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ANALYSIS

Rice Intensive Cropping and Balanced Cropping in the Mekong Delta, Vietnam — Economic and Ecological Considerations

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A R T I C L E I N F O

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A B S T R A C T

Rice intensification in Vietnam relies on the construction of high dykes in the Mekong Delta floodplain to prevent flood waters from entering fields during the flood season. This enables three rice crops to be grown annually instead of two. On the floodplain, two rice crops can be described as “balanced cropping” since it has a long fallow period, which conforms to good agricultural practices, and also takes advantage of the flood's benefits. For example, it integrates the natural fish, other aquatic animals, and flood sediments during the flood season as part of the rice field ecosystem. This study surveys agriculture practices among “three crop” and “two crop” farmers on the floodplain. It is argued that planting three crops (“intensive cropping”) cannot provide a sustainable alternative to balanced cropping, either from an economic or an ecological viewpoint. Study findings emphasise the need to recognise the ecological value of balanced cropping systems for an efficient and environmentally sound production of food. In connection with this, it is suggested a case for limiting further dyke heightening since rice intensification, which is the aim of this large-scale water control, does not make economic sense.

1. Introduction

Agriculture on the floodplains of less developed countries has been intensified to meet population growth and economic development needs. While agricultural intensification has benefitted farmers economically, it has also raised concerns about the sustainability and cost effectiveness of an increased reliance on external inputs, especially agrochemicals. In addition, intensification often requires the building or upgrading of large-scale irrigation infrastructure which, along with moves toward intensification, requires cautious assessment for several reasons. For instance, irrigation systems that facilitate intensification can fragment floodplains and disrupt natural flows of water, sediments, nutrients, and aquatic life. This affects the ecology and the environment and this, in turn, can have feedback effects on agriculture and fishing (Campbell, 2012; Hashimoto, 2001; Hoa et al., 2008; Howie, 2011). This is particularly relevant for the floodplain of the Vietnamese Mekong River, which has high biological diversity and supports two productive sectors, agriculture, and fisheries (Baran, 2010; Campbell, 2012; MRC, 2010).

In an environmentally sensitive delta ecosystem such as the Vietnamese floodplain, an important question is whether or not intensified agricultural systems provide viable alternatives to existing less intensified systems. This paper focuses on the most recent phase of rice intensification in the Mekong wherein current targets for floodplain agriculture is the production of three rice crops per year using high dykes to completely prevent floods. Hence, two-rice crop systems, which were enabled by the use of low dykes to delay floods, are now being converted to three-rice crop systems with dyke heightening (Le et al., 2007). At present, both the two-rice crop systems and three-crop systems have become the dominant types of land use on the floodplain. There are now thousands of high dykes in the Mekong Delta (AGDSI, 2013). In only 12 years, the three-rice crop areas in the four provinces located in this floodplain have increased sevenfold, from 53,500 ha in 2000 to 403,500 ha in 2012 (Duong et al., 2014).

The two-crop system within low dykes, admits an integrated two rice crops – one natural flood capture system. Such natural flood “crop” on over flooded rice fields provides locals, especially the poor and the landless, with free goods such as wild fish, other aquatic animals, and aquatic vegetables. In terms of wild fish alone, the Vietnamese Mekong Delta (VMD) produces about 700,000 tons of inland fish per year. This accounts for one-third of the overall Mekong fish catch which is categorized exceptionally important by global standards (Baran, 2010). In addition, allowing rice fields to be overflooded during the flood season also makes use of the flood for an efficient and environmentally sound production of rice. For example, the floodwaters bring alluvial sediment, which rejuvenates the fields by adding both macronutrients (e.g., N, P, K, Ca, Mg, S) and micronutrients (e.g. B, Cu, Fe, Cl, Mn, Mo, Zn). It also provides the soil with the additional organic matter, which helps maintain soil fertility for rice cultivation. The

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amount of sediment deposited on fields ranges from a few to tens of tons per hectare (Duong et al., 2011). The flood season also provides the natural pest control mechanisms in rice fields through a combined use of species come along with it. As found by Xie et al. (2011), for example, the natural fish can act as biocontrol agents in rice ecosystems.

On the other hand, planting continuously three rice crops seems to be against good agricultural practices, for example, Integrated Pest Management, which encourages rotation, and longer fallow time. Studies in the Mekong Delta found that two-crop rice farmers have higher rice yields per crop than three-crop rice farmers (Berg, 2002; Huynh, 2011). The negative impacts of high rice cropping intensity on rice productivity are further confirmed by a long-term continuous cropping experiment in the Philippines (Dobermann et al., 2000). This study shows that yields have decreased cumulatively by 38–58% within the 24-year period of growing three rice crops a year. The average yield reduction ranged from 1.4–1.6% for each crop per year. The two-crop system is, therefore, more balanced than the alternative intensive three-crop system.

The term “balanced cropping” in this study refers to the two rice crop–one natural flood capture system that exists with low dykes. “Intensive cropping” refers to the three-crop system with high dykes. This study is a survey of the agricultural outcomes experienced by farmers of balanced and intensive cropping systems in the Mekong Delta. It is argued that intensive cropping cannot provide a sustainable alternative to balanced cropping, either from an economic or an ecological point of view. The net income per crop from intensive cropping is lower than balanced cropping due to longer-term effects on crop productivity. It leads to an annual net income from intensive cropping that may not be as large as expected and is not significantly different from the incomes of balanced croppers. After taking into account the value of family labour at market wage rates, the annual net income from intensive cropping is significantly lower than that from balanced cropping. Moreover, spillovers effects, the side effects arising in a seemingly unrelated context, from intensive cropping constrain the productivity of neighbouring balanced cropping farms. Also, the added third crop has displaced the valuable natural flood (particularly fish) harvest. If these spillover costs and forgone fish output could be quantified, criticisms on intensive cropping as an unsustainable alternative to balanced cropping would be strengthened. The findings imply that the cumulative environmental effects of farming conversion involve changes in ecological processes that may not be well understood but which far surpass short-term issues in importance.

These findings must be seen in the context of policies favouring intensified agricultural production, which result in depletion of aquatic resources. Moreover, the case for balanced cropping is increasingly constrained by government policies that pursue large-scale irrigation infrastructures to enable intensified agricultural production. Government policies that promote balanced rather than intensified cropping systems generate more diverse systems that deliver not only food security but also safeguard biodiversity, ecosystem services, and economic security in rural areas.

2. Materials and Methods

To gain an overview of farming outcomes for floodplain rice farmers, interviews with intensive and balanced cropping farmers from two sites in An Giang province were conducted. The assumption is that, before dyke heightening, rice production between the two sites surveyed had homogenous characteristics. In addition, one more balanced cropping site in another Dong Thap province was added. The inclusion of this third site, which was originally dissimilar to the first two sites, was to ascertain balanced cropping's character in the presence of site-specific condition.

All these three sites are situated in the major rice producing areas of the VMD floodplain and all once experienced the same flooding levels before the use of high dykes (Fig. 1, Table 1). Both An Giang and Dong Thap also have the highest increase rates and the highest areas of intensive cropping (Duong et al., 2014). More than half of the rice planted areas in An Giang are now practicing intensive cropping as associated with 1939 high dykes (AGDSI, 2013; AGGSO, 2013) whereas one-third of Dong Thap province practice intensive cropping within 670 high dykes (DTGSO, 2013; DTSD, 2015). The recall survey was conducted for the rice cultivation period of November 2011 to October 2012.

2.1. Study Area Selection

The VMD is the most important rice-producing region in Vietnam. It produces almost 57% of the national rice output (GSO, 2013).The Delta lies within the humid tropics and is characterised by high mean monthly temperatures (27 °C) and high, but seasonal, rainfall (1600 mm). The rainy season is from May to November when over 90% of the annual rainfall occurs (AGDSI, 2009). The VMD floodplain or high flood zone lies in the Plain of Reeds (POR), a vast wetland covering the northern parts of Dong Thap, Tien Giang, and Long An provinces, and the Long Xuyen Quadrangle (LXQ). Formerly, the Mekong River floods covered this floodplain from July or August until November or December each year.

Thoai Son district (1) in An Giang province is an intensive cropping site. Chau Thanh district (2) in the same province is a balanced cropping site. These two sites are located in close proximity to each other, with only a canal separating them. Hence these sites formerly shared similar social and natural conditions, such as soil fertility. Intensive cropping has been pursued in Thoai Son district for more than 10 years. This period is long enough to reflect cumulative effects on rice productivity, which may have resulted from the practice of intensive cropping.

On the other hand, Tam Nong district (3) in Dong Thap province is a non-contiguous and balanced cropping site. Rice farming in this site has occurred under less favourable conditions with consistently lower rice yields (AGGSO, 2012, 2008, 2006, 2000; DTGSO, 2012, 2007, 2005, 2000).

With intensive cropping (Thoai Son), the first rice crop is grown from mid-December to mid-March, the second from mid-April to mid-July, and the third from mid-August to late November. For the contiguous balanced cropping (Chau Thanh), the first crop is grown from early December to early March and the second from early April to early July. For the non-contiguous balanced cropping (Tam Nong), the first crop is grown from mid-November to late February and the second crop from mid-April to late July. The break time between the first and second crop in Tam Nong is two weeks longer than that in An Giang.

2.2. Field Survey

At each study site, 120 rice-producing households were randomly selected and interviewed using two separate structured parts of a single questionnaire. This provided 110, 99, and 101 usable questionnaires for intensive cropping in Chau Thanh, contiguous balanced cropping Thoai Son, and non-contiguous balanced cropping in Tam Nong, respectively. As detailed information was needed to assess rice productivity and pesticide use, it took about 2 h for each respondent to complete the questionnaire. Due to the length of these interviews, which could negatively affect the quality of the respondents' answers, the questionnaire was separated into the two parts. One session was for detailed household level information pertaining to inputs, costs, and benefits of rice production. The other was for detailed pesticide use. Each took about one hour to complete. A short break in between was provided.

Regarding pesticide use, rice farmers were asked to give the common name of the pesticide they used, the number of times they sprayed it, the quantity of undiluted chemical they used, and the price and volume per container. If respondents could not remember the common name, we asked them to show the bottle (if possible) or we showed them pictures of the bottle or described its appearance or usage in order to achieve identification. For each pesticide, we collected data