Vietnam and India by using two-stage structural model with an integration of economic and crop simulation growth iii) to assess the yield gaps between water-limited potential yields (simulated yields or experimental yields) and achievable yields (farmers yield under optimum management). iv) to conduct yield forecast for most common rice cropping system under rainfed conditions using different rice varieties. Finally v) to identify the potential management practices to minimize negative impacts on improving rainfed rice yields through economic and crop simulation methods.

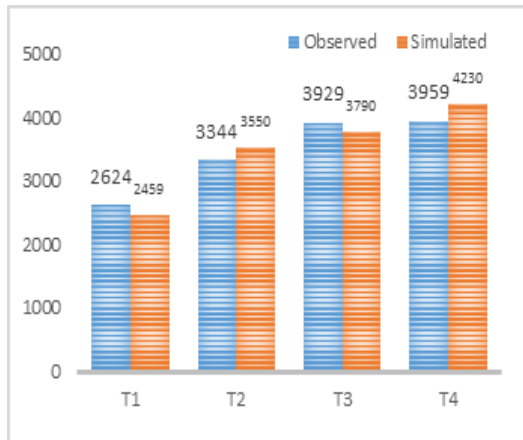
3 . 研究の方法

Several methods have been developed to estimate the impact of the climate change on agriculture. However, in this study we developed a new integrated cross-disciplinary approach that is an economic model of two-stage production function for rainfed rice farming, which includes production shocks (weather, flooding and drought), input choices and observed changes in yield growth such as crop/biophysical models included in this approach. For this study, we have conducted a rice crop experiments in farmers field in both selected countries for identifying and sharing the information of new farm management techniques. However, for economic model and farmers' perception we surveyed A sample of 150 households in the rice crop affected by the drought prone villages in coastal districts of Andhra Pradesh and Bac Lieu, Soc Trang provinces in Vietnam.

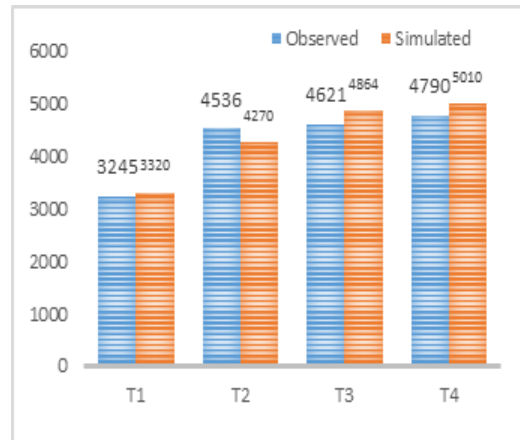
4 . 研究成果

The simulation results of crop experiment conducted at Vietnam and India reveals that the suitable nutrients level (fertilizer utilization efficiency) of each rice cultivar contributes to enhance farmers' income and maintain a sustainable soil water environment in this region. The research findings exhibit that there was a strong correlation between grain yield and plant height, panicles number m^{-2} and number of filled spikelets per panicle. Among different fertilizer applications, $50N \text{ kg N ha}^{-1} - 40 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1} - 30 \text{ kg K}_2\text{O ha}^{-1}$ obtained the highest grain yield as well as the most effective economic with producing of the varieties DS 20 and Jasmine 85 in Vietnam and Improved Samba Mashuri (ISM) in India.

Moreover, these varieties are tolerant to diseases resistant as well. Lastly, we recognized



DS 20 Variety



Jasmine 85

that late sowing as one of the significant adaptation measures for the prolonged drought and insufficient rain.

- There was strong positive correlation between grain yield, plant height, panicle number m^{-2} and number of filled spikelets per panicle in both DS20 and Jasmine 85 rice varieties.
- Among fertilizer treatments, the treatment 3 is economically most applicable for producing yield of 3929 kg/ha for DS20 variety; and for the Jasmine85 variety the crop yield was obtained 4536 kg/ha under treatment 2.
- The suitable nutrient level of each rice cultivar with extremely fertilizer utilization efficiency contributes to enhance the farmers income and as well as to maintain a sustainable soil-water environment in this region.
- The implementation of key adaptation strategies as an appropriate fertilizer application techniques would improve the crop yields and reduce the cost of cultivation around 5.0 -10.0 percent.
- Farmers have expresses the opinion that ISM was more resistant to accommodate than samba masuri and Swarna rice varieties. In addition, the extra benefit of this variety is tolerant to the bacterial leaf steal disease. This variety matures 10 days earlier than Samba Masuri that is beneficial as it saves input costs and saves from premature rains.

Lastly, as part of this project we trained 30 scientists in the Mekong Delta on Decision Support System for Agrotechnology Transfer (DSSAT) crop modeling, particularly, by using the rice crop experimental data that from this project. This crop experimental activities associated with agriculture have a direct impact on society, for instance improved rice varieties and farm management technologies contributes to enhance farmers` income and maintain a sustainable soil water environment in these regions.

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〔産業財産権〕

出願状況（計 0 件）

取得状況（計 0 件）

〔その他〕

ホームページ

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6 . 研究組織

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該当なし

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