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Data collection survey on rice related programs/projects in the CARD member countries (with Study on the local rice competitiveness in 15 selected countries) : Final Report. -- Japan International Cooperation Agency : NTC International Co., Ltd. : RECS International Inc., 2021. 8, Annex A.

Competitiveness Analysis of Local Rice to Imported Rice
Ghana

1. Objectives and outline of the analysis

The program of CARD2, launched in 2019, aims to increase rice production in Sub-Saharan Africa from 28 million tons to 56 million tons by 2030. The competitiveness of local rice against imported rice would be an important aspect to look into to achieve this aim. Given this context, a study comparing the competitiveness of local and imported rice for 15 countries[1]. was implemented by Japan International Cooperation Agency (JICA) from February to August 2021.

With relentless efforts in rice sector development, the competitiveness of the locally produced rice against imported rice has been recently improving in Sub-Saharan African countries. However, the pace of development in local rice is not sufficient due to the rapid expansion in demand. In addition, local rice often faces competition from imported rice. The main objective of this survey was to analyze the competitiveness of major local rice varieties against imported rice. DRC (domestic resource cost) approach was applied to quantitatively analyze the competitiveness, and sensitivity analysis to discuss the achievable approach to improve it. The competitiveness analysis should be updated as more information becomes available, since the situation on the rice sector in Sub-Saharan Africa is constantly changing and the information in the current survey was very limited.

2. Local rice and imported rice

2.1. Comparison of local rice and imported rice

Rice consumption in Ghana has more than quadrupled in the last 60 years, becoming a common staple food. Rice is the second most important grain food after maize. However, the production quantity cannot grow the same pace as this increasing demand, and the demand is being met by imports. As a result, the self-sufficiency rate remains at around 45% (Fig. 1). The quality of branded local rice has been improved in recent years, but unbranded local rice is still commonly contaminated with foreign materials, made up of co-mingled varieties, and have a large share of broken and yellowish grains (Ayeduvor, 2018). Although the local rice, even branded and well-packaged, is sold with lower price than imported rice, consumers have tendencies to prefer imported rice due to their better quality.

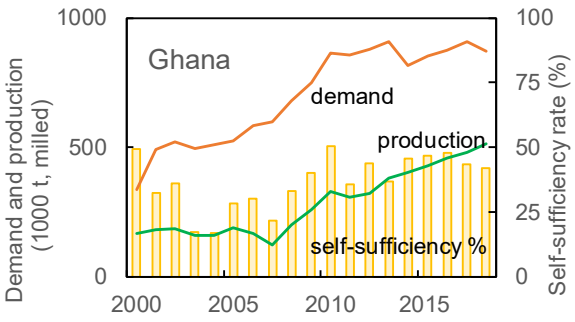

Fig. 1. Rice supply in Ghana.
Source: Made by JICA Survey Team based on data from FAOSTAT, browsed in June, 2021.

Rice markets in Ghana is segmented. Many supermarkets and malls primarily sell imported rice and branded local rice, while, traders in traditional open markets sell mostly unbranded local rice. Branded local rice is primarily sold in supermarkets in Kumasi and Tamale, but not widely in Accra (Ayeduvor, 2018).

[1] Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Kenya, Liberia, Madagascar, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, Togo.

2.2 Consumers' preference

Figure 2 shows the results of consumer preference survey carried out in June-July 2021. The number of respondents to the web-based questionnaire survey was 100 in total. The people prefer the local rice in general. The important factors in choosing rice are taste, cleanliness, nutritional value, price, aroma and appearance. Regarding the most important factor which was the taste, local rice and imported rice is evaluated almost equally. The imported rice is evaluated better than the local rice in aroma, appearance and cleanliness. Regarding the price, however, the local rice is evaluated better than the imported rice. The competitiveness of the local rice would be increased by improvement of post-harvest handling, especially in terms of cleanliness

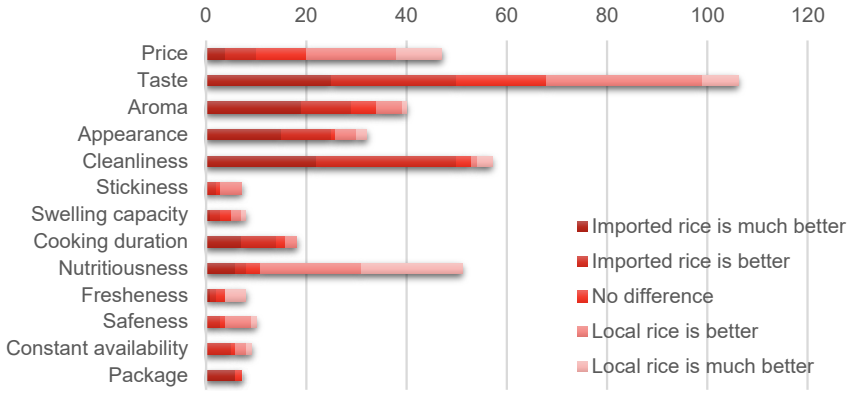

Fig. 2. Important factors when choosing rice and comparison between imported and local rice.

2.3 Major brands/varieties

(1) Local rice

Rice varieties sold in traditional open markets are Jasmin 85, Togo Marshal, Mandii, AGRA Rice, Viwonor and TOX 3018 (Ragasa and Chapoto, 2016; Ayeduvor, 2018). AGRA rice is a type of rice that recently developed by Crop Research Institute (CRI) with support from AGRA. In traditional markets these varieties are often mixed up. Brands of local rice mainly sold in supermarkets are Royal Farmers, DUQ, Aduanehene, Barbrina, Esisel, Copa, Bongo Rice, Mr Rabbit Jasmin and Champion (Ayeduvor, 2018; Andam *et al*., 2019). According to most recent information from a survey in Akatsi Market, AGRA Rice and Legon Rice-1 were most sold in the market (CARD Training, 2021). Table 1 shows information of some varieties grown under different conditions (JICA, 2008). Information, such as yield and growing period, of varieties mentioned above were not available.

Table 1. Rice varieties under different rice ecologies in Ghana.

Rice ecology	Variety	Growing period (days)	Expected yield (t/ha)
Irrigation/rain-fed lowland	GR 19	115 - 130	4.0 - 5.5
	GR 21	115 - 130	4.0 - 4.5
	TOX 3107	115 - 130	5.0 - 5.5
	FARD 15	115 - 130	5.0 - 5.5
	ITA 330	115 - 130	5.0 - 6.5
Midland/drought-prone lowland	IR 12979-24-1	110	n.a.
	GR 18	125 - 135	5.0 - 6.5
	Shikomo (TOX 3108)	n.a.	n.a.
Upland	IRAT 262	90 - 103	2.5
	ITA 320	90 - 105	2.5 – 3.0
	IDSA 85	90 - 105	2.5 – 3.0
	WAB 181-18-1	90 - 105	2.5 – 3.5

Source: JICA, 2008.

In Ghana rice is mostly cultivated in rain-fed condition (lowland and upland) which occupies about 84% of the country's total rice growing area. The share of the rice production ecologies and their average yield are shown in Fig.3.

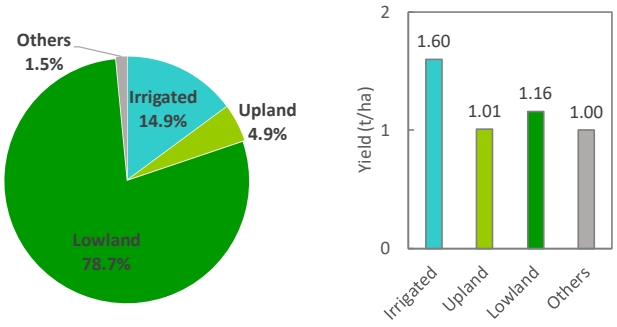

Fig. 3. Percentage of rice ecologies and their average yield.
Source: Made by JICA Survey Team based on the study of Diagne *et al.*, 2013.

Main rice producing areas in Ghana are Upper East, Northern, Volta, and Upper West regions. The farmers in those regions produce 80% of the total rice in Ghana (Ayeduvor, 2018). Figure 4 indicates the distribution of rice producing areas. They are around Sogakope (or called Sogakofe), Tamale and Autare (Ayeduvor, 2018).

Figure 5 shows the main cultivation seasons in Northern, Southern, and Coastal regions. The growing periods are between 90-130 days (JICA, 2008). The period shown here is the optimum time, especially under the rain-fed cultivation, however, many farmers plant late, in some cases 3 months later than the optimum timing. In irrigated area, some farmers start planting during harvest time of rainy-season cultivation, but the area with two cultivations are limited to about 50% (JICA, 2008).

Fig. 4. Distribution of rice producing areas.
Source: GIEWS FPMA Tool, FPMA Tool (fao.org)

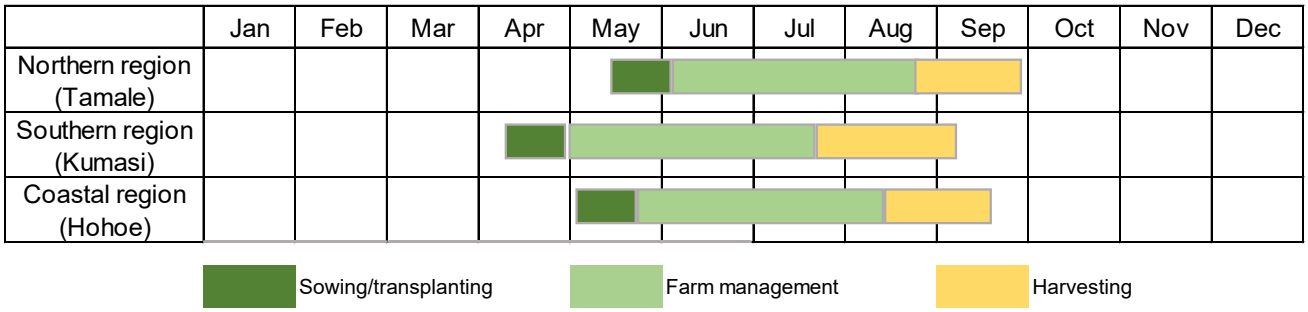

Fig. 5. Rice cultivation season in Ghana.
Source: Made by JICA Survey Team based on JICA, 2008.

(2) Imported rice

Major imported rice brands in Ghana are Millicent (from Viet Nam), Cindy (Viet Nam/UAE), Gino (Thailand), Lele (Thailand), Fortune (Viet Nam/Thailand), Royal Aroma (Viet Nam/Thailand) and Basmati (Pakistan/Basmati) (Ayeduvor, 2018; Andam *et al.*, 2019).

Table 2 shows the quantity and values of imported rice from major exporting countries according to the International Trade Center (ITC). The first exporting country is Thailand, followed by India and Pakistan. Rice from Thailand has share of 42%. The unit value of rice from Thailand which is aromatic rice is very high (824 USD/t). Total imported quantity has been decreased in last 5 years by 12% annually (Table 2). However, more rice from China and Pakistan are coming in to Ghana recently.

Table 2. Information about imported rice (Total quantity of milled rice, husked rice, broken rice, etc. in 2020).

	Quantity imported (t)	Share in quantity (%)	Value imported (1,000 USD)	Unit value (USD/t)	Growth in imported quantity between 2016-2020 (%, p.a.)	Average tariff (estimated) applied by Ghana (%)
Total	**211,121**		**107,220**	**508**	**-12**	
Thailand	54,992	42.2	45,286	824	-29	20
India	72,188	25.5	27,293	378	-12	20
Pakistan	48,945	19.2	20,638	422	68	20
China	21,004	5.6	5,953	283	186	20
Myanmar	6,394	2.1	2,224	348	-38	20
Taipei, Chinese	1,640	1.8	1,960	1,195	384	20
United States of America	2,939	1.7	1,841	626	-14	20
Cambodia	2,775	1.7	1,836	662	218	20
Singapore	96	0.1	61	635		20
Germany	56	0.0	45	804	28	20

Source: Trade Map - List of supplying markets for the product imported by Ghana in 2020 (Mirror)

2.4 Marketing

(1) Market structure

Figure 6 shows the local rice supply chain with estimated rice quantities in each channel, based on the survey in 2008 (JICA, 2008). Here, the rice producers are categorized into three groups, (1) with irrigation system, (2) rain-fed with intermediate intensification of input, and (3) rain-fed with low input. The second group is the majority for rice production in Ghana.

Their characteristics are as follows;

(1) Producers with irrigation system, producing high quality rice for large cities.

(2) Producers under rain-fed condition, trying to produce rice with rather good quality. However, the main purpose of the cultivation is for self-consumption.

(3) Producers under rain-fed condition, with low input, producing rice for the self-consumption and sell the surplus.

In the survey of 2008 half of the local rice was in the value chain, and the other half was for their consumption. Figure 6 shows that only 30% of locally produced rice reaches urban markets. However, in recent years, small-scale rice farmers who sell their produce to small-scale processors who are usually women associations has been increasing (Amikuzuno *et al*., 2013).

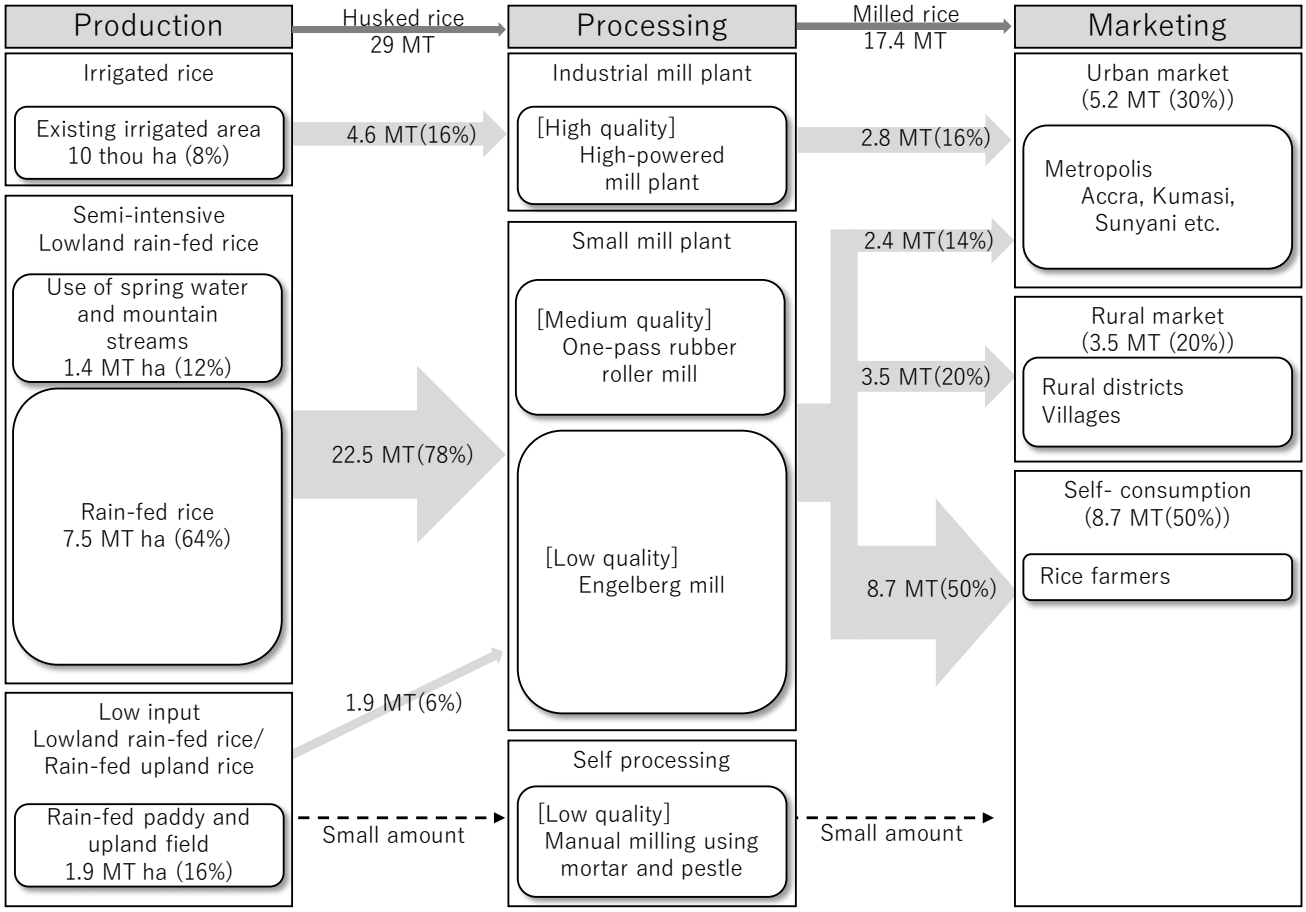

Fig. 6. Supply chain of local rice in Ghana.
Source: Made by JICA Survey Team, based on JICA, 2008.

(2) Market path of local rice and imported rice

Ghana's biggest seaport is Tema (25 km from Accra) and the second is Takoradi (188 km). Five most important inland rice markets are Accra, Kumasi, Techiman, Tamale and Bolgatanga (Amikuzuno *et al.*, 2013). The major producing areas of local rice are around Sogakope (Sogakofe), Tamale and Autare (Ayeduvor, 2018). Main market path of local rice and imported rice are shown in Fig. 7.

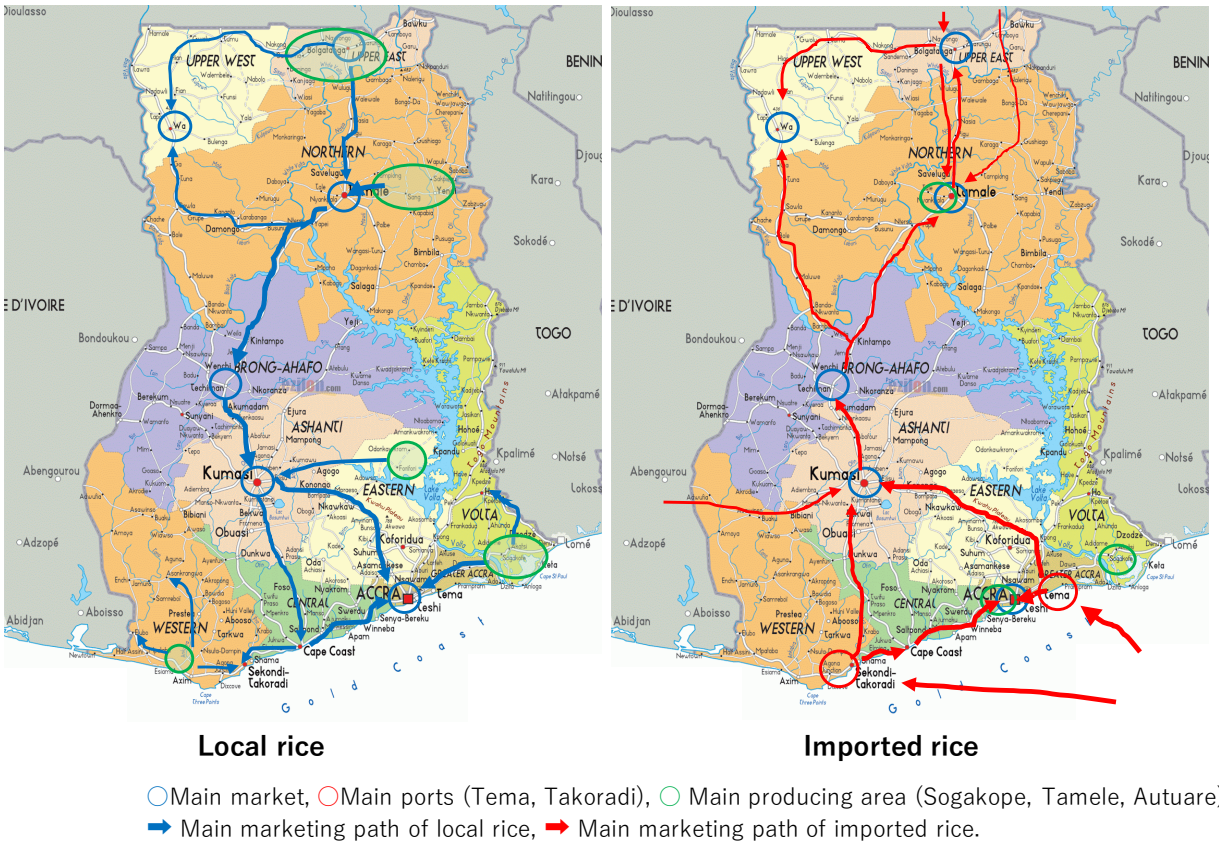

Fig. 7. Main marketing path of local rice and imported rice.
Source: The flows were drawn by JICA Survey Team, based on JICA, 2008, Amikuzuno *et al.*, 2013, CARD Training, 2021.

2.5 Price comparison in the market

Since the on-site survey for the price comparison was not conducted, information from several references are compared and discussed below.

Ayeduvor (2018) and Andam *et al.* (2019) reported that the local brands have lower price than imported rice brands at shops. Table 3 shows price of local brands and imported brands at retails and shops, and consumers' preference. The most preferred brand was Gino (imported brand) although it was most expensive at shops.

Table 3. Price of selected local rice brands and imported rice brands at retails/shops (GHC/kg), and consumers' preference.

	Retail price [a]	Price at shops [b]	Most preferred brand [a] (%)
Local brand			
Copa	5.60	6.00	12
Royal farmers	5.50		
DUQ	5.16	6.00	8
Champion		6.60	16
Imported brand			
Gino	6.85	8.60	53
Millicent	6.87	6.80	14
Royal Aroma	9.62	6.80	6

Source: Ayeduvor, 2018 and Andam *et al.*, 2019.
a) The imported rice price is average of 59 supermarkets in Accra and Cape Coast. The local rice price is of mini-supermarkets.
b) Prices at shops are average of 400 rice shops in Accra.

The other recent data set of last two years (FPMA, FAO) also shows that the average price of local rice is lower than that of imported rice in all major wholesale markets (Table 4, Fig. 8). The local rice is more expensive in Accra

than rice producing area, while imported rice becomes more expensive in local areas than in Accra where the port (Tema) is close.

Table 4. Average price of local rice and imported rice in last two years at wholesale market in different towns (GHC/kg).

	Price at wholesale market (GHC/kg) [a]					
	Accra	Kumasi	Bolgatan	Tamale	Techiman	Wa
Local	4.47 ± 0.26	3.38 ± 0.34	4.51 ± 0.56	2.73± 0.36	3.35 ± 0.57	n.a.
Imported	5.13 ± 0.42	5.70 ± 0.44	7.07 ± 1.47	7.50 ± 0.25	6.83 ± 0.78	7.16 ± 0.51

a) Average (± SD) of last two years (Feb 2019-Feb 2021), Source: GIEWS FPMA Tool, FPMA Tool (fao.org), browsed March 2021.

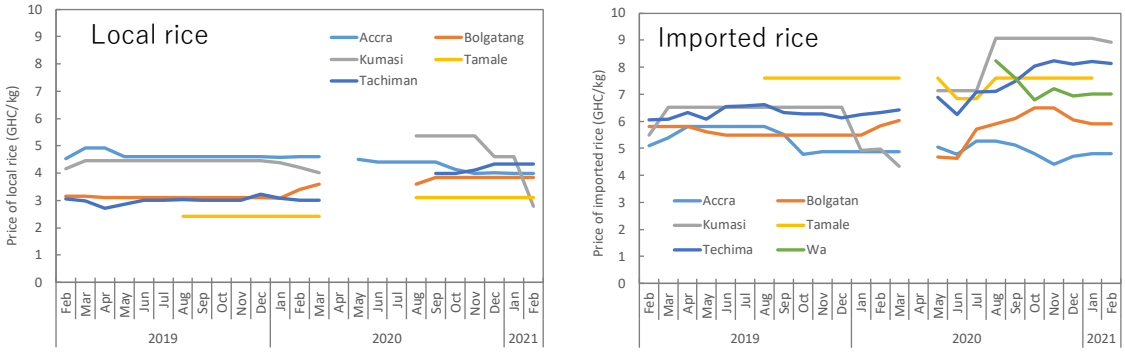

Fig.8. Wholesale price of local rice and imported rice for last two years in different towns.
Source: GIEWS FPMA Tool, FPMA Tool (fao.org), browsed March 2021

Figure 9 shows the rice price trends of selected wholesale and retail markets. Data sets were collected by SRID (Statistics, Research, and Information Directorate) of MoFA. This figure also shows that local rice had lower price than imported rice in last 10 years, at both wholesales and retails.

Furthermore, according to the recent market survey in 2021 at Akatsi market, AGRA Rice and Legon Rice 1 were sold at 6 - 8 Cedi/kg, and imported rice was sold at 5.8 – 10 Cedi/kg in average (CARD Training, 2021).

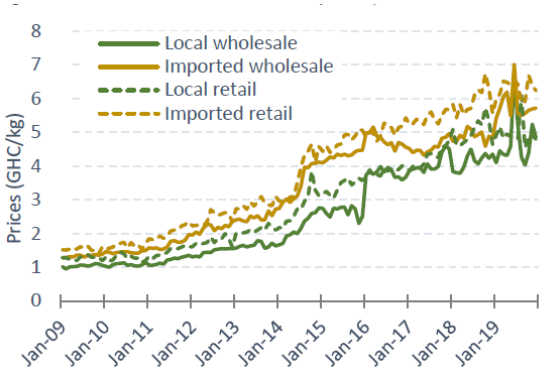

Fig. 9. Wholesale and retail rice price (2009-2019).
Source: MoFA-IFPRI, 2020.

Table 5 shows the comparison of costs for local rice and imported rice. The local rice compared were under rain-fed condition in Volta region and irrigated condition in Northern region, and imported rice were from three areas in Thailand. The total cost of producing and marketing rice in Ghana is considerably higher than those in Thailand. This is due to higher input costs, lower milling efficiency, higher milling cost and marketing cost in Ghana (Ragasa *et al.*, 2014)

Table 5. Comparison of production costs to bring rice to retail markets (2011).

Country	Ghana		Thailand		
Area (rice ecology)	Volta region, (rain-fed)	Northern region, (irrigated)	Northeast, (rain-fed)	Central, (irrigated)	Central, (irrigated)
Variety, rice type	Aromatic	Non-aromatic	Khao Horn Mali	Pathumthani 1	Suphanburi 1, Chainat 1
Total production cost (USD/t paddy)	316	283	220	201	159
Milling yield (%)	60	55	62	62	62
Total production costs (USD/t milled rice)	527	515	355	325	256
Farm-gate price	1,111	548	753	500	376
Total milling costs (USD/ t milled)	296	98	87	95	93
Total marketing costs (USD/t milled)	154	130	136	74	66
Calculated value at retail (USD/t milled)	**1,562**	**777**			
Calculated FOB price at port (USD/t milled)			**1,113**	**763**	**537**

Source: Ragasa *et al*., 2014.

3. Competitiveness analysis

3.1 Production cost of local rice for DRC ratio analysis

For DRC analysis to evaluate the competitiveness of the local rice, six cases under different conditions in different areas were compared. They were;

Case I: Average farmer in irrigated areas

Case II: Average farmer in lowland rain-fed areas

Case III: Rain-fed in Tamale

Case IV: Irrigated in Upper East

Case V: Rain-fed in Upper East

Case VI: Irrigated in Ashanti

Table 6 shows the rice production costs for DRC analysis. Case I and II are calculated based on CRI/SARI/International Food Policy Research Institute survey in 2013, and Case III - VI are the results of informal interviews with farmers in different areas in 2012-2013 season by Ragasa and Chapoto (2016). Different farmers adopt different inputs and have different levels of output (yield). Generally, fertilizer input and labor intensity were higher under irrigation than under rain-fed condition. The fertilizer application was highest in Case I, and the labor intensity was highest in Case VI. As a result, total production costs per area were higher in irrigated area than that in rain-fed, even without considering the irrigation infrastructure cost. As an instant, the cost in Case VI (4,354 GHC/ha) was more than three times as much as Case III (1,320 GHC/ha). However, because Case VI has higher yield than Case III, the cost per rice weight resulted in almost the same level (1.20 GHC/kg, milled rice in Case III and 1.25 GHC/kg, milled rice in Case VI). Main varieties cultivated in the farms interviewed (Case II – VI) were Jasmine 85, Togo Marshall and Mandii.

Table 6. Production costs of different rice ecologies in different areas.

	Case I	Case II	Case III	Case IV	Case V	Case VI
	Ave. farmer in irrigated areas [a]	Ave. farmer in lowland rain-fed areas [a]	Tamale (rain-fed) [b]	Upper East (irrigated) [b]	Upper East (rain-fed) [b]	Ashanti (irrigated) [b]
Yield (t, paddy /ha)	3.0	1.7	1.9	3.0	2.0	6.0
Cost						
Water managing fee	95			105.7		156.6
Land preparation (Tractor)	150	150	62	247	90	300
Fertilizer	673	300	237	544	445	436
Chemicals	66	66	49	47	49	75
Labor (hired)	707	343	178	1,045	300	1,501
Labor (family and communal)	903	672	672	903	672	903
Transport from plot to house	40	40	37	59	37	50
Other material and cost	200	100	20	171	57	770
Capital interest [c]	158	87	65	154	94	224
Total production cost (GHC/ha)	**2,992**	**1,758**	**1,320**	**3,265**	**1,744**	**4,354**
Total production cost (GHC/kg, milled) [d]	**1.72**	**1.78**	**1.20**	**1.88**	**1.50**	**1.25**
Irrigation development [e]						
Construction	1,114			1,114		1,114
O & M	1,114			1,114		1,114
Total irrigation cost (GHC/ha)	**2,227**			**2,227**		**2,227**
Total irrigation cost (GHC/kg, milled)	**1.28**			**1.28**		**0.64**
Total cost (GHC/ha)	**5,219**	**1,758**	**1,320**	**5,492**	**1,744**	**6,581**
Total cost (GHC/kg, milled)	**3.00**	**1.78**	**1.20**	**3.16**	**1.50**	**1.89**

Source: Modified by JICA Survey Team based on Ragasa and Chapoto, 2016.
a) Based on CRI/SARI/IFPRI[2], surveyed in 2012-2013.
b) Based on informal interviews of selected farmers in 2012-2013 season.
c) Capital interest was estimated for the expenses on material inputs and 40% of labor inputs by applying 10% of annual interest rate.
d) Conversion rate from paddy grain to milled rice of 0.58 (Ragasa *et al*., 2014) was used to estimate production costs per milled rice weight.
e) Irrigation development cost: The unit hardware cost of 'success' projects in sub-Saharan region (3,552 USD/ha in 2000 price) from Inocencio *et al*., (2007) was converted to the year of production cost data by GDP deflator, and multiplied by 0.01, assuming the interest rate is 10%. This is applied to both annual construction cost and O & M cost.

3.2 Marketing cost for DRC ratio analysis

Table 7 shows the marketing cost for local rice from the producing areas to the wholesale market in Accra for DRC analysis. The transport costs were estimated according to the distance, based on the access cost from Tamale to Accra in 2013 (FAO-MAFAP, 2016). The milling cost of 165 GHC/t (Ragasa *et al.*, 2014) was additionally included to the original data sets of FAO-MAFAP (2016) for DRC analysis.

[2] CRI (Crops Research Institute)/SARI (Savannah Agricultural Research Institute)/IFPRI (International Food Policy Research Institute)

Table 7. Marketing costs from farm gate to wholesale market in Accra.

	Marketing cost from production area to Accra wholesale market (GHC/t, paddy)			
	Csse I and II Average distance (481 km)	**Case III** From Tamale (618 km)	**Case IV and V** From Upper East region (583 km)	**Case VI** From Ashanti (Kumasi) (248 km)
Cost				
Transport [a]	43	55	52	22
District Assembly Levy	5	5	5	5
Milling [b]	165	165	165	165
Loading	2	2	2	2
Off-loading	2	2	2	2
Sack	20	20	20	20
Storage	10	10	10	10
Labor for sewing sack	10	10	10	10
Trader's margin (10% of wholesale price [c])	131	131	131	131
Total cost (GHC/ t, paddy)	**400**	**235**	**397**	**367**
Total cost (GHC/ kg, milled [d])	**0.68**	**0.68**	**0.63**	**0.67**

Source: FAO-MAFAP (2016).
a) Transport cost was calculated based on the access cost from Tamale to Accra according to the distance from each production area.
b) Milling cost was obtained from Ragasa, *et al.* (2014) in USD, and converted to GHC by exchange rate of 2.9 GHC/USD of 2014. It is assumed that millers are close to the consumption area.
c) The wholesale price in the original survey was reported as 1,311 GHC/t, paddy.
d) Conversion rate from paddy grain to milled rice of 0.58 (Ragasa *et al.*, 2014) was used to estimate the costs per milled rice weight.

Table 8 shows the marketing costs for imported rice from the Port of Tema (25 km away from Accra) to the wholesale market in Accra. The estimated cost of 2013 from FAO-MAFAP (2016) is used for the DRC analysis.

Table 8. Access costs from the border to the point of competition for rice (wholesale market in Accra (GHC/t).

	Market cost (GHC/t, milled)
Cost	
Processing fee (1% of CIF [a])	10
NHIL (National health insurance levy)	26
Port charge (inspection fees, service charge, the Ghana Shippers Council fees)	358
Transport to market	138
Trader's margin (5% of CIF)	55
Total cost (GHC/t, milled)	**587**
Total cost (GHC/kg, milled)	**0.59**

Source: FAO-MAFAP (2016)
a) The CIF price used in the original survey was 1,099 GHC/t, milled rice.

3.3 Competitiveness analysis by DRC ratio

(1) DRC ratio analysis

In this survey, we use DRC (domestic resource cost) ratio as an indicator for the competitiveness of local rice. This measures the comparative advantage of local rice production at the capital's wholesale market, where local rice and imported rice are sold side by side (Kikuchi *et al.*, 2016). The DRC ratio is the cost-benefit ratio between the cost of domestic resources used to produce one unit of rice and the net foreign exchange that can be earned by exporting one unit of rice. We use 'tradable-good component ratio' and 'domestic-resource component ratio' of each cost needed for production and marketing of rice. Domestic rice production has a comparative advantage if DRC ratio < 1.0. Regarding the exchange rate of the currency, due to the lack of precise information on the shadow price, the market exchange rate was used to calculate the prices according to the corresponding year for conversion of foreign currency into local currency. The tradable-good component ratio refers to Kikuchi *et al.* (2016).

Table 9 shows the results of the DRC analysis. It also shows the DRC ratios without irrigation construction cost and O&M cost. The data sources of production costs, irrigation costs, marketing costs for local rice and marketing cost for imported rice are shown in Table 6, 7, and 8. As shown in these tables, cost information are from different

sources and from different years. The detailed calculation results of the DRC ratio are shown in the attached table (after the reference list).

99% of farmers under irrigation and 49% of farmers in rain-fed condition grow improved varieties. Major improved varieties are Jasmine 85, Togo Marshall and Mandii (Ragasa and Chapoto, 2016). In 2020, the imported rice is mainly from Thailand (42%) and India (26%) (Table 2). However, in 2013, year of the data of production cost and marketing cost, Viet Nam and Thailand were major exporting countries to Ghana and their total share was 70%. For the DRC analysis, the average CIF price of imported rice in 2013 (1.28 GHC/kg) was adopted.

When calculated including the costs of construction and management of the irrigation infrastructure, all the DRC ratio (Case I, IV, VI) were higher than or equal to 2.0 (Table 9). Average farmers in Ghana (Case I), and farmers in Upper East (Case IV) under irrigation obtain the DRC ratio higher than 7.0, while, farmers in Ashanti (Case VI) got 2.0. This is due to the high yield in Ashanti (6.0 t/ha). Farming in Case VI adopted high labor intensity, the highest in six cases, but its DRC ratio was rather low due to the high yield. According to the report by JICA (2008), when proper inputs are effectively used with good crop management, to achieve high yield of 5.0-6.0 t/ha, the same level as Case VI, is possible under irrigated condition.

The DRC ratios under rain-fed condition ranged from 1.02 to 1.77. Only Case III had the DRC ratio about 1.0, which indicates the local rice produced under rain-fed condition in Tamale is as competitive as the imported rice. Farming in Case III (Tamale) was using lowest cost for fertilizer and least labor work among all the cases, but the yield was higher than the average in lowland rain-fed areas (Case II). Case II which had the highest DRC ratio among rain-fed condition was requiring 1.3 times as much as the total production cost of Case III.

In Ghana, though irrigated area is limited to 15% (Fig. 3), about 50% of farmers under irrigation practice double cropping of rice per year (JICA, 2008). Therefore, DRC ratio with double cropping cultivation was calculated with Case I (Average farmer under irrigation) and Case VI (Irrigated in Ashanti), where the DRC ratio was 8.17 (the highest) and 2.00 (the lowest among irrigated cultivation), respectively, in order to find the effect on the competitiveness. When it is assumed that the yield in the second season is equivalent with the same level of farm inputs, the DRC ratio of Case I changes to 3.29 from 8.17, and that of Case VI changes to 1.43 from 2.00. It is because the cost of irrigation structure per unit area becomes half in the calculation. This indicates the advantage of double cropping in increasing the competitiveness, especially with Case I where the DRC ratio was high with single cropping, but it was not significant enough to make the DRC ratio 1.0 in both cases.

When calculated excluding costs of construction and management of irrigation infrastructure, the DRC ratios were lowered drastically, especially with Case I and IV (Table 9). They were reduced from 8.17 to 1.68, and 8.12 to 1.88, respectively. This can suggest that irrigated rice cultivation, though very limited in Ghana (Fig. 3), is not far from competitive level when the cost of irrigation infrastructure is treated as a sunk cost. If the existing large-scale irrigation scheme can be managed well for longer time, instead of starting the new construction of irrigation facility, the local rice, such as Jasmine 85 and Togo Marshall, have reasonable competitiveness against the imported rice.

We have to note that, in all cases, import tariffs are not included in the calculation in this analysis since the DRC ratio analysis in principle is to evaluate the competitiveness of local rice without government intervention. Therefore, including tariffs would improve the competitiveness of local rice in all cases.

Table 9. Result of DRC analysis.

Case	Production conditions/areas	Yield (t/ha)	DRC ratio (DRC without irrigation cost [a])
I	Average farmer in irrigated areas	3.0	8.17 (1.68)
II	Average farmer in lowland rain-fed areas	1.7	1.77
III	Rain-fed in Tamale	1.9	1.02
IV	Irrigated in Upper East	3.0	8.12 (1.88)
V	Rain-fed in Upper East	2.0	1.40
VI	Irrigated in Ashanti	6.0	2.00 (1.02)

a) Irrigation infrastructure cost is the sum of construction cost and O&M cost (10% of the infrastructure unit cost). The detail information is shown in Table 6 (the production cost table).

(2) Sensitivity analysis

Sensitivity analysis was conducted for Case I (without irrigation infrastructure cost), II, IV, and V (without irrigation costs). Table 10 shows the possible approaches to lower their DRC ratios and increase the competitiveness.

Case I and IV: These two cases, compared with Case VI, used more fertilizer but employed less labor, and therefore achieved half yield (Table 6). It is assumed that if crop management is practiced appropriately with more labor input, their yield could be improved to around 5.0 t/ha since yield of 5.0-6.0 t/ha is achievable under irrigation with improved varieties (Ragasa and Chapoto, 2016; JICA, 2008, Table 1).

Case II and V: Case II and V both hire more labor than Case III, but lower yield. Therefore, if they reduce production costs by managing the labor more efficient, the DRC ratio could become lower. In Case II if the yield is increased by about 12% to 1.9 t/ha (same level as Case III), the ratio becomes 1.30. In Case V, the yield was already higher than Case III, therefore improving the yield might be challenging.

Table 10. Result of sensitivity analyses for DRC ratio.

	Possible approach to increase the competitiveness	Effect (change of DRC ratio)
Case I (without irrigation cost)	Increase the labor intensity (to the same level of Case VI) for better crop management, and increase yield from 3.0 to 5.0 t/ha.	1.68 → 1.12
Case II	Reduce the hired labor (to the level of Case III) by making the work more effective, and increase the yield from 1.7 to 1.9 t/ha (12% increase).	1.77 → 1.30
Case IV (without irrigation cost)	Increase the labor intensity (to the same level of Case VI) for better crop management, and increase yield from 3.0 to 5.0 t/ha.	1.88 → 1.11
Case V	Reduce the hired labor (to the level of Case III) by making the work more effective.	1.40 → 1.26

4. Related policy

4.1 Policy measures to stimulate consumption of local rice

The Deputy Minister of Agriculture has promised that the government will stop importing rice by 2020-2023 crop

season (GhanaWeb, 2021). The government under the Planting for Food and Jobs Programme has initiated several policies for helping rice farmers, include helping with the packaging of domestic rice to make it more attractive. Moreover, the government has increased the quantity of seeds that it gives to farmers.

According to CARD Training (2021), the following activities are being carried out to assist in improving the competitiveness of domestic rice.

- Supply of improved rice seeds at subsidized prices for farmers
- Supply of blended fertilizers at subsidized prices for farmers
- Exemptions on import duties on imported agricultural inputs such as plant and machinery or equipment
- Agro-processing companies established in Ghana will enjoy five years' tax holiday from the date of commencement of business
- Agro-processing enterprises that use local agricultural raw materials as the main input corporate tax rates based on their locations

Ghana's government has initiated several policies; increasing tariff on rice (FASDEP I, II, METASIP, etc.) and established the Ghana rice inter-professional body (GRIB) (Tanko and Amikuzuno, 2015). Imported rice has a 20% ad valorem tariff to which a 12.5% VAT is added. An increase of the tariff from 20% to 25% was considered in 2003, to respond to the import surge. The option was eventually not retained for various reasons including the willingness of the authorities to maintain an economic policy that complies with the recommendations of Bretton Wood's institutions.

4.2 Quality standards and status of the application

Ghana Standard Board has established a grade of one to five levels by the ratio of broken and chalky rice, and the contamination ratio of foreign matter, etc. for each of the long, medium, and short grains, and has established (Table 11) (JICA, 2008).

Table 11. Grades and requirements by Ghana Standards Board.

Grade	Permissible Limb of fractions and other extraneous matter											
	Broken%			Chalky%			Contamination ratio (weight %)					
	L	M	S	L	M	S	Foreign matter	Red grain	Insect damaged	Dis-colored	Presence of insect	Ad-mixture
1	5.0	5.0	5.0	2.0	5.0	5.0	0.6	Nil	0.5	Nil	Nil	2.0
2	15.0	10.0	10.0	5.0	8.0	8.0	0.6	Nil	0.5	Nil	Nil	2.0
3	25.0	20.0	20.0	10.0	10.0	10.0	1.0	Nil	0.5	Nil	Nil	4.0
4	30.0	25.0	25.0	15.0	15.0	15.0	1.0	0.5	1.0	1.0	Nil	20.0
5	35.0	30.	30.0	15.0	15.0	15.0	1.0	0.5	1.0	1.0	Nil	20.0
Moisture content: 13.5% or less Long grain (L): Length greater than 6.6mm Medium grain (M): length of between 6.2mm and 6.6mm Short grain(S): length of less than 6.2mm												

Source: Made by JICA Survey Team based on JICA, 2008.

In a baseline survey of the rice production and sales conducted by JICA study team in 2006, they graded rice for sale in the general retail market based on the standard. They investigated the relationship between the price and the grade, broken ratio or length, and reported that there was no difference in price of domestic rice by grade, crushing

rate, and grain length. While, Andam *et al*. (2019) selected three attributes for rice, namely country of origin, grading, and branding for implementing discrete choice experiment and experimental auction in Accra that direct way of estimating the 'Willingness to Pay. Grading is classified into Grade A (100% long and slender), Grade B (5% broken), and Grade C (50% broken) based on preliminary studies and interviews with key value chain actors. As a result, overall willingness to pay for grading and labelling was generally low.

5. Main issues and suggestions

In Ghana, rice is the second most important staple food after maize, and the demand is increasing drastically. The production amount is also increasing but the self-sufficiency rate is about 45%. Local rice is positively evaluated by consumers with taste and price, but not with aroma, appearance nor cleanliness. This indicates there is a need to improve the post-harvest handling. Both literature reviews and FAO database indicate that local rice is cheaper than imported rice at wholesale markets and retail shops. The price of local rice in the capital city was more expensive than that in the town close to the production area, such as Tamale. Only 30% of locally produced rice reaches urban markets.

The results of DRC ratio analysis indicated that rain-fed rice cultivation has comparative advantage against imported rice when the cost for fertilizer and labor were minimized. For irrigated cultivation, when including the irrigation infrastructure cost, high DRC ratio of more than 7.0 was obtained with two cases out of the three. The case with low DRC ratio of 2.0 under irrigation spends more production cost per unit area but less cost per milled rice due to its higher yield.

When irrigation infrastructure cost was treated as a sunk cost, the degree of non-competitiveness is not so serious with the DRC ratios of less than 2.0. The sensitivity analysis showed that if crop management is practiced properly with more labor input, and yield of 5.0 t/ha is achieved, the DRC ratio becomes a competitive level but without irrigation infrastructure cost. The advantage of double cropping was confirmed in irrigated cases but it was not significant enough to make the DRC ratio 1.0. These results suggest that the existing large-scale irrigation schemes need be managed well for longer time, instead of starting new construction of irrigation facility, in order to sustain the competitiveness of local rice.

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Attached Table: Calculation and result of DRC analysis

With irrigation infrastructure cost

		LOCAL PRODUCTION											IMPORT			DRC CALCULATION		
			Production cost				Irrigation cost		Marketing cost		Total		Border price	Marketing cost		Total cost		DRC ratio
		Paddy yield	Total	Total	Production				Farm-gate to market					Border to market				
			(/ha)	(/kg milled rice)	Tradable	Domestic	Tradable	Domestic	Tradable	Domestic	Tradable	Domestic	(CIF price of 1.28 GHC/kg) [a]	Tradable	Domestic	Tradable	Domestic	
	Production conditions										$\Sigma a_i P_i SER$ (①)	$\Sigma b_j P_j$ (②)	$P_w SER$ (③)	$\Sigma_k c_k P_k SER$ (④)	$\Sigma_m d_m P_m$ (⑤)	A = ①-④	B = ②-⑤	B / (③-A)
		t/ha	GHC/ha	---------- GHC/kg of milled rice ----------														
Case I	Average farmer in irrigated areas	3.0	2,992	1.72	0.47	1.25	0.51	0.77	0.12	0.55	1.10	2.56	1.28	0.08	0.51	1.03	2.05	**8.17**
Case II	Average farmer in lowland rainfed areas	1.7	1,758	1.78	0.47	1.31	0	0	0.12	0.55	0.59	1.86	1.28	0.08	0.51	0.52	1.35	**1.77**
Case III	Rainfed in Tamale	1.9	1,320	1.20	0.25	0.95	0	0	0.13	0.55	0.39	1.50	1.28	0.08	0.51	0.31	0.99	**1.02**
Case IV	Irrigated in Upper East	3.0	3,265	1.88	0.43	1.44	0.51	0.77	0.13	0.55	1.08	2.76	1.28	0.08	0.51	1.00	2.25	**8.12**
Case V	Rainfed in Upper East	2.0	1,744	1.50	0.41	1.09	0	0	0.13	0.55	0.55	1.64	1.28	0.08	0.51	0.47	1.13	**1.40**
Case VI	Irrigated in Ashanti	6.0	4,354	1.25	0.34	0.91	0.26	0.38	0.10	0.53	0.70	1.82	1.28	0.08	0.51	0.62	1.31	**2.00**

Without irrigation infrastructure cost

		LOCAL PRODUCTION											IMPORT			DRC CALCULATION		
			Production cost				Irrigation cost		Marketing cost		Total		Border price	Marketing cost		Total cost		DRC ratio
		Paddy yield	Total	Total	Production				Farm-gate to market					Border to market				
			(/ha)	(/kg milled rice)	Tradable	Domestic	Tradable	Domestic	Tradable	Domestic	Tradable	Domestic	(CIF price of 1.28 GHC/kg) [a]	Tradable	Domestic	Tradable	Domestic	
	Production conditions										$\Sigma a_i P_i SER$ (①)	$\Sigma b_j P_j$ (②)	$P_w SER$ (③)	$\Sigma_k c_k P_k SER$ (④)	$\Sigma_m d_m P_m$ (⑤)	A = ①-④	B = ②-⑤	B / (③-A)
		t/ha	GHC/ha	---------- GHC/kg of milled rice ----------														
Case I	Average farmer in irrigated areas	3.0	2,992	1.72	0.47	1.25			0.12	0.55	0.59	1.80	1.28	0.08	0.51	0.52	1.28	**1.68**
Case II	Average farmer in lowland rainfed areas	1.7	1,758	1.78	0.47	1.31			0.12	0.55	0.59	1.86	1.28	0.08	0.51	0.52	1.35	**1.77**
Case III	Rainfed in Tamale	1.9	1,320	1.20	0.25	0.95			0.13	0.55	0.39	1.50	1.28	0.08	0.51	0.31	0.99	**1.02**
Case IV	Irrigated in Upper East	3.0	3,265	1.88	0.43	1.44			0.13	0.55	0.57	1.99	1.28	0.08	0.51	0.49	1.48	**1.88**
Case V	Rainfed in Upper East	2.0	1,744	1.50	0.41	1.09			0.13	0.55	0.55	1.64	1.28	0.08	0.51	0.47	1.13	**1.40**
Case VI	Irrigated in Ashanti	6.0	4,354	1.25	0.34	0.91			0.10	0.53	0.44	1.44	1.28	0.08	0.51	0.37	0.93	**1.02**

a) Average CIF price of imported rice in 2013 (UN Comtrade[3], browsed on April 21, 2021) was used for the analysis

[3] Download trade data | UN Comtrade: International Trade Statistics