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Contents

Preface

Preface to the 19th International Symposium on Integrated Field Science "Trends and Prospects on the Policy for Rural Society and Farm Management-Comparative Research Between Asia and Africa"

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The agriculture has been based on the community in Japan from ancient time. However, the structure of community has changed with economic growth. So, it's become a pressing challenge to clarify the relation between the farm management and the rural society. Especially, we must take notice of the establishment of community-based farming in Japan. The countries in Asia and Africa have the same kind of community in rural area and agriculture has close relationship with them, Therefore, we set the present theme for 19th international symposium on integrated field science

We sincerely hope that this Seminar will contribute to creating a common understanding in Asia and Africa by addressing this issue from various angles and by examining specific measures to be implemented.

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Symposium mini review

Structural Problems of Agriculture and Rural Policy in Japan

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Keywords
Traditional rural society, Modernization, Agricultural structure reform, Rural policy

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Abstract

In Japan's agricultural policy since World War II, traditional rural society was regarded as negative beings from the perspective of agricultural modernization in the 1960s. But policy attitudes toward rural society have changed, and there was a growing tendency to use rural communities to adjust rice production and mobilize farmland tenancy from the latter half of the 1970s. Rural policy began to be implemented in earnest after the 1990s, especially in the 2000s, and behind that there were concerns that the decline in rural society would lead to the collapse of agriculture. The main reason for the decline of rural society is the depopulation and aging. However, the rural policy of the Ministry of Agriculture, Forestry and Fisheries (MAFF) was limited to conservation efforts with respect to agricultural resources. Since 2020, the rural policy has been revised with the aim of promoting rural revitalization. The MAFF has announced that it will promote the integration of rural policies. A new rural policy affects the whole policy framework that the MAFF has carried out agricultural structural reform, but adjustment between policies is expected to be difficult.

Introduction

In recent years, Japan's Ministry of Agriculture, Forestry and Fisheries (MAFF) has been trying to change its rural policy as a key area of its activities. The MAFF has created a strategic framework by linking rural policy with agricultural structure reform. Reviewing the MAFF's rural policy has important implications as it could lead to changes in such a framework. The present study analyzes the characteristics and significance of recent revisions to the MAFF's rural policy by examining the trends in such areas since the 1960s, when Japan underwent economic growth following World War II. I examine the characteristics of recent revisions to rural policies in the light of trends in such policies over the past half century.

I. Trends in Japan's rural policy

1960s to early 1970s

From the 1960s to early 1970s, the MAFF sought to modernize agriculture and rural society; that involved changing traditional elements that made up the economy and society in rural Japan. To do so, the MAFF intended to establish the "modern family farm," which was expected to yield an income equivalent to that of urban workers. The MAFF recognized the problems of low-productivity, low-income agriculture as well as undemocratic rural society. This was the perception of rural areas as "problem areas," as noted by Odagiri (2019).

At that time, the Agricultural Basic Law was enacted in 1961 to modernize Japanese agriculture—especially to raise farmers' income to that of urban workers. The MAFF aimed to increase agricultural productivity through mechanization and farmland improvement; it also endeavored to reduce the discrepancy in living conditions by improving infrastructure, such as electrification, improving the water supply and road network. However, no effective policies were implemented to modernize rural society other than extension services, such as guidance for improving rural life and introducing family agreements. The family agreement was modeled after the father and son agreement in the United States; it involved the division of roles for family members and setting holidays for farm work; it aimed to promote farm business management while maintaining good family relationships (see Gojo, 1998).

Mid-1970s to 1980s

In the mid-1970s, agricultural policy trends changed. In the history of agricultural policy, it is called "The Regional Agricultural Policy", which corresponds to the period until the 1980s. The MAFF increased its interest in rural society and

adjusted its policies accordingly.

One action was the rice production adjustment policy, which was similar to the set-aside policy of the EEC. It started as a temporary measure in 1969, simply to reduce paddy fields planting rice. However, since 1978, it has turned to reorganization of paddy field utilization from a long-term perspective. In addition to assigning paddy field reduction targets to farmers, policy emphasis had been placed on establishing a shift from rice cultivation to other crops. The aim was to rationalize the use of paddy fields by adding other crops, and for that purpose, the organization of farmers, such as the shared use of agricultural machinery, was emphasized.

Another step was increasing the mobility of farmland tenancy and promoting farm expansion by creating an organization to improve farmland use in rural communities. The farmland-use promotion project of the MAFF started in 1975, and was enacted in 1980 as the Farmland-Use Promotion Law.

The MAFF aimed to conserve agricultural resources and improve farmland use and agricultural productivity under conditions of agricultural overproduction. Thus, it was impossible for the government to realize this task, so rural society was expected to solve problems in implementing policies.

“Regional agriculture” is one of the most popular terms applied to rural Japan: it signifies agriculture based on traditional rural society and has been frequently used since this period. Two functions are expected of regional agriculture. One is an internal organization that responds to adjustment of agricultural interests and consensus building; the other is adapting to the external environment, including government policies. Rural Japan generally lived up to these expectations in this period in line with the MAFF’s renewed interest in rural society. The MAFF’s attitude to regard traditional rural society as negative beings diminished, and its policies shifted toward using rural society.

Since the 1990s

Japan’s rural policy has changed since the 1990s. The turning points are the "New Policy Direction for Food, Agriculture and Rural Area" issued in 1992 by the MAFF, and the "Food, Agriculture and Rural Area Basic Law" enacted in 1999. To be precise, in terms of changes in rural policies, the run-up period was from the 1990s to the early 2000s, and new rural policies were launched from the latter half of the 2000s. The direct payment policy for hilly and mountainous areas began in 2000, and Farmland/Water/Environment Conservation Measures started in 2007. In 2014, these measures were integrated as a Japanese-style direct payment system and enacted. As a result, greater emphasis was placed on implementing rural policies. In this regard, the following points should be noted:

1) Rural policy became positioned as central to MAFF strategies along with food and agricultural policies.
2) Rural policy involves a direct payment policy, which was introduced through agricultural policy reform.
3) The MAFF’s policies since the 1990s have combined different principles—market orientation (agricultural industrialization policy) and regionalism orientation (rural policy)—. The MAFF has described this combination thus: “industrial policy and regional policy as two wheels of a wagon.” “Industrial policy” signifies industrializing agriculture by promoting the expansion and incorporation of farm business and is also called “farm business policy”; “regional policy” simply means rural policy. The MAFF intended to develop farms through industrial policy; When agricultural structure reform would be realized, it could lead to an increase in agricultural income and the entrance of younger generations into agriculture, leading to the strengthening of rural societies. On the other hand, rural policy sought to conserve agricultural resources by maintaining rural communities. That is because agricultural resources cannot be conserved by means of public works or market mechanisms, and the existence of rural communities is a prerequisite for agricultural structure reform. In this way, the expression of "two wheels of a wagon" emphasized mutual complementarity between the industrial policy and regional policy.

Severe criticisms have been made of such rural policies, notably by Odagiri. He stated that rural policy was limited to agricultural resource policy and subordinate to industrial policy; it was not an equal wheel but a supplementary wheel. On the other hand, the rural development policies of other ministries have been reinforced owing to a growing range of such problems as depopulation and aging. The rural development policies of other ministries and those of the MAFF have become uncoordinated and lost their systematic relationship, which eventually led to derailment of the MAFF’s rural policy (Odagiri, 2020).

II. Recent revisions to rural policy and their characteristics

Initiating review of rural policy

The recent revision to the MAFF’s rural policy was expressed in the form of its 2020 Basic Plan for Food, Agriculture and Rural Areas. The key expression in this plan is “comprehensive regional policy,” which involves the following: (1) having several goals, such as job creation, living improvement, and creating vitality; (2) combining agriculture and other sectors; (3) collaboration of related public and private organizations; and (4) introducing as many measures as possible.

The relationship between rural policy and agricultural industrialization policy, which were described as “two wheels of a wagon,” is notable. To maintain rural communities, the 2020 plan emphasized promoting diverse farm businesses such as multi-crop farming and emphasized recognizing the significance of small farms. However, this direction is in conflict with agricultural industrialization policy.

Subsequently, a meeting group of the MAFF to review rural policy was established and chaired by Odagiri, who criticized the MAFF’s rural policy. In this respect, the MAFF's intention to change the policy was expressed. An interim report was published in June 2021. The report covered details about achieving the 2020 plan and aimed to change rural policy. The group officially met 12 times; however, after the interim report, the group met only once (in December 2021). Based on the interim report, a final report was compiled in April 2022.

Its main points are as follows:

1) Innovative job creation: the report underlines the innovative efforts in rural areas to create diverse employment opportunities and raise incomes.
2) Human resources: the report addresses population issues with respect to rural migration and entrance into farming as well as human resource development of related organizations (such as local governments) to increase support for rural areas.
3) "Region management organization (RMO)": the report stresses the need to establish RMO to manage businesses involved in rural development that undertake such functions as regional resource conservation.

Generally, the report adopts a positive stance with respect to rural development. However, some questions remain. For example, the report emphasizes the necessity to increase in the rural related population. It refers to those who are interested in the rural area and sometimes visit or stay in the rural area to participate in various events and initiatives. However, they aren't rural residents. The report stresses "the mirror effect of intercommunication" to enhance local value. But, there are some issues to consider regarding the relationship between (a) rural-inhabitant population who settle in rural areas, (b) rural-related population who are not inhabitants but are related to rural areas, and (c) rural development.

First, whether or not rural development will be possible if the rural-related population increases but the rural-inhabitant population decreases. The report looks at rural development due to the increase in rural-related population, and stands in a positive way of thinking about this question. However, in order to think about it in deep, there are some more points to consider about the relationship between the rural-related population and the rural-inhabit population. So, the second is whether the rural-related population will increase even if the rural-inhabitant population decreases. And the third is whether the increase in the rural-related population leads to the increase in the rural-inhabitant population.

This report found the reasons for the increase in the rural-related population in the consciousness of urban residents, which is "return to the countryside." Therefore, it seems that the report has positive ideas to the first and second issues above. Regarding the third issue, although not negative, the report does not place great emphasis on promoting the settlement of rural-related population. In other words, it's looking at rural development by increasing the rural-related population without emphasizing the element of rural-inhabitant population. However, it seems necessary to carefully consider the above three issues.

Another point to consider is that the report is primarily focused on the situations in mountainous regions, with a focus on addressing issues such as lack of employment/commercial facilities/and anything else. It is wondering whether the policy presented in the report could increase rural-related population. Attracting people from outside areas—especially from urban centers—would need efforts to enhance the benefits of living in rural areas as opposed to city life.

Implications of revising rural policy

Finally, I address the implications of revising rural policy. Until the 1980s, rural policies in Japan tended simply to deny or utilize traditional rural society. The difference between denying and utilizing such communities means the change in policy stance toward existing rural society. In the sense of supporting the survival of rural communities, rural policies began in earnest in the 1990s, when the jeopardy to rural society became recognized.

In Japan, rural communities maintain local common resources, such as irrigation and drainage facilities; an institutional infrastructure related to local government and agricultural organizations is developed also based on rural society. Concerns about the collapse of agriculture and rural society led to the formulation of rural policies in the 1990s. Subsequently, rural policies were implemented by means of subsidies for conserving farmland and other agricultural resources. However, the policies have been unable to exert an adequate effect on developing rural society. At the same time, an agricultural industrialization policy was introduced aimed at agricultural structure reform. That policy is one of the factors that led to the decline of rural societies: the decrease in the farming population and increased economic conflict between tenants and owners over farmland leases. I refer to this situation as the "dilemma of agricultural structure reform."

The revision to rural policy since 2020 has aimed to extend and integrate that policy; however, that revision has not resulted in effective measures regarding the dilemma of agricultural structure reform. As noted above, the 2020 plan expressed the significance of diverse, small farm businesses in maintaining rural communities, which was at odds with the agricultural industrialization policy for agricultural structure reform. However, there are few expectations that the agricultural industrialization policy will be revised to reflect the 2020 plan. Revising rural policy would shake the framework of the MAFF's strategy, which has positioned industrial policy and regional policy as the two wheels of a wagon. It is necessary to consider how the relationship between the two wheels of the wagon will change.

Activities and businesses in non-agricultural areas could be expanded to lower the significance of agriculture in rural areas and alleviate other problems there. Thus, revising rural policy should aim toward a comprehensive regional policy: shifting the basis of rural communities from agriculture to other areas could enhance the sustainability of those communities. Accordingly, it is necessary to consider whether future rural communities can conserve agricultural resources and develop the ability to support regional agriculture.

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Symposium mini review

The Relation Between the Farm and the Community in Japan

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Keywords
Community farming, farm size, relationship, farm succession and transfer

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Abstract

In Japan, the price of agricultural products, especially rice, tends to remain low. Therefore, it becomes necessary to enlarge farm size. The average farm size in Japan is about 2 ha, so some farmers adopt community farming. This paper attempts to investigate the characteristics of typical community farming and the related issues.

Introduction

Recently, in rural areas of Japan, the aging and depopulation of the farm household members has been increasing. At present, more than half of the population engaged in farming is 65 years old or older. Thus, the number of farms has been decreasing rapidly. To overcome these problems, community-based farming organizations have been established. On the other hand, average farm size, which used to be approximately 1 ha until twenty years ago, tends to be larger. There are some large-scale farms of more than one hundred ha. In this paper, we investigated the relation between such farms and the rural community in Japan.

Materials and Methods

We reviewed the literature concerning the development of community-based farming in Japan. In addition, a field survey of typical community farming and large-scale farming was conducted.

Results

1. History of community farming

In earlier days, the shortage of labor during busy farming seasons was solved regionally or collectively. Farm households in a community exchanged labor for work that was difficult to handle by a single household, such as rice planting and roof rethatching. This was a mutually balanced, reciprocal community arrangement. Further, the same kind of labor exchange activity existed in Asia and Africa. This kind of cooperative work drastically decreased around 1960, because of the advancement of mechanization in agricultural production. However, from around 1970, community farming, in which residents in a community carry out farming jointly by mutually helping each other, increased slightly in the eastern part of Japan. This was because the average farm size was quite small and it was not possible for individual farmers to get adequate income in this area. However, as a measure for stabilizing income for paddy field management the government policy of 2007 encouraged the organization of community farming. The target farmers for government support (i.e., provision of subsidies) are: a) Certified individual farmers: more than 4 ha, b) Community based farming: more than 20 ha.

2. Study of current cases of community farming

We conducted a survey of several types of community farming in Hiroshima Pref., which has 272 community farming organizations and 16.7% of its area is covered by rice fields.

1) Household participation types

H Farm: Members 41 households, directors: 9 persons, Total area: 25.7 ha (rice 24.6 ha, vegetables 1.1ha)

In this system, rice cultivation is shared equally among all the households in the village. Any household that cannot attend to farm-work, has to pay money for community farming.

2) Individual farm company type

F farm: Management responsibility:With the village; Managers:3persons out of wife, husband and mother and father; Workers: 3 persons:Mr. A: 40s, Mr. B: 30s, Mr. C: 20s; Cultivated area: 69ha:rice 57 ha, soybean, vegetable, and pasture 12 ha.

The number of households which rent the land to this company: 120.

This company has a farmer's market and a bakery shop. The events and social gatherings of the village are held

in the garden of this farm and some agricultural products are distributed by the farm to the villagers, free as gifts. In this way, the farm establishes a close relationship with the community.

3) Community farming operated by village association

A farm: This farm is operated by the residents' association. Its activities are farming, farmer's market, and promotion of settlement in this village (rented houses, nursery) and elderly welfare.

4) Cooperation with other enterprises

K Farm: This farm is the joint venture of the company, combining agriculture and community farming. The manager comes from the company and farm work is carried out by farmers in each village.

Conclusion

The farms have a close relationship with the village and villagers in the western part of Japan. However, community farming particularly faces a serious shortage of labor and managers. So, some community farms are now considering hiring young workers from outside the village and transferring the farms to them. One of the most important research tasks in farm business management is to investigate how to build good relationships with the workers and the village or the community.

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Symposium mini review

The New Trend of Community Farming in the Tohoku Region

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Keywords
abandoned farmland, civil engineering, corporate status, hire employees, own sales outlets

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Abstract

This study aims to identify new trends in community farming in the Tohoku region, one of Japan's leading breadbasket regions. The findings indicate that many community farming organizations are acquiring a corporate status and employing full-time workers, leading to increased revenues from community farming organizations. Additionally, there is a trend toward introducing or expanding new labor-intensive crops, such as vegetables and fruit trees, requiring a large labor investment, highly mechanized land-use crops, such as rice and soybeans, and direct marketing. Lastly, there is a tendency to engage in projects needed by the local community, such as outsourced farm work and civil engineering projects. As described above, community farming organizations evolve from organizations that complement farmers' management and maintain farmland use in the community to integrated business entities that support the local community.

Introduction

Since the 2000s, the price of rice, a primary agricultural product in Japan, has declined significantly due to oversupply. In the 2010s, many farmers who supported agricultural production began retiring, and the resulting decline in farm households became more severe, continuing to this day (Ando, 2021).

Japanese farmers have responded to this crisis by creating cooperative organizations to save costs and supplement labor in agricultural production. Since the mid-2000s, many community farming organizations have been established, aided by agricultural policy.

Agricultural communities are the most basic social grouping unit for agricultural production and livelihood in rural villages in Japan (Ministry of Agriculture, Forestry and Fisheries Library, 1985). Such rural communities have maintained and managed common assets, such as agricultural drainage canals and farm roads, and events, such as festivals to pray for a good harvest. A community farming organization involves farmers living in a village participating and working together to conduct part or all of the agricultural production process under a unified will. The contents of the joint activities include agreements on cultivation methods, joint ownership and use of agricultural machinery and facilities, and consignment of farm work. Some organizations share the business management, becoming a single management entity. In addition, when a community farming organization acquires a corporate status, it can own or lease farmland as an organization, enhancing its external credibility in terms of worker employment, marketing operations, and financing.

Since community farming organizations are positioned as major agricultural production players in Japan's agricultural policy, and analyzing future development is an important theme when considering the country's food supply. This paper aims to identify new trends in the business activities of community farming organizations in the Tohoku region of Japan, one of the country's largest breadbasket regions, comprising one-quarter of Japan's rice paddy area. Additionally, the policies implemented in the late 2000s led to many community farming organizations being established, and the Tohoku region is a typical example.

Trends in the Number of Community Farming Organizations in Japan

Trends in the Number of Community Farming Organizations

Fig. 1 shows the trend in the number of community farming organizations in Japan and the Tohoku region, indicating a rapid increase around 2007 due to a change in agricultural policy. The policy aimed to stabilize management by being

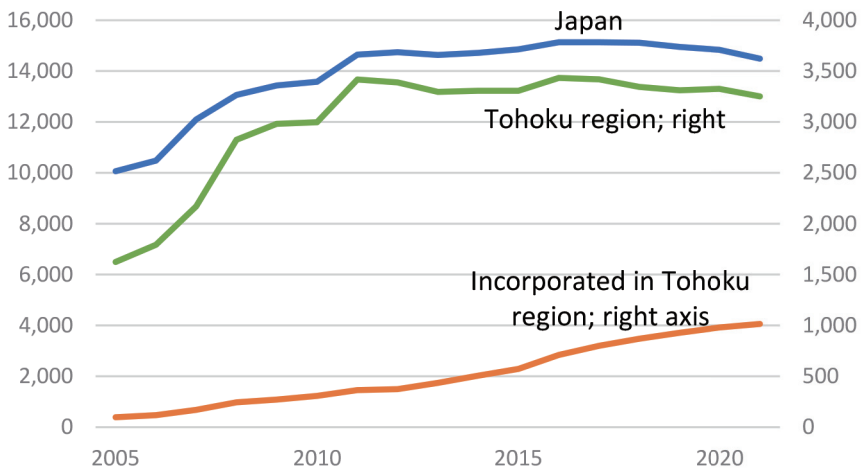

Fig.1. The number of community farming organizations in Japan and Tohoku region. Source: Ministry of Agriculture, Forestry and Fisheries, *Survey of Community Farming, Syurakueinoujittaichosa in Japanese.*

limited to farmers with more than four hectares of cultivated land or community farming organizations with more than 20 hectares of cultivated land. Since few farmers can meet the former condition, a division arises between farmers who are eligible for the policy and those who are not. Such a division is not desirable when living in a community. Therefore, community farmers have been trying to establish community farming organizations to clear the 20 hectares requirement. Local governments and agricultural cooperatives also promoted this endeavor; thus, the establishment of community farming organizations has progressed throughout Japan.

The new policy was introduced in 2007; eventually, in the 2010s, the establishment of new community farming organizations slowed. The number of organizations has remained around 14,000 but has declined in recent years.

As in the rest of Japan, community farming organizations in the Tohoku region increased rapidly in the late 2000s and remained around 3,400 in the 2010s, representing about one-quarter of the total number of community farming organizations in Japan. The number of organizations with corporate status in the Tohoku region continuously increased, exceeding 1,000 in 2021 and reaching 1,015.

Activities of Community Farming Corporations in the Tohoku Region

When looking at the ratio of community farming corporations producing and selling agricultural products from 2016 to 2020, the rice ratio remained consistent, from 91.0% to 91.6%. Wheat, soybeans, sugar beets, and potatoes dropped 4.3 percent, from 68.7% to 64.4%. Other agricultural products increased by 7.3 percent, from 59.7% to 67.0%.

Most organizations produce and sell rice because many community farming organizations are located in paddy field areas; however, the ratio of organizations producing and selling other agricultural products is rising. This suggests an increase in producing and selling horticultural crops, which are less mechanized and require more labor than main crops, such as rice, wheat, soybeans, and potatoes, for which mechanization of the production process is advanced.

As described above, while the number of community farming organizations is leveling off, the number of community farming organizations with corporate status is increasing, and the range of crops grown by these organizations is broadening. Next, we extract recent trends by examining the advanced cases of community farming organizations in the Tohoku region to determine how management content is changing.

Analysis of Advanced Case in the Tohoku Region

Overview of K-Corporation

The case study is K-Corporation (K-Corp), a community farming organization in Yokote City, Akita Prefecture, established in 2010 by Mr. S (63 years old). Since its establishment, he has been the representative director by calling on farmers in his community. The total area of land managed by the K-Corp is 100 hectares. Members lease their paddy fields to the K-Corporation and receive 12,000 JPY per 10 hectares. When members engage in farming work performed by the K-Corporation, they are paid 800 to 1,000 JPY per hour; currently, 11 of the members, or 33%, are engaged in such work. The company employs five full-time workers from outside the company, four of whom are in their 20s, indicating that K-Corporation provides employment opportunities for young people.

In addition to major crops, such as paddy rice, soybeans, and wheat, the farmers grow edamame, green onions, watermelons, and more than 20 other vegetables.

While most Japanese farmers are members of agricultural cooperatives and sell their produce on consignment, K-Corporation has developed its own sales network and sells rice, buckwheat, vegetables, and other products directly to these cooperatives. The company also sells white rice, milled at its own facilities, and brown rice. In addition, the company has acquired the Japanese Good Agricultural Practice certification. In this way, K-Corp produces agricultural products, invests in facilities, and makes efforts to sell its products under favorable conditions.

K-Corporation has been expanding the size of its farmland by borrowing land from farmers leaving the surrounding area. As of 2010, the total area was 46 hectares, and it gradually

increased to 64 hectares by 2015. In 2016, the company hired a full-time employee from outside its membership, triggering a further increase in cultivated land under management, which reached over 100 hectares in 2017. During this time, the company began to work on new soybean, wheat, and horticultural crops.

Business Initiatives Targeting Local Communities

As the number of farmers continued to decline, Mr. S, the representative of K-Corporation, established a new corporation, N-Corporation (N-Corp), to engage in businesses other than agricultural production. K-Corp's corporate form, an agricultural cooperative corporation, is limited to agriculture-related businesses under the system. N-Corp comprises several sub-businesses:

The first is the outsourced farm work business, which undertakes mechanical work to produce soybeans and buckwheat from farmers in neighboring areas.

The second is civil engineering work related to agricultural resources, such as farmland and waterways, including the dredging and mowing of local agricultural drainage channels. This serves as the foundation for paddy field cultivation. Additionally, N-Corp rehabilitates abandoned farmland by cutting roots and clearing land, which K-Corp leases to grow soybeans, buckwheat, and wheat.

The third is the brokerage business to sell and purchase used agricultural machinery and equipment in anticipation of the increasing demand for used agricultural machinery and equipment no longer needed by farmers leaving their land.

These businesses are expected to become necessary in communities where farmers depart from farming. K-Corporation and N-Corporation are expected to grow as players in businesses meeting the needs of local communities outside of agricultural production.

Conclusion

The following points can be noted as new trends among community farming organizations in the Tohoku region.

First, many organizations are acquiring a corporate status and hiring full-time employees. Since full-time employment means fixed monthly labor payments, community farming organizations must increase their revenues to cover these costs.

Second, organizations tend to start or expand the cultivation of profitable horticultural crops that require relatively significant labor investment and crops, such as rice and soybeans, for which the production process is highly mechanized.

Third, they tend to take advantage of increased production to develop their own sales outlets and engage in marketing businesses.

Fourth, as the number of farm households continues to decline, there is a trend to respond to the growing needs of the local community, such as farm work outsourcing and civil engineering projects.

As described above, community farming organizations are evolving from organizations complementing farmers' management and maintaining farmland use in the community to integrated business entities that support the local community with agriculture at its core.

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Symposium mini review

The Challenges of Large-scale Farming Policy on Rice Growing Communities in Thailand

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Keywords
Group farming, Rice production, Rural community, Agricultural development, Joint-use fund

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Abstract

The Large-scale farming policy targeting rice producers have been promoted since 2017 in Thailand. Under the policy, many rice farmers' groups are established, but certain number of groups stopped their functions. The aim of this study is to discuss whether the concept of Large Land Plot of Rice (LLPR) is applicable to rice production in Thailand through addressing the following points: 1) Political background and specific characteristics of LLPR, and 2) Prospected Challenges of LLPR for applying it in Thailand.

The basic scheme of LLPR was succeeded from past rural development policies for grouping farmers and/or rural residences in Thailand. However, LLPR has a specific concept i.e., enhancing productivity through large scale grouping of rice producers. This concept was intended to reflect the demand of Thai society and economy. The fiscal burden of protective policies for rice producers is evoking a demand of enhancing rice productivity.

We used two cases of LLPR to show the actual situation, regarding the difficulties and possibility to overcome them. During implementation of LLPR scheme on the rice growing communities, the challenge was observed: malfunction of social network in local communities. These challenges cause troubles in consensus building and maintaining the scale of LLPR. However, in the case which had the system of investment from members, the group could involve all members and keep to extend their activities.

Introduction

Establishing farmers' groups for implementing policies is one of the approaches of rural development programs in Thailand. Since Prem administration (1980~1988) promoted the bottom-up rural development scheme which was called "Ko Cho Cho" in 5th National Economic and Social Development Plan, Thai Government has adopted the similar manner to the rural development policies (Shigetomi, 2000; Amekawa, 2016). Under the scheme, farmers' group can decide the usage of government support. Thus, even if one policy establishes some groups, the activities and management systems are different by groups. The scheme has been adopted to agricultural development programs also, and there are many kinds of farmers' groups for producing value added products, introducing sustainable farming system and enhancing market linkage (Petcho *et al*., 2019).

The ongoing policy for large-scale farming of rice farmers which is called "Large Land Plot of Rice (LLPR)" has established many groups of rice producers in the whole country. However, previous research revealed that there is malfunction of groups soon after their establishment (Uchook, 2019). On the other hand, though other researchers studied how the program contribute to enhancement of rice productivity, they could not confirm the clear contribution of LLPRs (Ohara *et al*., 2021; Sumonwan and Suneeporn, 2017). The discussion of previous studies shows the doubt regarding the applicability of LLPR scheme on the local rice growing

communities in Thailand. To discuss whether the concept of LLPR is applicable to the field in Thailand or not, we need to make clear the following points: 1) Political background and specific characteristics of LLPR, and 2) Prospected challenges of LLPR to be accommodated by rice growing community in Thailand.

Scheme of Large-scale Farming of Rice Production

LLPR was started in 2017 as a part of "The Five-year Agricultural Development Plan under The Twelfth National Economic and Social Development Plan (2017-2021)" (Office of Agricultural Economics, 2017). The purpose of LLPR is to enhance the productivity of rice through organizing large scale farmers' group and reduction of production cost. At the beginning of the program, 200 members and 480 ha of registered paddy was necessary (Office of Agricultural Economics, 2018), but the conditions were relaxed to 30 members and 48 ha (Ohara *et al*., 2021). About 3,759 LLPRs had been established and 590 thousand ha of paddy had been registered in the whole Thailand until March 2022. Around 60% of them were in Northeastern region, which is the most important production area of rice in Thailand (Department of Agricultural Extension, 2022).

The flow of establishment and operation of LLPR is as follows. First, a local government and branches of national agencies (e.g. Department of Agricultural Extension (DOAE) and Rice Department (RD) in the Ministry of Agriculture and Cooperatives) offer a local community to establish LLPR. The village decide activities, how to use subsidies, members and how much paddy they register, and report their decisions to the local government. After that, the agencies provide in cash and/or in kind supports to the group. The group operates services for its members with the government supports. The services are machinery sharing, joint shipment to millers and joint procurement of seeds and fertilizers, and their price are set lower than the market price. The similar scheme was also observed in the groups established in the past policies (Tanaka and Yasunobu, 2019). Thus, the basic scheme of LLPR was supposed to be succeeded from them.

The specific characteristics of LLPR compared to past rural development policies were its purpose (enhancing rice productivity) and approach (large scale grouping of rice producers). In the concept of LLPR, reduction of inputs and enhancement of unit yield was emphasized more than past policies. In addition, in contrast to past farmers' groups established in the unit of administrative villages, LLPRs covered multiple villages to secure the number of members and the area of registered paddy. These characteristics reflected the background of forming LLPR in the context of Thai society and economy.

Political Background of Large-scale Farming

The demand of enhancing rice productivity is becoming larger and larger in Thai society, and this trend is related to the fiscal burden of protective policy for rice industry. The policy for supporting rice industry was one of the main topics of political interest and the trend has accelerated since the beginning of 2000s. Until the middle of 1980s, price setting and distribution of rice were carried out on an open market, and Thai rice industry grew as a major exporter of rice in an international market against a backdrop of low input price (labor, materials and land) (Kouzaki, 1995; Fukui *et al*, 1993). After the rice pledging policy was started in 1986, the intervention of Thai government to the rice market was still limited.

However, from 2001 the rice pledging scheme was enlarged to support rice price and rural household's livelihood under the Thaksin administration (2001~2006). This policy became one of the causes for conflicting between urban and rural population (Tusmura, 2014). Since finishing the Thaksin administration because of the military coup, the direction of rice policy has repeated to expand and to withdraw depending on the change of regime (Inoue, 2019). In 2014, the rice pledging scheme promoted by Surayut administration stopped because of over fiscal burden and the direction of rice policy was changed to make rice farmers independent from government support in Prayuth administration. In spite of this declaration, the price support for rice producers has gradually re-increased since 2015 because withdrawing the support for rice producers might be the trigger of heavy repellence from residences in rural area (Inoue, 2021). To mitigate the burden of protective policy while keeping the position as a major rice exporter, it is necessary to enhance rice productivity and make rice producers independent from the government supports.

Challenges of Large-scale Farming Policy on Rice Growing Communities

We confirmed the difficulty and possibility to overcome it through the observation of 2 actual cases in the field. Both cases were located in Khon Kaen province, Northeastern region. We conducted face-to-face interviews to the leaders of them in 2018 and 2019. In the 1st case, when the group was established, 8 villages and 200 members joined but in 2019, the group was resolved and just 4 villages and 52 members were remained. Most of remained members lived in one village and members in the villages belonged to an existing farmers' group. As the leader said, the group was split because of the difficulty of consensus building and the scale of it became the same as the group established by the past policy. In contrast, the second case of LLPR succeeded in expanding the scale of its business. In the group, a main activity was lending of combine harvesters provided by government. At the beginning, the number of combine harvesters was not enough to roll all registered paddy, and the number of members who could use the service was limited. However, the group could gather investments from all members because the group distributed a part of group's revenue as a dividend to its investors to the group. Utilizing government support, revenue and investment from members, the group could conduct a capital investment to enlarge its business scale.

From the above, to locate LLPRs covering multiple villages can be a reason of make its management difficult. In the past policies, farmers' groups were established based on the unit on an administrative village (Shigetomi, 2000; 2006). In the functioned cases of the groups, existing social networks on the local community might contribute to decrease a transaction

cost on the group operation. On the other hand, under LLPRs which cover multiple villages, the social network seems not to function on the group management because each village has their own social network. the situation of 1st case might be caused by such kind of reasons. While, on 2nd case, the group could keep its scale and extend their activities. All members of the group joined not only joint-use of machinery, but also the investment to the groups and the members could be a kind of stakeholder. Preparing the easy way to join the group activities possibly contribute to keep the scale of rice farmers' group covering multiple villages.

Summary

LLPR was started in 2017 to enhance the productivity of rice through large scale grouping of rice producers. The basic scheme of LLPR was succeeded from the past rural development policies, but the policy has a specific concept: large scale farming for enhancing rice productivity. The specific concept reflected a demand of Thai society and economy. Because of the fiscal burden of protective policies for rice producers, a demand of enhancing rice productivity is becoming larger and larger.

For applying the concept of LLPR on the rice growing communities in Thailand, 2 obstacles were observed: diversity of members as rice producer and malfunction of social network on the community. These difficulties cause troubles regarding consensus building and keep the scale of LLPR. We observed 2 cases of LLPRs in Khon Kane province. One was a case where the group split and could not keep its scale, but the other was a case where the group could keep its scale and enlarged its business. The latter case had the system of investment from members and the system functioned to involve all members.

To apply the scheme of LLPR on the rice growing community in Thailand, it is inevitable to involve members who have various scales and intensions regarding rice production. To consider the manner to operate large scale group for rice production, it is necessary to understand socio-economic behaviors of each member and relationship between the behavior and the management of LLPR.

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Symposium mini review

Role of Farmers' Organisation in Rice Development: Lessons from Mwea

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Keywords
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Abstract

Farmers' organisations play an essential role in agriculture development, especially for smallholder farmers. Despite this crucial role, they have been plagued by challenges in governance and management. Governments in Sub-Saharan Africa recognise the importance of farmers' organisations. This study explains the role played by a farmers' cooperative in rice development in Kenya. The cooperative was critical to sustain the growth in rice productivity by providing credit and access to inputs including mechanised services and the development of rice milling which improve the quality of rice. Governments should pursue policies that strengthen farmers' organisations such as those regulating governance, aggregation, and value addition. Further, these organisations provide key avenues of providing support to farmers in case of crisis.

Introduction

The Kenyan government is pursuing agricultural transformation guided by the Agriculture Sector Transformation and Growth Strategy (ASTGS) 2019-2029. The ASTGS seeks to grow smallholder farmers' income, add value to agriculture and boost household resilience to climate change. If these objectives are achieved, the government aims to fulfil its role in providing food to consumers at an affordable price while producers remain profitable. Rice is the fastest-growing cereal in Kenya in terms of per capita consumption at 12% p.a. (MoALF&C, 2019). As such, the government developed the National Rice Development Strategy (NRDS) II 2019-2030 to guide the development of rice in the country. Both the ASTGS and the NRDS allocate significant roles to non-state actors such as the private sector and civil society groups to deliver the objectives of these strategies.

Rice is primarily produced under irrigated systems in Kenya. Approximately 80% of rice produced in Kenya is through public sector irrigation schemes. Smallholder farmers cultivate rice in these schemes. Upland rice cultivation is yet to take root in Kenya. The country has three rice-growing clusters, the western region, the central region, and the coastal region. Local production accounts for less than 10% of domestic demand, with a huge volume of imports coming from Asia, with Pakistan being the largest importing country of rice to Kenya.

Farmers' associations such as cooperatives and Farmer Producer Organisations (FPOs) have played a critical role in the development of agriculture. In Kenya, farmers' cooperatives are credited with the boom in coffee development, and more recently, in the dairy industry (KMT, 2022; GoK, 2022). However, they face challenges such as mismanagement, lack of competitiveness due to their bureaucratic structure, and other inefficiencies contributing to poor performance.

This study reviews the role played by a farmers' cooperative in the most successful rice production area in Kenya, Mwea Irrigation Scheme (MIS). The paper explains the development of rice growing in Mwea, highlighting the success and challenges faced by the farmers' cooperative. The study provides lessons and implications for strengthening farmers' cooperatives not only for rice in Kenya and the region but for other commodities.

Role of farmers' organisations in the development of rice production in Mwea

Mwea Irrigation Scheme was established in 1954. The scheme area has approximately 12,000 ha solely under rice cultivation, producing approximately 80% of the paddy rice produced in Kenya. In the past, the government had controlled production and marketing of rice, until 1999 when rice

production was liberalised. Farmers were initially allocated four one-acre parcels of land per household (1.6 ha), but some farmers have since bequeathed their land (use rights) to their offspring.

Under state management, the MIS was managed by the state through an agency, the National Irrigation Authority (NIA) (formerly National Irrigation Board). The NIA provided farmers with inputs such as seeds, fertilizers, other chemical inputs, and farm machinery services. In addition, its field agents provided necessary knowledge about rice production to farmers through regular field inspections. Farmers had to strictly adhere to a one-crop-per-season-per-year cropping calendar which ran from June to November. After harvesting, farmers were allocated a quota of the harvest for their own consumption, and the remaining harvest would be delivered to the NIA. The NIA ran a mill, the Mwea Rice Mills (MRM) as a subsidiary company. MRM would mill and sell rice and remit revenue to NIA. Farmers would then receive the revenue from the NIA after it deducted the cost of inputs and irrigation fees from the sale revenue of rice.

In the post-liberation era, Mwea Rice Growers Multipurpose (MRGM) Cooperative took over some key functions of NIA. The cooperative, established in 1964, for the purpose of saving and loaning members, took over the input distribution functions from NIA, and milling and marketing functions from MRM. With the cooperative taking over these functions, the rice production in MIS has developed. It is estimated that about 40% of farmers in MIS are members of MRGM.

In Kenya, although the agriculture sector dominates the economy, commercial lending to the sector has remained very low at 4% (Kenya Bankers, 2018). Wainaina *et al*., (2017) showed that demand for agricultural credit was very high among smallholders. Cooperative societies have responded to this demand to be the leading lender of agricultural credit to smallholders. In MIS, the MRGM provided inputs such as seed, fertilizer, and mechanised inputs to farmers. Njeru *et al*., (2016) demonstrated that credit from MRGM allowed farmers to register high productivity, surpassing that of Asia at the highs of the Green Revolution. Njeru (2012) showed that farmers in MIS used high amounts of fertilizer and attained high yields. Farmers who could not access credit from MRGM paid high-interest rates from credit from traders, potentially limiting their growth. At present, MRGM provides services to non-members but on a cash basis. This demonstrates that the cooperative has also grown to be a service provider competing with the private sector service providers in MIS.

MRGM has also been used its structures to train farmers on rice production technologies. Due to the larger number of farmers who are its members, it has received support from development partners such as JICA to disseminate technologies such as water-saving rice cultivation practices. MRGM has also received a grant of combine harvesters which eliminate the harvest losses registered when farmers used a log-and-thrash method. In addition to the cost and time saved for this activity, there have been cases where harvest yields have been improved by 30% by using combined harvesters

MRGM has also been an avenue to government support to farmers. For instance, during the Covid 19 pandemic, the government provided producer price support through the cooperatives. This was useful in cushioning farmers against the adverse effects of the pandemic. Moreover, MRGM has been able to mobilise its farmers to access subsidised fertilizer in the past.

Mano *et al*., (2022) showed that the MRGM was also very critical in the development of rice milling in MIS. The quality of rice is affected by the quality of milling. MRGM played a key role in learning and diffusing rice milling technologies to other millers in MIS. MRGM learnt the use of destoners and colour sorters in the milling process. They also trained mill operators who were poached to work for other rice millers. MRGM has kept its doors open to other millers to learn from them, and overall, the quality of rice from Mwea has significantly improved. In addition, MRGM developed its own brand for milled rice sold to urban consumers. Other millers also established their brands to sell milled rice.

It is important to emphasise that the critical role played by MRGM would not have been possible without good governance. MRGM has experience challenges in the past as shown by Njeru (2012), when some farmers stopped delivering rice to the cooperative due to delays in payment. However, in overcoming governance and management challenges, MRGM was able to be central to rice development. This is consistent with the plan by the government to strengthen farmers' organisations including cooperatives to enhance value of agricultural output (GoK, 2022).

Summary and conclusions

Farmers' associations can be very useful in the development of agricultural value chains. This study explains the essential role played by a farmers' cooperative in the development of rice production in Kenya. This role is similar to that played by cooperatives in other value chains such as dairy. To sustain this role, good governance of cooperatives remains critical. The government should therefore pursue policies aimed at strengthening the management of farmers' associations. In Kenya, such policy is being pursued through amendments to the Cooperative Act. Further, public goods investments that support farmers' associations such as aggregation and value addition will sustain the development of value chains and the roles played by these associations. The Warehouse Receipts Systems (WRS) Act, and Commodity Exchange (COMEX) bill, are examples of such policies. Opportunities lie in the operationalisation of the Acts.

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Symposium mini review

An Overview of the Impacts of Food Security Programs in Ethiopia

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Abstract

In spite of the rapid economic growth in Ethiopia, poverty and food insecurity are still persistent problems. Repeated drought and other shocks forced a large number of people to remain chronically food insecure and dependent on humanitarian relief. Changes to emergency food aid provision have been made to make it development-oriented and productive. In response to this, the productive safety net program (PSNP) and household asset-building programs (HABP) have been implemented since 2005 and 2010 respectively. Therefore, the objective of this paper is to give an overview of Ethiopia's food security programs particularly the impacts of PSNP and HABP on beneficiary households. Reviewed studies indicated that the food security programs have brought positive impacts on beneficiaries through improving household food security, reducing distress assets sales, smoothing consumption, and improving resilience to shocks, but failed in building assets and improving nutritional status. However, this paper is limited in its depth and scope to make generalization on the impacts of PSNP and HABP on beneficiary households. Thus, further in-depth, and systematic review of studies on the impacts of food security programs not only at household level but also at community level remain important to understand multiple aspects of food security program outcomes.

Introduction

Ethiopia is Africa's second most populous country with a population of 110 million in 2019 (World Bank, 2020). Agriculture is the most important sector which accounts for 80% of exports, 40% of the GDP, and 75% of employment (Cochrane and Bekele, 2018). Despite rapid economic growth since 2005, poverty and food insecurity are still persistent problems. Repeated drought and other shocks forced large number of people to remain chronically food insecure and dependent on humanitarian relief. Even though humanitarian aid can help save lives, it is often unable to help households to pull out from poverty trap (Béné *et al*., 2012). This paper aimed to show an overview of Ethiopia's food security programs particularly PSNP and HABP and their impacts on beneficiary households through making a review of journal articles, program evaluation reports, and discussion papers.

Food security Programs in Ethiopia

Before 2002, the intervention to chronic food insecurity was mainly emergency food assistance. In order to shift emergency food aid to development aid, Ethiopia's Food Security Programme (FSP) has implemented PSNP in 2005 and HABP in 2010 (GFDRE, 2010). PSNP aimed to smooth food consumption and prevent distress sales. It has two main components: i) public works (temporary employment). ii) direct support (direct transfers of cash or food to not able-bodied vulnerable groups) (GFDRE, 2009).

In sub-Saharan Africa, Ethiopia's PSNP is the largest social protection scheme with about 8 million beneficiaries which accounts for about 10% of its population and covers 290 chronically food-insecure districts (Desalegn and Ali, 2018). Targeting of beneficiary households have been made using both geographic and community-based methods.

Impact of Food security programs

Studies showed that food security programs particularly PSNP and HABP have brought significant impacts on beneficiaries such as improving food security (Berhane *et al*., 2015; Gilligan *et al*., 2009; Hailu & Amare, 2022), reducing distress sales of assets (Sabates-Wheeler *et al*., 2020), smoothing consumption (Feyisa, 2021; Welteji *et al*., 2017)

and improving shock resilience (Knippenberg and Hoddinott, 2017).

Different studies showed that PSNP had positive effects on improving household food security (Berhane *et al*., 2015; Gilligan *et al*., 2009; Hailu & Amare, 2022). According to Sabates-Wheeler *et al*. (2020), PSNP lowered the food gap of beneficiaries by 0.5 months. PSNP membership has also improved households' calorie intake (Abebaw *et al*., 2010; Hailu & Amare, 2022; Zerhun Ganewo Galato, 2020), diet quantity and dietary diversity (Berhane *et al*., 2015; Irenso & Atomsa, 2018). By contrast, studies by Berlie (2014) and Gebrehiwot & Castilla (2019) find that PSNP had no significant impact on household dietary diversity. There is no clear evidence on the impacts of food security programs on nutritional status. Even though Debela *et al*. (2015) and Porter & Goyal (2016) showed PSNP short and medium term positive nutritional effects, other studies did not find evidence on nutritional improvement of beneficiaries (Bahru *et al*., 2020; Berhane *et al*., 2015; Gebrehiwot & Castilla, 2019).

PSNP improved the resilience of households to the impacts of shocks (Knippenberg & Hoddinott, 2017). Kibrom *et al*. (2020) showed that the incidence of household food insecurity due to COVID-19 was lower on PSNP beneficiaries than non-beneficiaries. The food gap from August 2019 to June 2020 increased by 0.5 month for non-beneficiaries whereas for PSNP beneficiaries was 0.1 month. PSNP has played a protective role for reducing the impacts of the pandemic and making the beneficiaries resilient. Program participation also helps to reduce distress sales of assets. A longitudinal study by Sabates-Wheeler *et al*. (2020) showed public work beneficiary households that reported making a distress sale of livestock had fallen from 54% in 2010 to 25% in 2014. Households used the cash transfer, which they received from public work, to meet their food needs during shocks. However, the pace of asset accumulation is not faster. The programs have not showed significant impact on improving agricultural input use, adopting new technology and increasing yield (Bahru & Zeller, 2022; Berhane *et al*., 2015; Hoddinott *et al*., 2012). On the other hand, Adimassu & Kessler (2015) find PSNP improved soil fertility management practices.

The impacts of food security programs have also showed differences depending on the type of transfer (cash/food) and the access to both programs (PSNP and HABP). According to Sabates-Wheeler & Devereux (2010), households receiving either food or both food and cash transfer had better food security, income improvement, and livestock ownership than households receiving cash transfer alone. On the other hand, Baye *et al*. (2014) find that cash transfer has enabled better improvement on household dietary diversity than food transfer. Households that participated in both HABP and PSNP showed higher fertilizer use and agricultural investment than PSNP alone (Hoddinott *et al*., 2012).

Constraints and Challenges

Despite its positive outcomes, the food security programs have underperformed in building assets and improving nutritional status (Andersson *et al*., 2011; Gebrehiwot & Castilla, 2019). The amount of payment is inadequate to facilitate asset accumulation and unable to graduate beneficiaries from the programs (Sabates-Wheeler *et al*., 2020). The programs are highly dependent on donors' support which covered 60% of social protection expenditure in 2015/16 (Endale *et al*., 2019) and 82% of financing for the PSNP in 2017/18 (UNICEF, 2019). However, the government had made a commitment to hand over programs by its budget in 2014 but it did not. Repeated occurrences of drought, conflict and pest infestation are exacerbating the problems of chronic food insecurity which results in an increase in beneficiaries (Béné *et al*., 2012; Knippenberg & Hoddinott, 2017).

Conclusions

Food security programs helped to protect vulnerable households from destitution and severe food shortage by improving their food security. However, the programs had little impact on asset accumulation and nutritional status. Further study on the impacts of food security programs on nutrition, agricultural production and infrastructure development should be done. This paper is limited in its depth and scope focusing only on PSNP and HABP and their impacts on beneficiaries to give an insight. Given these limitations, we recommend in-depth and systematic review of studies on the impacts of food security programs not only on households but also on community needs to be done to get a full picture.

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Symposium mini review

The Current Situation of Export-oriented Horticulture Production in Kenya and its Implications for Rural Development

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Keywords
Horticulture exports, rural development, market-driven, private sector

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Abstract

Kenya embraced agricultural diversification as part of agriculture reforms since 1980s. These reforms were popularized by market-oriented and private sector driven exports of non-traditional crops such as horticulture. At the time, the country was experiencing failing traditional exports (tea and coffee), declining GDP, and falling agricultural productivity. Diversification into horticulture aimed at giving opportunities in employment and self-employment for rural households. Consequently, the sector has been pivotal in commercialization of smallholder farming and provision of social and economic outcomes to farmers. Nonetheless, the sector also highlights some of the shortcomings of a market and private-sector driven development and its potential to diminish the benefits targeted for the rural poor. Therefore, in this report we give an overview of the current situation and emerging issues in the export-oriented horticulture sector in Kenya.

Introduction

Agriculture is important in Kenya because of the role it plays in the economy i.e., contributing 27% of the GDP and 65% of the total export earnings. Agriculture support millions of livelihoods through income, employment, and food security needs. In Kenya, half of the population is still living below poverty line and 36.5% of total population is food insecure (World Bank, 2018). Moreover, over 70% of the population living in the rural areas depends on smallholder Subsistence farming, which makes the status of Kenyan agriculture important.

Kenyan agricultural productivity is still low over the last few decades with the only economic dynamism seen in the horticulture sector (World Bank, 2018). Dynamism in horticulture is the result of agricultural reforms in the 80s, which aimed to accelerate growth and development through private sector and market-driven export of non-traditional crops (Gertz, 2007; Tyce, 2020). The reforms targeted to raise productivity by integrating smallholder farmers in export markets and create job opportunities.

Therefore, rural households take part in export-oriented horticulture production as laborers or as production for large-scale farms (Dolan, 2001; Jaffee, 2003; Neven *et al*., 2009). The main horticultural exports are vegetables, fruits, and flowers, with small holder farmers accounting for 70-80% of the total export value of vegetable and fruits exports, compared to only 5% for flower exports (Heher & Steenbergen, 2021). Job creation is estimated to supply over 350,000 jobs directly and supports over 6 million people in the different stages of the supply chain (KNBS, 2020).

Conversely, lack of bargaining power in the crucial decisions of production, prices and wages could diminish social and economic benefits in target. In this report, we give an overview of the current situation of export-oriented horticulture in Kenya and implications for rural development. The scope of the discussion will cover (1) production dynamics (2) as a tool of rural development (3) Supply chain governance and power dynamics.

The report was prepared using review of literatures found in Web of Science database and Google Scholar. However, we acknowledge that we have not adopted a systematic review that allows for deeper analysis and discussion. In addition, the discussion raised here might not be representative of all contemporary issues in this topic, and there are other aspects not covered in the report, such as environmental implications.

Production dynamics

Smallholder participation in exports is popularized by different contract schemes. Farmers must secure the capital investment and infrastructure such as irrigation, machinery, and postharvest technologies to secure a contract (Ashraf *et al*., 2009; Dolan & Humphrey, 2000; Gichuki *et al*., 2020; Tallontire *et al*., 2014). This acts as an assurance of capacity to meet year-round demand and strict market requirements regarding quality (Rao *et al*., 2012). In absence of that, the increase in urban markets and supermarkets has led to the emergence of middle-income farmers. Like export production, urban and supermarket channels are governed by contract schemes and requires capital investment and infrastructure to produce throughout the year. The only difference is that the risk is lower compared to the export markets (Ashraf *et al*., 2009; Neven *et al*., 2009).

The transition from subsistence farming to commercialized supermarkets or exports markets depends on the ability of productive assets, quality requirements and securing a contract with the buyers (Ashraf *et al*., 2009; Fibaek, 2021; Neven *et al*., 2009). Sometimes farmers exit if they are unable to meet markets requirements or if the returns are low. Lack of strong contract enforcement may be possible when one party fails to honor the contract or does not follow through in case of crop or market failure (Gichuki *et al*., 2020; Tallontire *et al*., 2014).

Horticulture exports as a tool for rural development

IFAD (2006) defines rural development as a strategy designed to improve the economic and social aspects of the rural poor. In this context, economic outcomes are realized through raising farmer incomes, jobs creations and market access. The greatest impact of horticulture exports is wage employment (Ulrich, 2014; Fibaek, 2021), and raised productivity in smallholder farming can increase the income up to fivefold (Dolan & Humphrey, 2000 and Rao *et al*., 2012). Finally, increased market access opportunities both regionally and overseas has enhance farmers capability to produce for different markets simultaneously (Ashraf *et al*., 2009; Krishnan, 2016; Neven *et al*., 2009).

The social outcomes include building of human, social and physical capitals. Human capital manifests in an expanding wage-earning class with various employment benefits depending on the nature and tenure contract (Ulrich; 2014). Inclusivity of vulnerable groups i.e., youth and women (make up 70% of the total workers) (Dolan, 2001) touches on gender emo. However, this is different in the case of smallholder contract farming where participants are often distinguished by wealth and household characteristics such as age, education, and often male headed households (Muriithi & Matz, 2015; Neven *et al*., 2009).

Unbalanced power dynamics lead to exclusion the poor and vulnerable

Rural development strategies need to be inclusive i.e rural populations should be able to develop capabilities and take advantage of opportunities available in their environment. This is critical in improvement of quality of life of resource-poor smallholder farmers, workers, women, youth, and marginalized groups (IFAD, 2016).

Unchecked control of the private sector could diminish benefits of the resource poor smallholder farmers (Tallontire *et al*., 2014). Increased vertical coordination along the supply chains gives buyers absolute control of how export crops are produced and supplied (Asfaw et., al, 2010). In some cases, buyers have a list of their preferred suppliers who must adhere to very strict and costly food safety and quality requirements. As a result, the buyers can adjust prices and product supply with or without regards of the contracts stipulations (Dolan & Humphrey, 2000; Jaffee, 2003; Neven *et al*., 2009).

Similarly, wage employment in large- scale export farms often associated with low wages, poor working conditions, long working hours, gender division of labor and lack of worker representation (Fibaek, 2021; Ulrich, 2014). Some buyers have put initiatives such as enforcement of ethical standards in advocacy for better wages and working conditions (Ehlert *et al*., 2014). However, these standards are often voluntary and only raise wages slightly above or equal the subsistence level (Dolan & Humphrey, 2000; Ehlert *et al*., 2014). As a result, horticultural exports can only be associated with higher incomes and not wealth creation (Muriithi & Matz, 2015).

Conclusion

Export oriented production contributes to agriculture and rural development. Rural households have generated higher incomes and build social capitals like education, skills, and technology. Incorporating the vulnerable groups is a step towards inclusive development goals, however, they only raise incomes and hardly build wealth for the long-term. Further, the inability to raise the capital and infrastructure required to meet the demand and strict market requirements shifts the goal further. Finally, unbalanced power dynamics between poor resource farmers and buyers diminish their ability to bargain for better prices, higher wages, and better working conditions.

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The 19th International Symposium of the Integrated Field Science Center

複合生態フィールド教育研究センター 第 19 回国際シンポジウム

Trends and Prospects on the Policy for Rural Society and Farm Management-Comparative Research Between Asia and Africa

Date and Time:	**February 8th, 2022 (Tue)10:00 – 16:45 JST**
Venue:	**Online**
Language:	**English**
Participation fee:	**Free**
Organized by:	**Field Science Center, Graduate School of Agricultural Science, Tohoku University**

To register, go to the link below, or scan the QR code.

The login link will be sent to your email address.

Link (Microsoft Teams): https://bit.ly/3IMPqX9

Program

Registration and Opening (10:00 ~ 10:40 JST)

10:00 ~ 10:35 Online Registration

10:35 ~ 10:40 Opening Remarks
(**Dr. T. Sumita**)

Session 1: Young Researchers Session (10:40 ~ 12:20 JST)

Group 1: Chairperson: **Yuan Meng**

10:40 ~ 10:50 Hanzhong Liang (*Laboratory of Agricultural Economics and Farm Management*)
Empirical Analysis of the Low-Carbon and Circular Agriculture Pilot Policies' Impact on Agricultural Greenhouse Gas Emissions Based on DID Model—A Case Study of Zhejiang Province, China

10:50 ~ 11:00 Thi Cam Van Nguyen (*Laboratory of Field Science and Technology for Society*)
Smallholders Inclusion in Staple Food Contract Farming: Collective Action Approach and its Impact on Farmers Income in Vietnam

11:00 ~ 11:10 Arsénio Agostinho Mutatisse (*Laboratory of Field Science and Technology for Society*)
Analysis on banana consumers' attitude: Exploring farmers' local markets in response to exports restrictions in Mozambique

Group 2: Chairperson: **Thi Cam Van Nguyen**

11:10 ~ 11:20 Yuan Meng (*Laboratory of Agricultural Economics and Farm Management*)
Attitude and intentions related to blood tests for Enzootic Bovine Leukemia virus: Targeting small-scale breeding farmers in Miyagi Prefecture

11:20 ~ 11:30 Shin Tan (*Laboratory of Land Ecology*)
Investigating the effects of bedding cleanliness on sleep-like posture of Japanese Black fattening cattle

11:30 ~ 11:40 Dr. Muhammad Shahid Riaz Rajoka (*Laboratory of Animal Food Function*)
A Study of immunoregulatory mechanism of exopolysaccharide producing immunobiotics to develop novel Immunosymbiotics

Group 3: Chairperson: **Hanzhong Liang**

11:40 ~ 11:50 Masaya Saito (*Laboratory of Field Science and Technology for Society*)
Examining the applicability of UAV and satellite remote sensing data for soybean cultivation

11:50 ~ 12:00 Ye Rongling (*Laboratory of Crop Science*)
Feasibility of intraspecific mix cropping in Japan - Trials with soybean lines in Kawatabi Field Center

12:00 ~ 12:10 Midori Nawano (*Laboratory of Field Science and Technology for Society*)
Evaluation of temporal transition of Chlorophyll-a concentration observed by GCOM-C/SGLI in Onagawa bay

Discussion on Session 1 (12:10 ~ 12:20 JST)

12:20 ~ 13:00 Break (40 minutes)

Session 2: Trends and Prospects on the Policy for Rural Society and Farm Management-Comparative Research Between Asia and Africa (13:00 ~ 16:45 JST)

13:00 ~ 13:05 Welcome Address
(**Dr. Ogura:** *Field Science Center representative*)

Group 1: The policy for rural society and farm management in Japan
(Chairperson: **Dr. Magezi)**

13:05 ~ 13:25 Shunsuke Yanagimura (*Setsunan University*)
Structural Problems and Rural Policy in Japan

13:25 ~ 13:45 Tsuyoshi Sumita (*Tohoku University*)
The relation between the farm and community

13:45 ~ 13:55 Katsunori Nakamura (*Akita Prefecture University*)
The new trends on community farming in Tohoku Region

Group 2: The policy for rural society and farm management in Asia
(Chairperson: **Mr. Gu)**

13:55 ~ 14:15 Yuki Toyama, Asres Elias Baysa, Kumi Yasunobu, Utaranakorn Panatda and Supaporn Poungchomp (*Khon Kaen Univ., Tottori Univ.*)
The challenges of large-scale farming policy in the rice-growing community in Thailand

14:15 ~ 14:35 Mohammad Rondhi (*University of Jember, Jember, Indonesia*)
A Case Study of Klambu Wilalung and Klambu Kiri Irrigation System in Indonesia

14:35 ~ 14:55 Jia Lei (*Shanghai Academy of Agricultural Sciences*)
The current situation and challenges in rural revitalization in China

14:55 ~ 15:05 Break (10 Minutes)

Group 3: The policy for rural society and farmers' organizations in Africa
(Chairperson: **Mr. Mutatisse)**

15:05 ~ 15:25 Timothy Njagi (*Tegemeo Institute of Agricultural Policy and Development, Egerton University*)
The role of farmers' organization on the irrigation management in Mwea District, Kenya

15:25 ~ 15:45 Alena Yidnekachew Merkeb, Asres Elias Baysa and Kumi Yasunobu (*Tottori University*)
Food Security Programs and Social Protection in Ethiopia

15:45 ~ 16:05 Jane Githiga, Asres Elias Baysa and Kumi Yasunobu (*Tottori University*)
The current situation of rural development and local food production

16:05 ~ 16:10 Break (5 Minutes)

Discussion on Session 2 (16:10 ~ 16:30 JST)

16:30 ~ 16:40 Announcement of the IS-IFS Best Presentation Award to an outstanding presentation in the Young Researchers' Session.
(**Dr. Keeni**)

16:40 ~ 16:45 Closing Remarks
(Dr. Magezi)

The current situation and challenges of Rural Revitalization in China

Jia LEI

Shanghai Academy of Agricultural Sciences

Agricultural production in China has been conducted in a fragmented small scale for a long time. Since the reform and opening up in 1978, China's agricultural sector has undergone a significant transformation. With agricultural policies being mainly revolved around production-oriented and focused on growth, the agricultural production increased at an average rate of 5.4% per year between 1978 to 2019. These policies have successfully guaranteed the supply of agricultural products and improved food security. However, the production-oriented agricultural policies have also led overuse of chemical fertilizers and pesticides that caused land degradation and environmental pollution, as well as food safety problems. In addition, prioritizing urban development while neglecting rural areas in the past few decades has contributed to a rapid economic growth, but this urban biased development has caused uneven regional development. The income inequities have intensified with exceeding the ratio of 3.3 to 1 in 2009, despite the fact that disposable income has grown in both urban and rural areas. Other problems in rural area emerged as the declining and aging of populations, disappearing of villages and depletion of natural resources. In order to tackle the problems mentioned above as well as to promote the sustainable development of agricultural production and its rural area, the Rural Revitalization strategy was initiated by the central government in 2018. The strategy is not limited to improving agricultural production and economy, it also put great emphasis on supporting rural development. According to the Strategic Planning for Rural Revitalization (2018–2022), a fully revitalized rural area would meet the following five goals: thriving businesses, pleasant living environments, social etiquette and civility, effective governance and affluent life. Regarding the implementation of the Rural Revitalization, provincial-level government usually introduces more detailed policies or action plans according to different local conditions, which includes approaches such as improving rural infrastructures, promoting industrial integration, tackling environmental pollution, exploring traditional culture, among other approaches. Based on a case study in Shanghai, we illustrated how Shanghai implemented the rural revitalization strategy by launching pilot projects of building a Rural Revitalization model village, addressed its challenges as well as put forward the topics that need to be taken into consideration for future research.

Empirical Analysis of the Low-Carbon and Circular Agriculture Pilot Policies' Impact on Agricultural Greenhouse Gas Emissions Based on DID Model
– A Case Study of Zhejiang Province, China

Hanzhong LIANG and Keiichi ISHII

Graduate School of Agricultural Science, Tohoku University

At the 2021 Leaders Summit on Climate, leaders from various countries made their statements and commitments about reducing greenhouse gas (GHG) emissions. At the summit president Xi Jinping announced that greenhouse gas emissions by China would be reduced over 60% relative to the level of 2005 by 2050 and reaffirmed its pledges to peak the emissions by 2030 and reach carbon neutrality by 2060. In order to better achieve the goals related to energy conservation and reducing GHG emissions in agriculture, Ministry of Agriculture of People's Republic of China in 2015 made Zhejiang Province the first national low-carbon and circular agriculture pilot province. Specialized policies were conducted in Zhejiang Province for reducing the use of chemical fertilizers in agriculture, improving the efficiency of using chemical fertilizers and pesticides, popularizing low-emission agricultural machinery, and basically realizing the resource utilization of livestock and poultry waste and the harmless treatment of livestock and poultry waste.

Based on the panel data of the 20 cities in treatment group (Zhejiang Province) and control group (Hubei Province) from 2011 to 2020, the agricultural GHG emission of each city was estimated. In order to overcome the endogenous problem of the sample selection and the exogenous problem of other macroeconomic policies, this research adopted the difference-in-difference model to assess the effect of pilot policy on GHG emission in different cities and analyze the reasons.

The empirical results showed that after taking into account variables such as income level, rural employment and average power of agricultural machinery, agricultural GHG emissions in Zhejiang Province decreased by an average of 6.681 million tons after 2015, compared with Hubei Province, driven by the Low-Carbon and Circular Agriculture Pilot Policies.

According to the results of the analysis, the estimated value of the policy treatment effect is negative and the significance level is 1%, indicating that the pilot policy has a significant reduction effect on the agricultural GHG emissions in Zhejiang Province. Specifically, 6.681 million tons of the 8.18 million tons reduction in the average agricultural GHG emissions in Zhejiang Province after 2015 came from the treatment effect of the pilot policy.

However,the research can only examine the impact of the pilot policy related to agriculture GHG emissions and cannnot assess the specific impact of the policy on farmers during its implementation. And agricultural GHG emissions can be effectively reduced by increasing forced transformation of agricultural system are likely to harm farmers' interests in the process of policy implementation. With the breakthrough of data and methods, the relevant shortcomings of this research are to be explored in depth by subsequent studies.

Smallholders Inclusion in Staple Food Contract Farming : Collective Action Approach and its Impact on Farmers Income in Vietnam

Thi Cam Van NGUYEN, Eustadius Francis MAGEZI and Tsuyoshi SUMITA

Graduate School of Agricultural Science, Tohoku University

Contract farming (CF) is considered a solution to address market imperfections in linking farmers to markets by reducing transaction costs in agricultural production. However, only about 5 percent of smallholder farmers in developing countries are participating in CF schemes. This suggests that for CF to have a broad contribution to poverty reduction and increase small-scale farmers' income, it needs to be included in many developing countries. One of the promising smallholder CF schemes is the Large Field Model (LFM) which was introduced in Vietnam in 2011, in which smallholder rice farmers pooled their land, formed cooperatives, and made production contracts with agribusiness firms.

The goals of this study are to identify key factors that influence farmers' decisions to participate in contract farming under LFM and whether it has a positive impact on farmer household income by employing econometric approaches and estimation tools to provide empirical estimates of collected data.

According to the summary statistics from 102 samples collected in the study area, the majority of farming household heads are elderly males with extensive experience in rice farming. All of our respondents, regardless of CF status, are small-scale farmers, with each household cultivating an average of 0.28 hectares of paddy land.

The main outcomes of this study are as follows : First, the findings show that contract farmers have less experience, own more cultivated area, and have paddy fields further from the main road than non-contract farmers, whereas no significant difference was found in age, education level, and gender of household head as well as a number of rice plots between two groups. Second, despite the fact that participating in CF is associated an increase in fertilizer, crop establishment, and pest control costs, our investigation suggests that LFM contract farming results in higher paddy yield, revenue, and income from rice cultivation for small-scale farmers. Regarding household income, we find that CF is negatively related to non-farm agricultural income and overall household income, suggesting that non-contract farmers reinvest in non-farm income opportunities. Third, because the magnitude of CF impacts varies by village, this study adds to the body of knowledge on the heterogeneous effects of contract farming on the same crops but under different agreements.

Analysis on Banana Consumers' Attitudes : Exploring Farmers' Local Markets in Response to Exports Restrictions in Mozambique

Arsénio Agostinho MUTATISSE, Eustadius Francis MAGEZI and Tsuyoshi SUMITA

Graduate School of Agricultural Science, Tohoku University

Banana is the third major produced fruit in Manica, central Province of Mozambique, just after avocado and litchi. In 2020, 86% of its production in the country was exported. Following the restrictions on exporting fruits, established in 2008 and following years, due to fruit fly invasive pest in the country, large farmers had to share local markets with the already weakened small ones for local consumers. However, even after lifting the exportation restrictions, an understanding of local fruits (banana) consumers' attitudes is crucial, as it can contribute on the prevention of the similar market ''disturbance'' or ''unfair'' competition in the near future. In this research, a Multinomial Logit Model (MLM) approach is used to analyze the banana consumers' attitudes in Chimoio, a capital city of Manica, and central province of Mozambique.

Using a structured questionnaire, 234 consumers were interviewed (retrieved from approximately 372,821 people living in the city, according to 2017 National Census), in July, 2017 and data analyzed at SPSS 16.0. The sample was characterized as having : 58.5% of female and 41.5% of male ; 73.3% were at the age of 21 to 40 years old ; 72.7% were enrolled or finished either High School or University and 51.3% practiced remunerable activities. Six categories of banana price were set and used as dependent variable. Using the conventional α=0.05 threshold, the following predictors (independent variables) : age, gender, education, occupation/ remuneration status, selling place, buying criteria and ripping stage were found significant, while the consumption frequency, type of banana and price evaluation were not, although this last was found ''near significant'' (α=0.069).

The model suggests that the buying/selling place is the major predictor variable, however data findings suggests that lower prices (corresponding to lower banana quantities) are more likely to be found in local informal markets. Consumers with the tendency of having higher education are less likely to buy banana at lower prices. Occupation/performing remunerable activities were also found as major predictors, however their influence decreases at higher prices. At higher prices , all predictors (variables) become less likely to influence consumers' attitudes towards banana consumption, which might suggest that more research should be done for this market segment, either in Chimoio or other cities in Mozambique, as their findings might suggest other consumers' attitudes and/or behavior, information that can be crucial in policy development, aiming to link small farmers with the markets.

Keywords : Consumers' attitudes; Local markets; Multinomial Logit; Chimoio; Mozambique

Intentions Related to Blood Tests for Enzootic Bovine Leukemia virus: Targeting Small-scale Breeding Farmers in Miyagi Prefecture

Yuan MENG and Keiichi ISHII

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In recent years, the prevalence of enzootic bovine leukosis (EBL) has increased worldwide. In Japan, the number of EBL cases caused by bovine leukosis virus (BLV) infection has multiplied, causing significant economic losses. There is no treatment for EBL, and no vaccine is currently available. Thus, prevention of disease is now the only way to control the spread of BLV. Blood inspection is the first and most crucial step in eradication measures.

In Japan, beef cattle are of high value, and the economic loss to farmers is very high because cattle infected with BLV have no treatment and must be culled. Breeding farms are risking infection both in cows and newborn calves. However, it is difficult for small-scale breeding farmers to take extensive BLV eradication measures, especially blood tests, because of limited finance and space. In Miyagi Prefecture, the majority of breeding farms are small-scale farms. Therefore, it is essential to clarify the current status of blood inspection activities in small-scale breeding farms and establish mechanisms to encourage them to start controlling BLV from adopting blood tests.

This study aims to clarify the factors that influence the intentions to perform blood tests of BLV among small-scale breeding farmers. A questionnaire survey was carried out among the small-scale breeding farmers through the assistance of NOSAI Miyagi, and 156 answers were valid. The questionnaire covers primary farm attributes and the current implementation status of BLV prevention measures such as blood tests. In this study, we adopted factor analysis and Binary choice model to analyze the variables to influence the intentions to perform blood tests targeting small-scale breeding farmers.

A factor analysis was conducted, and six factors were extracted. Each factor was named as [Management Risk], [Knowledge of BLV], [Appropriate Feeding], [Penalties], [Requests] and [Incentives]. Next, Binary choice model was used to analyze the intentions to perform blood tests. As a result of the analysis, it is found that the [Management Risk], [Penalty], [Requests], and [Incentive] factors positively influence the adoption behavior of blood tests by farmers at a statistical level of respectively 1%, 1%, 10% and 1%. Among the farm attributes, [household income], [feeding pattern], and [willingness to pay of PCR test] variables were found to influence farmers' intentions to adopt blood tests.

The results show some penalty policies related to eradication measures are necessary to strengthen the intention to implement blood tests. Veterinarians and specialists should promote BLV eradication measures to enhance the knowledge and manage risks of BLV for breeding farms. Moreover, it is essential to encourage farmers to test through incentive measures such as lowering or compensating the fees for blood tests.

Investigating the Effects of Bedding Cleanliness on Sleep-like Posture of Japanese Black Fattening Cattle

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When cattle are lying with their heads touching their bodies or ground, it is considered as sleep-like posture. Sleep-like posture can be observed when cattle are well accustomed to the surrounding environment. This posture might be an indicator of comfort for cattle. Bed cleaning makes comfortable resting place for cattle in indoor housing. The present study aimed to investigate the effects of bedding cleanliness on a sleep-like posture of cattle.

Two batches of experiments were carried out at Kawatabi Field Science Center of Tohoku University in April and in May, 2021. In each batch, eight Japanese Black fattening cattle were used in the experiment. Four cattle were assigned to the treatment group (GT), and the other four cattle to the control group (GC). The bedding materials were replaced once during the experiment as a cleaning treatment in GT. No cleaning treatment was conducted in GC during the experiment. In the next batch, the cattle in GT previously were assigned to GC and *vice versa.* Cattle sleep-like posture and bedding cleanliness were measured twice within one week before the cleaning treatment and twice after the treatment. Two types of sleep-like postures (SP1: Cattle bent its neck and rested head against the body; SP2: Cattle lied completely flat on the ground with neck stretched) were measured using accelerometer and video recording, and the duration, bout number, and bout length per day were quantified. The sum of the duration of SP1 and SP2 was calculated. To quantify bedding cleanliness, the ammonia concentration in the air and moisture content in the bedding materials were measured. The effects of treatment (GT, GC), period (before cleaning, after cleaning), and their interactions on sleep-like posture and bedding cleanliness were tested using the generalized linear mixed model.

Both ammonia concentration in the air and moisture content in the bedding materials significantly decreased after cleaning treatment in GT compared with GC ($P < 0.01$). Interaction between treatment and period on each sleep-like posture was significant ($P < 0.05$, respectively). The duration ($P < 0.05$) and bout number ($P < 0.01$) of SP1 increased after cleaning in GC compared with GT. On the contrary, the duration ($P < 0.1$) and bout number ($P < 0.01$) of SP2 tended to increase after cleaning in GT compared with GC. However, there was no effect of treatment and period on the sum duration of SP1 and SP2. The present results suggest that cattle might prefer to take a more relaxing sleep-like posture (SP2) when they are kept in cleaned bedding. The switch of sleep-like posture might indicate the comfort of cattle in indoor housing.

A Study of Immunoregulatory Mechanism of Expolysaccharide Producing Immunobiotics to Develop Novel Immunosynbiotics

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Over the past decade, the use of probiotics as feed supplements in animal production has in-creased considerably, due to the ban on antibiotic growth promoters. Various chemical and physical properties of Lactobacillus EPS, such as the structural, rheological, and shelf-life enhancement of different food products, are mentioned. Moreover, EPSs play a characteristic role in starter culture techniques, yogurt production, immunomodulation, and potential prebiotics.

An exopolysaccharide, designated as MM89-EPS, was isolated from Lactiplantibacillus plantarum MM89. It was comprised of glucose and mannose molecules with an average molecular weight of 138 kDa. FTIR and NMR spectra showed that MM89-EPS had characteristic polysaccharide functional groups. MM89-EPS displayed excellent water solubility and capacities to retain water and oil due to its porous structure. MM89-EPS exhibited no significant cytotoxicity on RAW264.7 cells and showed strong immunomodulatory activity by increasing phagocytosis, acid phosphatase activity, and cytokine production in RAW264.7 cells. Furthermore, an in vivo study revealed that splenic indices, intestinal IgA levels, serum cytokine levels, and lymphocyte proliferation were increased in an MM89-EPS-treated cyclophosphamide-induced immunosuppressed mouse model.

To summarize, our results indicate that MM89-EPS can efficiently enhance the immunostimulatory activity of immune cells and an immunosuppressed mouse model. Hence, MM89-EPS may be use as a potential source of immunomodulatory agent in various food products.

Keywords: Lactiplantibacillus; breast milk; exopolysaccharide; immunomodulatory activity; techno-functional properties

Examining the Applicability of UAV and Satellite Remote Sensing Data for Soybean Cultivation

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In this study, the suitability of remote sensing data from satellites and drones for soybean yield estimation was examined. The possibility of evaluation of field drainage using satellite remote sensing data was also examined. Test sites were on Shinchi Town in 2019 and 2020, and on Minamisoma City, Fukushima prefecture in 2021. The near-infrared band was extracted from Sentinel-2 satellite data obtained between March and June of 2019-2021 to evaluate the field drainage. Images observed by cameras mounted on a drone in 2019 and 2020, and by WorldView-2 satellite in 2021 were analyzed.

Vegetation indices were calculated with acquired images. The vegetation indices used in this study were NDVI, GNDVI, VARI, and GCC. NDVI and GNDVI use near-infrared wavelengths in their calculations, while VARI and GCC were indices using only visible bands. Regression analysis was conducted with each vegetation indices and the soybean yields. Sentinel-2 data analysis showed that near-infrared reflectance from the bare soil on the target field decreased after obvious rainfalls. In addition, spatial variability of near-infrared reflectance in the field was observed. Sentinel-2 near-infrared reflectance images can be used as an indicator of the drainage of the field.

Results of regression analysis between vegetation indices and the soybean yields showed that the correlations of VARI and GCC with soybean yield were comparable to those of NDVI and GNDVI. This result suggests the possibility to predict soybean yield using cameras that can observe only visible spectrum. Application of inexpensive digital cameras is expected to reduce the introduction cost for drone-based agricultural remote sensing.

Feasibility of Intraspecific Mix Cropping in Japan *-Trials with Soybean Lines in Kawatabi Field Center*

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Intraspecific mix cropping of multiple genotypes of a single crop has been a great concern. Mix cropping traditionally utilizes multiple crops (interspecific) and is conducted in developing countries. The interspecific mix cropping generally improves crop productivity by compensating resource use temporally and spatially. Its reductive effects on pests and diseases are also expected. However, different plant shapes and maturity limits mechanization. On the contrary, the intraspecific mix cropping may allow mechanization with maintaining the general mix cropping effects. Some studies have already reported the positive effect of intraspecific mix cropping but the practical application is quite limited. Under the situation, we conducted field experiments of soybean in Kawatabi Field Center, Graduate School of Agricultural Science, Tohoku University.

For the applicable mix cropping in modern agriculture, we established 3 concepts : same harvest time, similar seed size and similar nutrition contents. For the purpose, near isogenic lines were selected with different growth habits, indeterminate (IND) and determinate (DET), by considering mix cropping effects.

Five -year experiments indicated that mix cropping of 1 IND line and 1 DET line (alternative arrangement) had significant positive effects on leaf area and yield, but the enhancement of yield was not large. Mix cropping of 5 IND lines and 5 DET lines (mix seeding) had higher positive effects on yield than that of 1 IND line and 1 DET line, suggesting that the genotypic diversity is important in mix cropping. However, the positive effects on yield were unstable among years. The average increase of yield by mix cropping was only 5 %, being inadequate for the practical application. The enhancement of seed productivity or other advantages, such as pests and diseases, may be required. The IND lines tested in this study did not show superior growth and production compared to DET lines, being one of the restriction factors of low positive effects on yield. Further study on finding out suitable IND and DET lines and combinations is needed.

Evaluation of Temporal Variability in Surface Chlorophyll-a Concentration Estimated by GCOM-C/SGLI in Onagawa Bay

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SGLI (Second-generation Global Imager) is a multispectral sensor mounted on the GCOM-C satellite which has 250 m spatial resolution for monitoring chlorophyll a (Chl-a) concentration in the ocean. We evaluated the usefulness of the GCOM-C/SGLI data products for estimating Chl-a variability in Onagawa Bay located along the Sanriku Coast on the Pacific Ocean of northern Japan. Spatio-temporal patterns in the distribution of Chl-a concentration is useful information for sustainable aquaculture operations because the surface chlorophyll data indicates the amount and the location of naturally occurring phytoplankton on which cultured species such as shellfish and ascidians feed. However, estimating Chl-a variability using satellite data in shallow coastal waters, particularly nearshore areas, can be challenging due to possible interferences originating from benthic and terrestrial substrates.

In this study, we compared monthly transitions of Chl-a concentrations estimated by the G-COMC/SGLI with in situ observation data obtained at 12 sites in Onagawa Bay between January 2018 to February 2021. At sampling stations where the distance to the nearest land was $\geqq$ 500 m, the SGLI estimates correlated significantly with in situ Chl-a measurements. This suggests the GCOM-C/SGLI product can be used reliably for estimating the spatio-temporal Chl-a variability so as long the sampling stations are located sufficiently far from the coastline. Moreover, we analysed the Chl-a variability in association with changes in the monthly average of sea surface temperature (SST) based on "JAXA Himawari Monitor" to assess the potential influent of the Oyashio Current. The Oyashio Current comes from the Arctic Ocean and flows southward passing through the Bering Strait transporting cold and nutrient-rich water into the Pacific Ocean.

Our study indicated the Chl-a values estimated by the SGLI were consistently higher when the waters of the Oyashio Current flew in or passed around the coast of Onagawa Bay, suggesting higher primary productivity observed in Spring months may be driven primarily by the intrusion events of the Oyashio Current.

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