How Do New Cash Crops Spread or Not Spread?

The Case of Rice in a Suburban Area, Ghana

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Abstract

This paper examines the determinants of rice-cultivation adoption in inland-valley bottom areas in Ghana. In West African countries, surging import of rice has shown farmers a new and potentially huge income source. Around the second largest urban area in Ghana, Kumsi, there are inland-valley bottoms which are suitable for rain-fed rice cultivation. The puzzle is that not much part of these inland-valley bottoms has been utilized for rice production. In 2001, in four villages around Kumasi, we conducted a detailed household survey both on lowland-rice and upland-maize farmers. We found that the profit from lowland-rice cultivation was significantly lower than that from upland-maize farming. This paper also examines our predictions made from the profit comparisons in 2001 survey by the results of rice-farmer census conducted in 2011 in the same four villages.

1 Introduction

This paper examines the determinants of rice-cultivation adoption in inland-valley bottom areas in Ghana. In a classic literature, Hirschman (1958, p. 121) argues that a critical role of international trade in the course of economic development is to reveal a new market for latent entrepreneurs in a country. In West African countries such as Ghana, surging import of rice should have shown farmers a new and potentially huge income source. Ghana became an active rice importer in the 1990s. In 2008, the import of milled rice amounted to 116 thousand metric tons, which cost more than seventy-eight million US dollars (Food and Agriculture Organization (FAO) 2011). Combined with the trade of broken rice, import of rice accounted for 4.3% of Ghana's trade deficit in 2008 (International Monetary Fund (IMF) 2010).[1]

On the soil of Ghana, rice cultivation seems to be one of the most attractive for the farmers around Kumasi, the second largest urban area in the country. There are three major reasons. First, the surging rice consumption in West African countries is mainly due to the increase in urban population. Rising opportunity cost of time and limited space for cooking have rendered rice a staple food in urban area of West Africa (Kennedy and Reardon 1994; Tomlins et al. 2005, Table 1). According to the 2000 population census, Kumasi had more than one million population with a high growth rate (Ghana Statistical Service 2000). Thus, the farmers around Kumasi have had access to a huge market for rice. Second, unlike Accra which is the largest urban area, Kumasi is an inland city. Transportation costs from the ports should provide locally produced rice competitive edge against imported rice.

Third and most importantly, there are huge areas of inland valley bottom around Kumasi. In rainy seasons, many parts of inland valley bottom can be utilized as wet rice fields (Andriesse and Fresco 1991). Dekuku et al. (1993), however, reported that not much parts of inland-valley bottoms around Kumasi had been utilized for rice production. In our own survey in 2002 and 2008, we have confirmed under-utilization of inland-valley bottoms around Kumasi.

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[1]In 2008, Ghana was the third largest importer of broken rice: imported 278 thousand metric tons with 137 million US dollars.

More specifically, we found no or few rice farmers on many lowlands that had been cultivated for rice before. The major purpose of this study is to tackle this puzzle: under-utilization of inland-valley bottoms for rice production. We identify the factors that prevent the realization of potential comparative advantages of lowland rice production in the area.

This puzzle is not merely a local issue in Ghana. Even putting aside its obvious link to a large body of literature on the adoption of new agricultural technology, our study is relevant for a general issue in African agriculture. There have been two major challenges to the agricultural sector in African countries: high population growth rate and relatively infertile soil. Over the past two decades, the average population growth rate in African countries, 2%, is higher than the average of developing countries.[2] Most of the African continent is, however, covered with relatively infertile soil. Bloom and Sachs (1998) therefore argued that the African continent would inevitably depend on the cereal production of the other continents.

An immediate threat of this dependence on imported cereal is a rise in world cereal prices. In fact, in 2008, several West African countries suffered from social unrest due to the price hike of imported rice. A possible long-term threat is lasting high labor cost compared to the Asian developing countries. To maintain the high economic growth rates since the beginning of the 21st century, West African countries need to improve their agricultural productivity for reducing and stabilizing food prices, and consequently reducing their labor cost. In sum, African countries need to raise its staple crop production on relatively infertile soil.

Two ordinary measures to enhance food production are intensification and *extensification*. In West African countries where traditional farm land is often located in upland, however, successful intensification of cereal production is likely to result in reducing the production of perennial crops for export such as cocoa and coffee. We should also note that in upland areas, perennial crops are usually more environmentally friendly than annual food crops. Rapid agricultural *extensification* to marginal lands, on the other hand, often accelerates deforestation. Rice cul-

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[2]We should, however, note that the expected average population density of the African countries is still lower than that of the major Asian countries (Turner II, B. L., Hyden, and Kates 1993, 4).

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tivation in inland valley bottoms provides a way to circumvent these environmental difficulties expected from intensification and extensification. Exploring the obstacles for lowland rice cultivation in Ghana, therefore, may provide us a key to tackle the basic problem in the African agricultural sector.
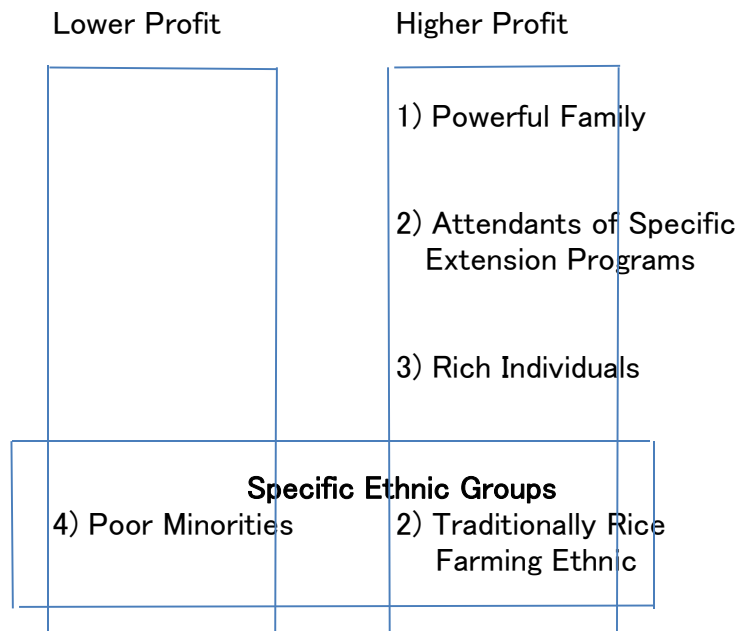
In our study area, the Ashanti region in Ghana, the possible obstacles to rice farming in inland-valley bottoms can be summarized by the following four hypotheses.

1. Lack of well-specified land tenure system. The local ethnic of the study area, Asante, is known for its complicated land tenure and inheritance systems (Berry 2001).

2. High learning cost of rice cultivation. In many countries, difficulties in learning has been a main suspect for slow diffusion of new agricultural technologies (Conley and Udry 2010).

3. Credit or labor constraints to farmers.

4. Lower profit of lowland rice compared to traditional upland farming. Due to small requirement of labor, slash-and-burn farming on upland is often profitable (Dvořàk 1992).

As a first step, we can evaluate these four hypotheses by examining the profit from rice farming and the characteristics of rice cultivators. Hypotheses 1, 2, and 3 indicate excess profit to the rice farming compared to the traditional upland farming. If hypothesis 1 holds, for example, most rice farmers are likely to come from powerful families in the area who have traditionally stable property rights in lowlands. In contrast, hypothesis four suggests a lower profit from rice farming in inland-valley bottoms. Under hypothesis 4, those who cannot access profitable upland farming would reluctantly cultivate lowland rice. Figure 1 visualizes these four hypotheses. We conducted a series of field surveys around Kumasi to estimate the profit from lowland-rice and upland-maize production. The latter, upland maize, is used as a yardstick to evaluate the excess or lower profit from lowland rice cultivation.

This paper proceeds as follows. Section 2 provides the background information of our study area. Section 3 explains the design of our field surveys. In section 4, we discuss general

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Figure 1: Four Hypotheses across Farmers' Characteristics and Profit

Lower Profit   Higher Profit

1) Powerful Family

2) Attendants of Specific
   Extension Programs

3) Rich Individuals

Specific Ethnic Groups
4) Poor Minorities   2) Traditionally Rice
                             Farming Ethnic

observations of the two surveys, extensive village survey and census in six villages. Section 5 examines the four hypotheses with the results of profit calculation of rice and maize farming. We found lower return from lowland rice than that from upland maize. Our estimates, although with some reservations, support hypothesis 4. Section six concludes the paper.

2   Study Area

Kumasi is located in the Equatorial-forest zone: approximately between latitude $6°30'$ and $7°00'$ North and longitude $1°30'$ and $2°00'$ West. Kumasi has been the political and cultural center of the southern Ghana, and is the capital of the Ashanti region. Between 1984 and 2000, its annual population growth rate was about 4.6%, which was much higher than the country average at that time: 2.5%. In the Ashanti region, the majority ethnic group is Asante, which belongs to the Akan language group. In Ghana, traditional chieftaincy is still in practice with legal

endorsement. The paramount chief of Asante states, *Asantehene*, lives in Kumasi. On the land in the Ashanti region, several players, from Asantehene to individual citizens, often can claim some property right. This is the background of hypothesis 1.

To consider the impacts of access to urban market, we set the study area within the 60 km radius from the center of Kumasi. In the study area, the average annual rainfall varies from 1,450 mm to 1,680 mm. The southern part of the study area has more precipitation than the northern part, but this difference is not so significant. There are two rainy seasons. The main rainy season starts in March and ends in July, whereas the minor rainy season starts in September and ends in November. The terrain is undulating: continua of upland and inland swamp.[3]

Since the early periods of the last century, cocoa has been the most important cash crop in the study area (Takane 2002). The major food crops have been cassava, maize, plantain, and cocoyam, all of which are usually cultivated on upland. Rice is a minor crop in the area. According to a rough official estimate in 1998, the cropped area of rice in the Ashanti region was 4,201 ha, while that of the maize was 109,890 ha (Policy, Planning, Monitoring and Evaluation Department (PPMED) 2000).

There are not many records about the rice cultivation in the Ashanti region. Two exceptional studies conducted by the researchers of West Africa Rice Development Association (WARDA), Dankyi, Anchirinah, and Apau (1996) and Dekuku et al. (1993), reported that the cultivation method of lowland rice in the area was mainly slash-and-burn. We reconfirmed the practice slash-and-burn rice cultivation in the informal preparatory surveys in 2000. For the examination of our four hypotheses, we chose maize as a typical upland food crop in the area. McCann (2005, Ch. 3) provided a detailed history of maize cultivation in the Ashanti area since its arrival from the New World.

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[3]According to the classification of rice-cultivation environments by Andriesse and Fresco (1991), the physio-hydrographic position of lowland in the study area is fluxial.

Figure 2: Villages surveyed in 2000 - 2001
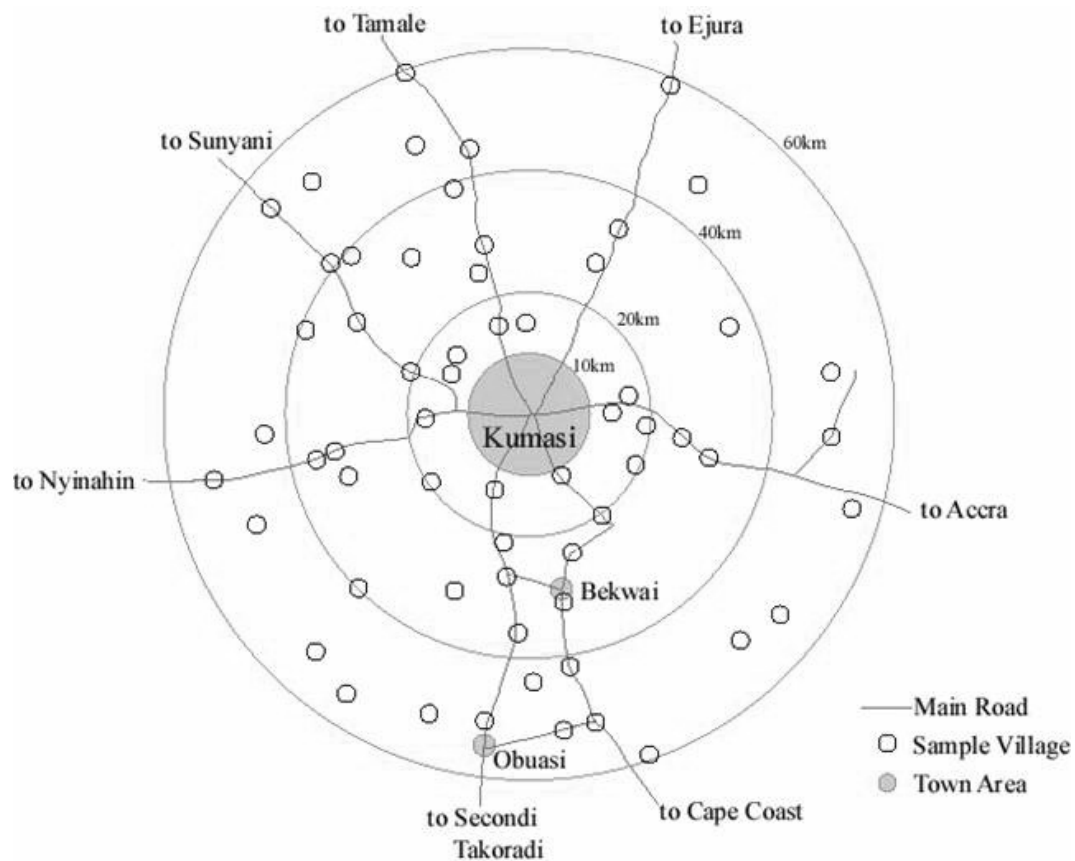
3 Survey Design

The major parts of our field survey were conducted over the year of 2000 to 2002. The field survey consists of three parts: extensive village survey, census in six villages, and intensive farmers' survey in four villages. A follow-up census survey in the same four villages was implemented a decade later, in 2011, to assess the diffusion of rice cultivation.

The extensive village survey was designed to obtain the general picture of the study area. Within the 60 km radius from the center of Kumasi, we randomly sampled 60 villages (rural towns) with lowland areas (Figure 2). In each of the sampled village, we conducted a group interview with the leaders of village and farmers' group. We also visited all the lowland areas in each village to measure the distance from the center of the village and to make a general

observation about the use of lowlands.

The census in six villages was implemented to obtain the sampling population for the intensive farmers' survey. The six villages were, therefore, selected from the villages with the record of relatively many (at least eight) rice farmers in the extensive village survey. We visited all the residential buildings in the village, and enumerated all the households and their members in each building. The census inquired about the ethnicity of household head, the major income source of each household member, whether they were engaged in lowland rice cultivation, and so on. The census itself provides valuable information on the characteristics of rice farmers compared to the other farmers in the villages. For the intensive farmers' survey, based on the results of the census, we randomly sampled 58 rice and 53 maize farmers from the four villages.[4] The intensive farmers' survey, conducted in the 2001-2002 crop season, consists of a detailed household survey and enumeration of inputs and output of lowland-rice and upland-maize production.

Our main output indicator is profit which is defined as crop sale plus imputed value of home consumption minus production costs including in-kind payment. Note that the profit here depends not only on productivity but also on, for instance, sale price. Those farmers who can wait for higher crop prices may enjoy higher profit even with low productivity. Similarly, those crops with a good marketing channel may have a leading edge to the other crops. These possibilities are what we would like to examine by comparing the profit of lowland-rice and upland-maize cultivation.

Although the sample size is relatively small, our intensive farmers' survey has three major advantages. First, the planted areas of rice and maize were measured by global positioning system (GPS). As was mentioned above, in the study are at the time of our investigation (2000-2002), the major cultivation practice was slash and burn. The information about the planted area under slash-and-burn practice is usually difficult to obtain. Farmers often burnt the large

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[4]Upon sampling, we tried to exclude the farmers who cultivated both lowland rice and upland maize. This is to capture specific characteristics, if any, of lowland rice farmers for testing our four hypotheses. Due to some sampling error, we later found that five out of the sampled 58 rice farmers did cultivate upland maize. None of the sampled 53 maize farmers cultivated lowland rice in our study period.

area, but might not plant crops all over the prepared area. In fact, among our sampled farmers, nine of rice and two of maize farmers could not estimate the size of their planted area at all.

Second, based on the careful preliminary surveys, the questionnaire was designed to capture the details of crop output and inputs. For example, the questionnaire investigated not only the in-kind payment to hired workers, but also inquired about the amount of harvest used for home consumption and small gift to neighbors measured in minor units such as bowl. The count of these minor uses of outputs raised the gross output of lowland rice by 13%. In measuring profits of house enterprises, de Mel, McKenzie, and Woodruff (2009) find that the home consumption of business materials is the major cause of measurement error. In our survey, we tried to hold out the concerns raised by de Mel, McKenzie, and Woodruff (2009) by multiple visits to the respondents with well-designed questionnaire.

Lastly, field measurement was implemented on the density of intercrops in upland maize farms. In our study area, upland farming is characterized by mixed planting. The result of field measurement helps us separate the cost for intercrops from the maize cultivation.

4 Rice Cultivation in the Ashanti Region: Census survey

Table 1 summarizes the main characteristics of the 60 villages sampled in the extensive village survey. There are 188 lowlands in the areas of these 60 villages: about three lowlands per village. Except for nine lowlands, these areas were utilized for food crop production such as vegetables, dry-season maize, and rain-season rice.[5] The group interviews counted in total 693 rice farmers in the crop season of 2000-2001.[6]

The spatial distribution of lowlands in the study sites is relatively equal: it does not depend on the distance from Kumasi or access to highway. But rice production in lowlands is not

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[5]In local language *Twi*, lowland is referred to as *wora*. In the area of *wora*, there can be *woratini*. *Woratini* indicates lowland which usually dries up in the dry season. In contrast, *wora* in general can be waterlogged all over the year. There are, therefore, lowlands that cannot be used for food crop production.

[6]The number of rice farmers reported here is likely to be underestimated. In the later visits, we sometimes noticed that village leaders mentioned a larger number of rice farmers. In the first visits, the leaders had suspected that investigations by strangers (that is, by us) might be related to land tax or rent payment.

Table 1: 60 Villages in Extensive Village Survey in 2000

	(1)	(2)	(3)	(4)	(5)	(6)
		By Distance from Kumasi			By Access to Road	
	Total	- 20 km	20-40 km	40 - 60 km	On Road	Off Road
Number of Villages Surveyed	60	12	24	24	30	30
Population in 1984 Census[a]	664	1118	555	547	779	550
Travelling Time to Kumasi (minute)[b]	66	34	55	92	50	81
Ohene[c]	19	8	6	5	8	11
Ashanti Village	56	12	22	22	29	27
Zongo Area[d]	26	4	8	14		9
Electricity	19	7	7	5	13	6
Dispensary	6	2	1	3	2	4
Rice Mill	15	3	4	8	7	8
Lowland in Village Area						
Number of Lowlands	188	37	70	81	98	90
Average Distance (meter)						
from Hamlet	1391	1549	1171	1392	1470	1199
from Bus Stop	2110	1624	2033	1963	1626	2245
Use of Lowland						
No Use except for Tree Crops	9	2	0	7	6	3
Vegetables in Dry Season	124	25	40	59	57	67
Use in Rainy Season						
No Use	40	13	5	22	16	24
Vegetables	30	5	17	8	19	11
Rice	98	11	38	49	48	50
Number of Rice Farmers[e]	692	186	324	182	361	331

a) Official government census in 1984.
b) All are by minibus or on foot and minibus.
c) Local traditional chief. Refer to the text.
d) Part of the village area where migrants concentrate to live. See the text.
e) For two lowlands, there are no information about the number of rice farmers.

equally distributed. The villages in the remotest zone (from 40 km to 60 km away from Kumasi) have more rice producing lowlands than those in less remote zone. Vegetables, on the contrary, tend to be grown in lowlands near Kumasi, not only in the rainy season but also in the dry season. It suggests that market access is more important with vegetable production. If we compare the number of rice farmers per lowland, however, the tendency is reversed. On average, lowlands in 10-20 km zone have the most rice farmers, while lowlands in 40 - 60 km zone have the least rice farmers.

Nineteen, that is, about one-third of the sampled villages have traditional chief, *ohene*. It indicates that these villages have relatively long histories. The other 41 villages were set up by the migrants either from these 19 villages or from the other villages. *Ohene* and his surrogates usually have strong rights over land. In principle, under the authority of *Asantehene*, *ohene* controls all the communal land in his village and the villages set up by the migrants from his village. The land controlled by chiefs is referred to as stool land.

A characteristic of Ghanaian, or West African, society is migration. People often move either permanently or temporary to the other regions of the country (sometimes to the other countries). In our sample, 26 villages have *zongo* area where recent in-migrants, mainly from the northern regions, concentrate to live. Even without *zongo*, however, there usually are many migrants in villages.

Table 2 summarizes the main characteristics of the six villages where we implemented the census survey. All the six villages except for one is located between 20 km and 50 km distance from Kumasi as villages in this zone tended to have more rice farmers than the others.[7] Two of the six villages are villages with *Ohene* and the proportion of Ohene villages is the same as that in the 60 villages in the extensive village survey. As for electricity, on the other hand, only one village (village III) received public electricity supply at the time of interview. This rate of electrification is lower than that of the 60 villages, among which almost one third were

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[7]Recall that these six villages were selected from the 60 villages in the extensive village survey with at least eight rice farmers.

Table 2: Six Villages in Census Survey 2001

Village	I	II	III	IV	V	VI
Population						
1984 Census[a]	855	723	962	259	862	558
2001 Census	901	990	2171	505	1095	842
Ratio of Female	52.7%	50.0%	48.9%	46.9%	49.2%	50.8%
(NI on sex)	(0)	(0)	(17)	(34)	(0)	(2)
Average Age	24.5	23.9	23.1	22.9	22.6	22.4
(Std Dev)	(21.40)	(20.2)	(18.3)	(19.4)	(19.5)	(19.5)
(NI on age)	(0)	(0)	(29)	(42)	(11)	(9)
Number of Income[b]	449	571	1282	250	600	563
Sources Reported						
Ratio of Farming	55.5%	46.8%	38.5%	53.2%	50.0%	53.3%
(NI on occupation)	(0)	(0)	(26)	(43)	(12)	(4)
Number of Rice Farmers[c]						
in 2001 Census	30	40	80	25	24	30
Estimates in	42	24	64	19	22	17
the Extensive Survey						
Distance to	30.45	35.90	22.50	43.50	47.40	72.85
Kumasi (kilometer)[d]						
Traveling Time to Kumasi	30	35	30	60	60	105
by Minibus (minute)						
Bus Fare to Kumasi	1300	1500	800	2200	1500	4600
in Old Ghanaian Cedi[e]						
Electricity	N	N	Y	N	N	N
Ohene	Y	N	Y	N	N	N
Ashanti Village	Y	Y	Y	Y	Y	Y
Zongo Area	Y	Y	N	N	N	Y
Number of Lowlands	4	3	3	2	3	3
Distance from Village	333	314	1024	156	224	208
Center (meter)[f]	417	476	2100	803	1005	647
	418	534	3100		1866	1850
	1276					

Source: Authors' survey conducted in 2001.

a) Official Government census in 1984.

b) For each household member, we asked up to 3 major income sources.

c) These two numbers are not directly comparable. The estimates in the extensive village survey is about the previous crop season: 2000-2001.

d) Straight distance measured on the topography maps.

e) At the time of our investigation: 7,000 Cedi = 1 USD.

f) Way of the major path to the lowland measured by GPS.

electrified as of 2001 (table 1). Since the electrification is one of the indicators of economic development, we could say that rice tended to be cultivated in the relatively less-developed villages around Kumasi. Among the six census villages, village III was much larger than the others in population, too. It is a kind of satellite town of Kumasi with the low ratio of farmers (38.5%).

One of the interesting observations in table 2 is that lowlands in the six census villages are located much nearer to village center than those identified in the 60 villages of the extensive village survey. Considering that most rice farmers need to carry the harvest from their rice fields to their home in the village on foot, the observation is understandable.

Our 58 lowland-rice and 53 upland-maize farmers were sampled from the four out of six census villages: villages I to IV. Table 3 and 4, respectively, summarize the characteristics of rice- and maize-cultivating households in the census surveys in village II and III. As will be shown later, village II recorded the lowest profit from lowland rice in the four sampled villages, while village III recorded the highest. For reference, the results of the recent 2011 census survey are added in these two tables.

Tables 3 and 4 clearly show that many rice farmers in the area were migrants, most of whom were Islams who came from northern regions, in particular, from the Upper-east region. This finding suggests the possibility of either hypothesis 2 (high learning cost so that the local ethnic, Asante, cannot do lowland rice) or hypothesis 4 (migrants cannot access profitable upland). In addition, we can observe that over the last decade, the number of rice farmers declined. For example, in village III, the ratio of rice farmers to village adults dropped to less than 4% from 7% in 2001.[8] There are, however, more Asante rice farmers recently (bottom row of tables 3 and 4).

Table 5 summarizes the size and mode of acquisition of lowland-rice and upland-maize fields. The bottom two rows show that between the lowland-rice and upland-maize fields, there

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[8] We need further analyses to clarify whether this decline is due to the decline in rice farming or to the decline in farming activities in general.

Table 3: Characteristics of Lowland Rice Farmers: Village II

	(1)	(2)	(3)	(4)	(5)	(6)
	2001 Census			**2011 Census**		
	Total	Rice	Upland Maize	Total	Rice	Upland Maize
	(≧ 18 yrs)	Farmer	Farmers	(≧ 18 yrs)	Farmer[a]	Farmers[b]
Number	513	39[c]	186	549	20	182
Ratio to Total (%)		(7.6%)	(36.3%)		(3.6%)	(33.2%)
Age	38.9	40.8	44.0	40.0	45.5	45.0
(Std)	(17.2)	(12.7)	(16.1)	(18.3)	(15.8)	(15.6)
Ratio of Female (%)	53.6%	15.8%	37.6%	53.2%	5.0%	31.9%
Family Head	182	28	106	233	18	131
(Ratio)	(35.5%)	(71.8%)	(57.0%)	(42.4%)	(90.0%)	(72.0%)
Below are only about Family Heads						
Religion: Only about Family Head						
Christian	60.4%	32.1%	62.3%	70.8%	51.4%	68.7%
Islam	29.1%	67.9%	26.4%	21.5%	48.6%	23.7%
Born in: Only about Family Heads						
This Village	35.7%	14.3%	43.4%	37.8%	27.8%	48.1%
Other Village	35.2%	32.1%	34.9%	36.1%	22.2%	31.3%
in Ashanti						
Other Regions	26.4%	46.4%	19.8%	24.0%	50.0%	18.3%
Upper East	9.9%	28.6%	8.5%	2.1%	11.1%	2.3%
Upper West	0.0%	0.0%	0.0%	1.3%	5.6%	0.8%
North	4.4%	3.6%	2.8%	6.0%	16.7%	5.3%
Ethnicity: Only about Family Heads						
Ashanti	58.6%	10.7%	61.3%	60.1%	33.3%	66.4%

a) Those farmers who planted rice in the past three years: either 2008, 2009, or 2010.

b) Those farmers who planted upland maize in the past three years: either 2008, 2009, or 2010.

c) Excluded one young rice farmer who is 17 yrs old.

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Table 4: Characteristics of Lowland Rice Farmers: Village III

	(1)	(2)	(3)	(4)	(5)	(6)
	2001 Census			**2011 Census**		
	Total	Rice	Upland Maize	Total	Rice	Upland Maize
	($\geqq$ 18 yrs)	Farmer	Farmers	($\geqq$ 18 yrs)	Farmer[a]	Farmers[b]
Number	1135	79[c]	390	1282	49	335
Ratio to Total (%)		(7.0%)	(34.4%)		(3.8%)	(26.1%)
Age	36.2	35.2	43.0	36.8	39.8	46.1
(Std)	(15.7)	(11.7)	(14.4)	(16.0)	(12.4)	(14.6)
Ratio of Female (%)	47.8%	19.0%	33.1%	50.4%	24.5%	31.0%
Family Head	497	57	300	523	35	245
(Ratio)	(43.8%)	(72.2%)	(76.9%)	(40.8%)	(71.4%)	(73.1%)
Below are only about Family Heads						
Religion: Only about Family Heads						
Christian	72.2%	36.8%	70.7%	70.6%	51.4%	65.3%
Islam	17.3%	49.1%	19.7%	19.3%	48.6%	25.3%
Born in: Only about Family Heads						
This Village	36.0%	5.3%	38.7%	30.8%	25.7%	38.8%
Other Village in Ashanti	30.6%	15.8%	38.0%	35.0%	8.6%	30.0%
Other Regions	31.2%	79.0%	32.0%	33.3%	62.9%	30.6%
Upper East	14.5%	66.7%	19.3%	7.5%	20.0%	8.2%
Upper West	0.4%	0.0%	0.3%	1.9%	5.7%	2.0%
North	4.0%	5.3%	3.7%	8.2%	34.3%	10.2%
Ethnicity: Only about Family Heads						
Ashanti	58.6%	3.5%	57.0%	51.1%	17.1%	55.5%

a) Those farmers who planted rice in the past three years: either 2008, 2009, or 2010.

b) Those farmers who planted upland maize in the past three years: either 2008, 2009, or 2010.

c) Excluded one old rice farmer who could not tell the age.

Table 5: Size and Mode of Acquisition of Rice and Maize Fields

	58 Lowland-rice Farms	53 Upland-maize Farms
Average Area (hectare)		
Farmers Estimates	0.77	0.76
(Standard Dev.)	(0.42)	(0.61)
[Number of No Answer]	[9]	[2]
Max	2.02	4.05
Min	0.13	0.11
Measrued by GPS	0.71	0.41
(Standard Dev.)	(0.42)	(0.37)
Max	2.40	1.95
Min	0.17	0.05
Mode of Acquisition		
Rented in	40	15
	(69%)	(28%)
Allocated Family Land	4	6
	(7%)	(11%)

is a sharp contrast in the mode of acquisition. About the planted area of lowland rice, there are no much difference between the farmers' estimates and the results of GPS measurements.[9] In contrast, maize farmers' estimates of their planted areas were nearly twice as large as the results of GPS measurement. This difference may be partly because many lowland rice fields were rented in. While 69% of lowland rice fields was rented in, that ratio of upland-maize fields was 28%. Some farmers did field measurement upon rent contract. In addition, those who rented in the farm land generally try to cultivate most of the area.

5 Profit

Table 6 summarizes the results of our profit calculations based on the 2001 intensive farmers' survey. The first row shows the crop income: total output value minus all the production costs

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[9]Nine rice farmers, however, could not make any guess about the size of their planted area, while only three maize farmers could not provide the estimates.

Table 6: Profit from Rice and Maize Cultivation: (in old Ghanaian cedi)

		(1) Lowland Rice	(2) Upland Maize	(3) Upland Maize (Subtract Costs for intercrops)[a]	(4) Upland Maize > 0.2 ha (Subtract Costs for intercrops)[a]
	Number of Observations	58	53	53	36
I)	Production Value[b] - Cost of Purchased Inputs (Other than Land Rent)	1,345,887 (1,617,307)	588,014 (592,893)	697,665 (590,331)	822,472 (636,379)
	per Hectare	1,883,873	2,063,552	2,430,370	1,934,604
II)	I) - Imputed Wages of Non-paid Labor	-875,157 (1,914,880)	-289,586 (582,516)	77,549 (488,789)	110,968 (514,439)
	per Hectare	-2,045,497	-1,121,995	238,908	358,062
III)	II) - Land Rent	-1,011,351 (1,905,604)	-323,673 (572,110)	43,462 (479,707)	72,868 (509,130)
	per Hectare	-2,278,607	-1,247,274	113,629	259,872

Source: Authors' own survey. In 2001, 7,000 cedi = 1 USD.

Numbers in parentheses are standard errors.

a) Subtract the half of the cost for land preparation and weeding. Refer
   to the text.

b) Include the value of captured wild animals (grasscutter) sold as meat.

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paid by the respondents either in cash or in kind. The crop income is the main concern for those farmers with few alternative activities: that is, with low opportunity cost. In the study area, rice has been recognized as a cash crop. Our result is in line with such farmers' perception. The average crop income from lowland rice, 1,274,326 old Ghanaian cedi (about 182 US dollars in 2002), is about double of that from upland maize (617,637 cedi).

When we consider the non-paid labor inputs, however, the numbers drastically change. In Row II) of table 6, from the crop income, we subtracted imputed labor costs of the respondents, their family members, and the exchange workers. For the shadow wage of the respondents and the other non-paid workers, we used the mode of daily wages to the agricultural workers in each village.[10] With these imputed payments, both lowland rice and upland maize resulted in negative earnings, but the red of the lowland-rice cultivation is more than three-times larger than that of upland maize (row II), columns (1) and (2) of table 6). This observation supports the results of informal interviews in which farmers often complained that lowland-rice cultivation was a hard work in muddy fields.

Furthermore, column (2) of table 6 seriously underestimated the profit from upland maize. As was mentioned in section 3, mixed cropping has been the common practice in upland farming. Only one out of our 53 maize farmers did not do mixed cropping. The other 52 farmers planted cassava, cocoyam, or plantain with maize. It is, however, virtually impossible to measure the return from these intercrops. This is because, over two to three years after the harvest of maize, farmers gradually harvest cassava, cocoyam and plantain. To obtain some rough estimate of the return from intercrops, we randomly sampled the four-square meters plots in the upland maize fields, and counted the number of each crop. We found that the ratio of maize and the other crops is about fifty-fifty.

In column (3) of table 6, we calculated the profit from upland-maize farming with the 50% of land preparation costs (clearing undergrowth, removing stumps, spraying herbicide, etc).

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[10]In these daily wages, we found little variation across the type of farm activities or hired workers' characteristics (except for sex). This observation may reflect the fact that in the study area, the labor market for casual wage workers is homogeneous due to the huge labor market in Kumasi.

That is, based on the counts of the crops in four-square-meter sample plots, we have boldly assumed that half of the land preparation cost was for the crops other than maize. In this calculation, although very small (78,670 cedi, that is about 11 US dollars), the upland maize recorded positive profit after subtracting all the cost including the implicit payments to family labor. In other words, the shadow wage of upland-maize farmers was almost equal to the market wage rate for casual workers.

Note that upland-maize has been the popular crop among the farmers in the area so that some of the sampled maize farms were cultivated as a side job: for instance, planted maize on a small open space in the oil palm plantation. To exclude such minor maize cultivations, in column (4) of table 6, we summarize only the maize farms with the planted area of 0.2 hectare and above. The average profit becomes 124,702 old Ghanaian cedi, about 18 USD.

Among the four hypotheses we presented, our profit comparison supports hypothesis 4. Lowland rice, in spite of the good access to large market of Kumasi, still cannot compete with the upland maize in profit.[11] The main problem is the large labor inputs required for rice production. In particular, bird watching to protect young rice ear takes a lot of time of rice farmers. About for a month, from early morning to sunset, the rice farmers need to stay in the field to scare birds coming for their rice. In our 58 samples, bird watching accounted for 25% of the total farming cost of lowland rice.

The census results of 2001 and 2011 listed in tables 3 and 4 seem to suggest an increase in Asante rice farmers over the past decade. As of 2001, the Asante farmers might be at the learning stage of rice cultivation from migrant farmers. If this guess holds, the Asante rice farmers attained lower profit in 2001 than the migrant farmers. When we calculate the profit of lowland rice of the 13 Asante samples, however, it was -498,292 old Ghanaian cedi: the red is less than half of the total average (-1,011,351 cedi). At first glance, this is not supportive for hypothesis 2: high learning cost. But when we consider crop income (row I of table 6), the

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[11]The profit numbers, however, varied among four villages (Appendix). As a next step, we need to examine the differences across the four villages.

average of the 13 Asante respondents is 1,105,682 cedi. It is slightly lower than 1,345,887 cedi. We need further examination about the determinants of the profit.

6   Conclusion

Based on the detailed three surveys, in particular on the intensive survey on 111 farm households in central Ghana, we examine the four working hypotheses on the slow diffusion of a new cash crop in the area: lowland rice. We found that lowland-rice farmers suffered from very low shadow wage when we explicitly count the family labor inputs. The main difficulty in the lowland-rice cultivation in the area lied in its high labor demand. Without further labor-saving innovations in lowland rice farming, the extension services or projects for lowland rice promotion would face serious difficulties. The smaller number of rice farmers found in the census implemented ten years after the intensive farmers' survey shores up our prediction based on the profit calculation.[12] Our result suggests that the extension service should target at introducing labor-saving farming practices into lowland-rice cultivation. In the field visit in 2011, we observed the use of fish net for bird chasing in the rice fields. It exemplifies farmers' search for labor-saving rice farming technologies.

Appendix I

Tables 7 to 10 show the profit calculations in each sampled village.

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[12]Admittedly, however, we have not explicitly considered the shift from agriculture to non-agricultural activities in the village economies in the area.

Table 7: Profit from Rice and Maize: Village I

		(1) Lowland Rice (Subtract Costs for intercrop)[a]	(2) Upland Maize	(3) Upland Maize
	Number of Observations	13	12	12
I)	Production Value[b] - Cost of Purchased Inputs (Other than Land Rent)	800,940 (1,173,667)	667,761 (927,989)	773,240 (891,228)
	per Hectare	1,372,201	2,523,041	2,991,042
II)	I) - Imputed Wages of Non-paid Labor	-929,752 (1,045,834)	-221,656 (584,341)	121,365 (530,451)
	per Hectare	-2,122,152	-575,504	706,208
III)	II) - Land Rent	-1,026,957 (1,066,169)	-232,767 (601,990)	110,254 (542,328)
	per Hectare	-2,394,918	-596,642	685,069

Source: Authors' own survey. In 2001, 7,000 cedi = 1 USD.

Numbers in parentheses are standard errors.

a) Subtract the half of the cost for land preparation and weeding. Refer to the text.

b) Include the value of captured wild animals (grasscutter) sold as meat.

Table 8: Profit from Rice and Maize: Village II

		(1) Lowland Rice	(2) Upland Maize	(3) Upland Maize (Subtract Costs for intercrop)[a]
	Number of Observations	17	16	16
I)	Production Value[b] - Cost of Purchased Inputs (Other than Land Rent)	915,375 (546,966)	438,625 (389,220)	546,672 (425,337)
	per Hectare	2,149,566	1,809,265	2,156,103
II)	I) - Imputed Wages of Non-paid Labor	-1,739,037 (1,655,433)	-180,552 (409,411)	88,661 (376,336)
	per Hectare	-3,797,585	-716,149	314,529
III)	II) - Land Rent	-1,857,469 (1,630,482)	-219,380 (372,412)	49,833 (343,037)
	per Hectare	-4,076,274	-903,696	126,982

Source: Authors' own survey. In 2001, 7,000 cedi = 1 USD.

Numbers in parentheses are standard errors.

a) Subtract the half of the cost for land preparation and weeding. Refer
   to the text.

b) Include the value of captured wild animals (grasscutter) sold as meat.

Table 9: Profit from Rice and Maize: Village III

		(1) Lowland Rice	(2) Upland Maize	(3) Upland Maize (Subtract Costs for intercrop)[a]
	Number of Observations	18	17	17
I)	Production Value[b] - Cost of Purchased Inputs (Other than Land Rent)	2,227,308 (1,913,612)	671,169 (529,854)	805,007 (540,373)
	per Hectare	2,118,775	2,481,925	2,936,392
II)	I) - Imputed Wages of Non-paid Labor	269,669 (1,964,191)	-278,478 (603,913)	156,243 (481,513)
	per Hectare	-42,291	-1,415,449	382,515
III)	II) - Land Rent	94,613 (1,926,719)	-134,948 (611,941)	119,772 (496,015)
	per Hectare	-224,547	-1,575,995	221,970

Source: Authors' own survey. In 2001, 7,000 cedi = 1 USD.

Numbers in parentheses are standard errors.

a) Subtract the half of the cost for land preparation and weeding. Refer to the text.

b) Include the value of captured wild animals (grasscutter) sold as meat.

Table 10: Profit from Rice and Maize: Village IV

		(1) Lowland Rice	(2) Upland Maize	(3) Upland Maize (Subtract Costs for intercrop)[a]
	Number of Observations	10	8	8
I)	Production Value[b] - Cost of Purchased Inputs (Other than Land Rent)	1,199,628 (2,218,986)	590,469 (461,529)	658,188 (440,285)
	per Hectare	1,674,548	993,847	1,062,596
II)	I) - Imputed Wages of Non-paid Labor	-1,396,272 (2,295,256)	-633,156 (788,059)	-177,625 (637,306)
	per Hectare	-2,573,065	-2,129,837	-918,452
III)	II) - Land Rent	-1,543,397 (2,372,997)	-687,156 (720,167)	-231,625 (569,548)
	per Hectare	-2,859,675	-2,211,843	-1,000,458

Source: Authors' own survey. In 2001, 7,000 cedi = 1 USD.

Numbers in parentheses are standard errors.

a) Subtract the half of the cost for land preparation and weeding. Refer
   to the text.

b) Include the value of captured wild animals (grasscutter) sold as meat.

Appendix II: Implicit Wages to Family Members and Exchange Workers

For robustness check, we have calculated profits from lowland-rice and upland-maize cultivation under the various assumptions on the opportunity costs of non-wage workers: e.g., respondents themselves, their family members, and exchange labors. In this appendix, we explain our two basic assumptions on the opportunity costs. To all the shadow wages of non-paid workers, we added the costs for lunch.

In the first calculation, we adopted the ordinary daily-wage rate collected in the village survey as the opportunity cost of non-wage workers (shown in table 6). In each village, across various works from clearing to threshing, the same wage rate is applied. Due to the access to the big labor market in Kumasi, wage rates in each village are stable across months. Considering the usual work hours of hired agricultural workers, days with less that three-hour work are excluded.

In the second calculation, as the opportunity cost in each work of rice and maize farming, we used the hourly wage for that work in each village. Suppose that respondent A cleared the undergrowth of his plot for three day, six hours in each day, with a male member of his extended family. Suppose also that respondent B in the same village cleared his farm's undergrowth with a hired male worker: 8,000 cedi as a daily wage plus 1,000 cedi for his lunch. Respondent B spent two days, five hours in each day, for clearing undergrowth. From the case of respondent B, we calculated the hourly wage for a male worker for clearing undergrowth as 1800 old Ghanaian cedi. And applied it to the six-hour work of respondent A and the extended family member of respondent A, and to the five-hour work of respondent B. Specifically, the opportunity cost of, for example, respondent B is calculated by 1800 cedi $\times 5 \times 2$ days. In the application, we have calculated and used the average hourly payments in each village.

The second calculation may seem to be based on a natural assumption, but has at least two problems. First, both in lowland-rice and upland-maize cropping, there are works with no

Table 11: Profit Comparison under Two Assumptions

		(1) Lowland Rice	Imputed by hourly wage rate	(2) Upland Maize	Imputed by hourly wage rate
	Number of Observations	58	58	53	53
II)	Crop Income (I) - Imputed Wages of Family Labor	-946,717 (1,932,032)	-3,372,438 (3,215,515)	-254,379 (645,016)	-609,597 (920,323)
III)	II) - Land Rent	-1,082,911 (1,923,079)	-3,508,632 (3,213,796)	-288,465 (636,992)	-643,683 (921,036)

record of the use of daily-wage workers. In the case of rice farming, six out of fifteen works recorded no daily-wage payments to male workers. Complicating matters more in rice farming is that there were only three works recording female daily-wage workers: planting, weeding, and harvesting. There were no records of daily wage payments to child workers.[13]

For female wage, in principle, we used 1000-cedi less daily wage than the male workers (the lunch pay is assumed to be the same). This assumption is based on the observations in the work where we can observe both male and female daily-wage workers. Second, respondent A and B do not necessarily did their clearing work in the same period. Respondent A may do it in January, while respondent B may do it very late, say, in April. In this case, respondent A may have different opportunity cost than 1800 cedi mentioned above.

Table 11 shows a comparison between the profit calculation of the two methods discussed here. The imputed labor costs are significantly larger when we use the second method.

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[13]This does not mean respondents hided the use of child labor. There are cases of hired child workers, but in piece rate.

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