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Wage labor in rice cultivation areas near Lake Victoria in Western Kenya

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Rice is now the most rapidly growing food commodity in sub-Saharan Africa. This growth is mainly driven by urbanization. There is substantial research on the wage labor dynamics in rice production in Asia, but in Africa, there is limited analysis of the labor used in rice cultivation-the attributes, numbers, and costs which make it difficult to understand the actual market, such as how products are procured. This study aims to fill this gap in the research by comparing wage labor factors in two rice cultivation areas in Kenya: Awach and Ahero. The role of wage labor in farm household management as well as in the economy of the areas is considered. The results, based on two surveys, show that, at the Awach small-scale scheme, the yield was low and the cultivation area small, generating profit per household of only about one-half that of the more large-scale Ahero scheme. High wage expenses at Awach put pressure on rice farming management because, although family labor was used for rice cultivation, additional labor was required for transplanting and weeding, incurring expenses. These were covered by sales of rice in the previous year or sales of livestock. In both areas, wage laborers were mostly people residing in the same area. In the case of Ahero, the scale of the scheme itself was large, and the hired laborers were unknown. However, in Awach, there was a high rate of hiring neighbors, and thus, wage labor costs could also be understood as a source of income for people in the area. Therefore, it can be inferred, in the case of Ahero, that there is a mechanism of wage labor based on economic principles, whereas in the case of Awach, small-scale production using family labor may be less efficient, but there is an additional concern with community principles.

Key words: Rice cultivation, western Kenya, wage labor, economic principles, community principles.

INTRODUCTION

Rice is the food commodity in sub-Saharan Africa with the most rapid growth in market share. This growth is mainly driven by urbanization. Rice consumption in Africa is expected to continue to grow in the foreseeable future, as the proportion of the African population living in urban areas is expected to increase from the current 38 to 48% by 2030 (Seck et al., 2008). The domestic supply of rice cannot keep up with the rapidly growing urban demand; rice imports now comprise 40% of all rice consumed, thereby putting pressure on the finances of African countries (Saito, 2010). Furthermore, recent rises in global grain prices have led to food insecurity for the poor; thus,

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there is an increasingly urgent need to take measures against these problems and to increase the capacity to expand domestic production in the medium and long terms (Onyango, 2014). Responding to these circumstances, rice cultivation in Africa has been targeted by the Japanese government and other official development assistance (ODA) projects.

Kenya, located in East Africa, is one of the main countries targeted for rice cultivation support [Alliance for a Green Revolution in Africa, 2008]. Most rice cultivation in Kenya (80%) takes place under irrigated conditions, unlike other African countries (Kabutha and Mutero, 2002; Japan International Cooperation Agency, 2013). In western Kenya's Lake Victoria region, the second-largest area for rice production in Kenya, rice is mainly cultivated using irrigation schemes (Yamane et al., 2019). Rice is produced using the water provided by three irrigation schemes: Ahero, West Kano, and Bunyara. These large-scale rice production areas were established by the Kenyan government in the 1970s. In addition, multiple small-scale rice cultivation areas, where rice has been cultivated for about a century, are distributed around the large-scale rice production areas. Rice cultivation under irrigated conditions results in a much higher yield than that of rain-fed paddies, if modern agricultural techniques and varieties of rice are used (Inoue and Kumazaki, 1991; Tokuda and Nakano, 2014). However, modern farming techniques require more labor input (irrigation and chemical use, such as fertilizer or pesticides, transplanting, and preparation for transplanting) than other cultivation styles do (Tokuda and Nakano, 2014). For rice farmers using irrigation in Africa, employed labor is a problem not only from the perspective of management costs but also from the viewpoint of productivity (Yamane et al., 2019; Tokuda and Nakano, 2014; Yamada, 1996). In the abovementioned ODA project, the goal is to improve the management of rice farming conducted by individual farmers (Japan International Cooperation Agency, 2011, 2015). Labor costs comprise a high percentage of management expenses (Yamane et al., 2019), and it is possible to reduce rice cultivation management costs by promoting various types of support, such as mechanization. According to a previous report about rice cultivation in Tanzania, the labor supply structure available for rice farming determines whether the mechanism of labor supplied to farmers can be explained by community principles or economic principles (Nieru et al., 2016). Some reports, for example, state that the introduction of modern rice cultivation technology has caused economic disparities in different parts of the Philippines, and that support for rice cultivation management by local communities merely promotes this economic structure. There is also the potential to induce negative effects, such as a decline in reciprocity or an expansion of the economic gap between villagers [Hayami and Kikuchi, 2000].

The purpose of this study is to clarify the supply structure of wage labor in two rice cultivation areas—a large-scale rice cultivation area, the Ahero irrigation scheme (800 ha), and the small-scale Awach irrigation scheme (about 120 ha) (Figure 1). A survey comparing the two schemes was conducted at two survey sites over time focusing on the following six points:

(1) Local livelihoods and household composition, (2) agriculture other than rice cultivation in the region, (3) rice cultivation and rice management, (4) the use of wage labor for rice cultivation, (5) the securing of funds for wage labor, and (6) wages earned by wage laborers after clarifying the relationship between wage laborers and rice farmers. The survey clarified how much money was used and how it was used.

After that, problems with the current support content based on the local situation and considering the differences between regions were considered. This study clarifies the role of wage labor for farmers and communities that cultivate irrigated rice in Africa and considers appropriate means of support. In this study, we examined regional differences by comparing the two target areas and considered the presence or absence of annual changes over time.

MATERIALS AND METHODS

The plains located near the eastern shore of Lake Victoria in western Kenya are dotted with 11 small-scale rice cultivation areas, called outgrower areas (covering 900 ha in total), within two large-scale, irrigated-rice production areas that were constructed in the 1970s. Rice cultivation in the area is mainly conducted by the descendants of farmers from that era. Rice farming continues to take place even in the rice-growing areas around the large-scale irrigation areas.

In the Ahero (National Irrigation Board, NIB) and Awach irrigation schemes, both villages grew from a group of extended families with common paternal ancestry (Shipton, 2007); however, their structure differed, due to the different construction histories of the two irrigation schemes. In the large-scale Ahero scheme, farmers were initially forced to immigrate to several specific places in the scheme and started to cultivate rice under the strong control of the NIB. Therefore, the indigenous Luo village structure is not observed in the Ahero scheme. However, in 2003, a water-use association and a revolving fund for managing the farmers' funds were formed under the NIB's guidance, and farmers subsequently managed their funds independently.

Rice cultivation in Awach began in 1945, when it was founded by the then-colonial government, well before large-scale irrigation facilities were established (Yamane et al., 2019). In 1986, a farmer's group was formed and registered with the Ministry of Social Services. Funding of irrigation infrastructure in the area occurred via the Provincial Irrigation Unit (Yamane et al., 2019).

To begin cultivating rice, farmers were able to obtain the funds necessary by many means, such as selling their livestock. The cultivation areas in both schemes are in locations populated by the Luo people, descendants of a Nilotic pastoral tribe (Shipton, 2007). In the Awach scheme, rice is grown by two main patrilineal families, the Kimira and Katolo clans.

This study collected information about the history of the two target schemes, Ahero and Awach. The information was obtained by conducting a questionnaire survey of elderly people in each

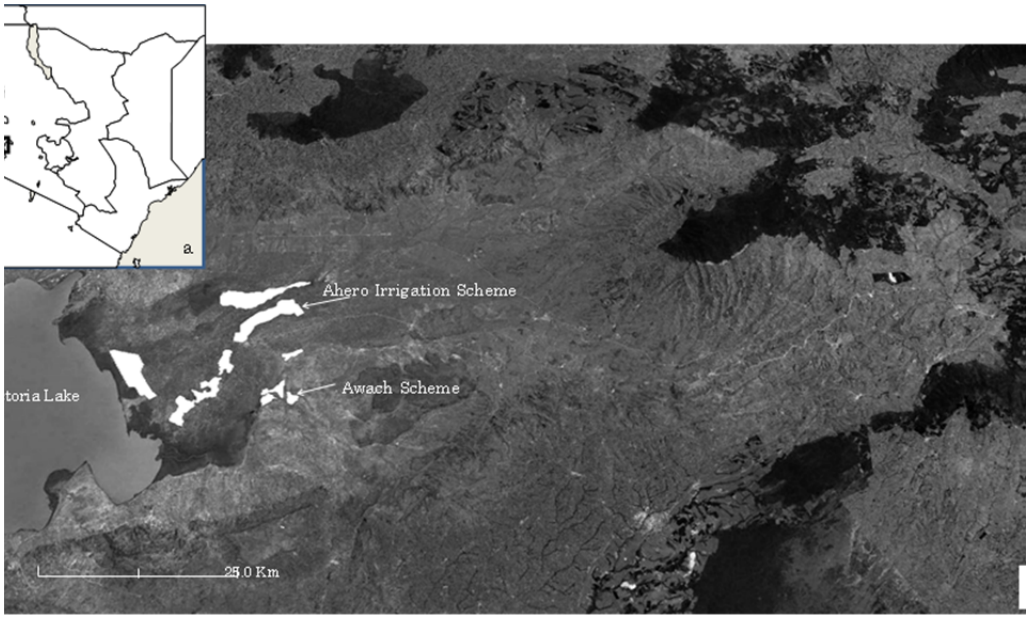

Figure 1. Location of the study site in Kenya (a) and a map showing the distribution of rice cultivation areas near Lake Victoria (b)

scheme, including the history of the schemes and the social structures of the rice farmers' villages collected in 2010, 2011, 2012, 2013, and 2015.

For 3 months in total, the authors conducted a homestay in the house of a rice farmer in the area and observed the lives of the farmers. Furthermore, in 2016, the authors rented rice fields in this area, cultivated their own rice, observed the relationship between wage laborers and employers, and collected information about rice cultivation and management.

Two experimental rice cultivation surveys were conducted between September 2016 and April 2017, one for each of the two schemes. The study used a participant observation survey [Maxwell, 2012], an empirical research method commonly used in anthropological studies, to understand how an individual's wage labor is secured, as well as the relationship between wage laborers and rice farmers. Fields were rented in both the Ahero and Awach schemes, and experimental rice cultivation was conducted. At the Awach scheme site, the first plowing was undertaken on September 22, 2016. The site was transplanted on October 20, 2016, and harvested on February 17, 2017. During the 150 days of the cropping season, the authors visited the experimental fields and stayed for a 50-day observation period. In the Ahero scheme, the first plowing was conducted in October 2016, and the transplanting and harvest were conducted on December 24, 2016, and April 17, 2017, respectively.

Questionnaire survey of rice farmers in Ahero and Awach

The questionnaire surveys were conducted twice, in 2012 and 2015, to collect general information about rice cultivation and farm management in each locality. For the 2012 survey, 17 local residents were selected, hired, and trained for three days to conduct interviews using a questionnaire. They were then asked to visit the rice farmers' residential areas to conduct the interviews. Based on the information from the surveyed households, this study analyzed the rice cultivation situation in each scheme, such as the cultivation area per household and the productivity of the rice farmers in 2011. This study analyzed 76 households in both the Ahero and the Awach schemes in 2012. Specifically, the same questionnaire survey was conducted in 2015 among 40 rice farmers in the Ahero scheme and 36 rice farmers in the Awach scheme to compare the situations of different years and to add more detailed information about wage laborers in each scheme. This study compares farmers' approaches to rice management, including wage labor employment, in both schemes.

Description of an account book

Household A is a general household in the Awach area and was selected as a typical example for the estimation of income from wage labor and how money was allocated in the household. The account books provided information about the ratio and role of the income obtained from rice in the household and the ratio of income from wages obtained via rice farming to households. The wife of the head of household A, who undertook rice cultivation in the Awach scheme, was asked to keep a household account book for 1 year beginning on August 1, 2017. Each day, this woman, who was born in 1956 and lived with her husband and children recorded the household's expenditures and income. She provided food and supported the household's overall needs. This information was used to examine the ratio of income between wage labor and the household.

RESULTS AND DISCUSSION

Farm management and household structure in the two schemes

Luo households tend to be grouped in a compound known as a *dala*. The average number of people living in a *dala* was a little higher in Ahero: 5.9 in 2012 and 4.5 in 2015

(Table 1). Since the 2015 survey was smaller than the 2012 survey, there may have been differences in household members due to site differences within the NIB scheme. The average size of households living in Awach (4.3 people in 2015) was not significantly different from that in Ahero (4.5 people in 2015). In Awach, many households grow not only rice but also sorghum and maize, which enable households to be self-sufficient. However, about 40% of households in Ahero cultivate only rice. The survey in Awach found that more than 90% of households in the region grew three crops (rice plus other grains). Meanwhile, households in Ahero had a large cultivation area in 2012, at 1.02 ha, but this had decreased to 0.65 ha in 2015 (Table 2). Meanwhile, in Awach, the cultivation area was smaller than in Ahero, at 0.55 ha in 2012 and 0.47 ha in 2015. The area cultivated for self-sufficiency cereals was larger in Awach, at 0.53 and 0.45 ha in 2012 and 2015, respectively, and about double the area in Ahero (0.27 and 0.14 ha in 2012 and 2015, respectively).

While the yield of maize and sorghum harvested in Ahero was more than 100 kg higher than that in Awach (Table 1), the number of livestock raised was not significantly different between the two areas. In Ahero, each household had around 5 cattle in both 2012 and 2015, as well as 4 smaller livestock in 2012 and 2 in 2015; meanwhile, Awach had 6.3 cattle and less than 4 small livestock in 2015 (Table 1). The most significant difference in household farm management between households in Ahero and Awach in any year was the amount of rice produced.

Rice cultivation and rice management

The paddy-field area per household in Ahero was about double in 2012 and about 1.5 times that of Awach in 2015. In addition, the amount of rice harvested per household in Ahero was about triple that of Awach in both 2012 and 2015. The rice yields per ha in Ahero and Awach in 2012 were 4,560 and 3,190 kg/ha, respectively, while in 2015, the rice yields per household in Ahero and Awach were 5,140 and 3,215 kg/ha, respectively (Table 2). Since the yield was higher in Ahero than in Awach, and the area was twice the size, the production per household was higher in Ahero than in Awach (Table 2).

The sales volume per household was also affected by such differences as the area of paddy field per household and the input amount of fertilizer between the two areas. The Ahero scheme sold an average of 3,540 kg/household in 2012 and 2,382 kg/household in 2015, while the Awach scheme sold just 850 kg/household in 2012 and 569 kg/household in 2015. The value of the Ahero sales exceeded 100,000 KSh/household in each year, whereas the Awach sales were worth only approximately one-fifth this amount. In this way, it was found that there was a large difference over the years in the scale of rice cultivation and rice cultivation management in the two survey areas.

Cost of wage labor in rice management

In each scheme, the author observed the rice cultivation practices. Rice cultivation requires the simultaneous labor of many people for planting and harvesting, weeding (especially when weeding is delayed by 10 days), scraping, and leveling; timing is also very important, especially as the yield may be lowered by approximately 1 ton per what unit of area if farmers fail to adhere to optimal timing (Johnson et al., 2004). In the case of Ahero, the water supply schedule is decided in advance for each block; it is desirable to start preparing the ground as soon as possible. However, in Awach, it is better to finish work ahead of time to secure water as soon as possible and start cultivation, owing to unpredictable rainfall patterns. It is difficult to perform these tasks with household labor alone, so these are often undertaken using paid labor.

This study calculated various expenses associated with rice cultivation, including wage labor costs. Expenditure on wages accounted for the greatest proportion of spending on rice cultivation (Table 3). In Ahero, the expenses varied greatly depending on the year, but wage expenses accounted for more than half of all cost for rice cultivation (about 60%) (Table 3). In Awach, the proportion of wage expenses was close to 80%. It can be inferred that it is very important to secure the wage cost for rice cultivation in this region (Table 3).

Wage labor contributes significantly to rice production. A detailed breakdown of wage labor is given as follows. Figure 2 shows 12 work steps that potentially involve wage labor as observed for rice cultivation. First, there are two rounds of plowing that take place before the start of rice cultivation. The first round is undertaken when the paddy field is dry; any grass that grew during its fallow period must be cut. The second round is undertaken under irrigated conditions and is left for about one week afterward. Any embedded grass floats to the surface of the water. The soil surface is leveled (Step 3) to transplant rice seedlings and to control the depth of water in the paddy. Sometimes, there is a one-month gap between the first and second plowings. Nursery beds are often provided with nurseries, but before and after the second plowings, many of the nursery beds are located close to the intake and are transplanted after nurturing for about three weeks. The first weeding is carried out 23 days after transplanting in Ahero and 37 days after transplanting in Awach, according to the results of the 2012 survey. Similar differences in weeding between the two sites were observed in the findings of participant-observers in 2016 also. Many farmers in Ahero carry out a second weeding, and then begin heading rice about two months after transplanting and scaring birds away one month after the heading. There are also three types of harvesting work:

Table 1. Rice cultivation by area - self-sufficiency, size of harvest, and number of domestic livestock per household.

		Ahero		Awach	
		2012	2015	2012	2015
		77 households[1]	49 households	77 households	40 households
Family					
Family members per household (people)[2]		5.9	4.5	4.6	4.3
Average number of non-employed people		3.2	1.1	3.00	1.29
Average number of employed people		2.70	2.39	2.60	2.02
Type of occupation	Agriculture	2.21	2.00	2.29	1.57
	Trader	0.21	0.03	0.10	0.03
People/household	Farmer	0.03	0.28	0.10	0.24
	Other	0.28	0.00	0.21	0.18
Agriculture					
Area size (ha/household)	Rice	1.01	0.65	0.55	0.47
	M&S[3]	0.27	0.14	0.53	0.4
Yield (kg/household)	Rice	4.291	2.935	1.497	768
	M&S[4]	333	313	217	242
Number /household	Cattle	5.2	5.5	6.1	3
Number /household	Small ruminants	4.1	1.8	5.8	3.7

[1]Because different areas cultivate different cereals, this study obtained information about which crops were grown by the households and classified the households by this combination. [2] This study divided the number of people into those who did not live together in a *dala* for more than 6 months and family members.[3] Total area of land where maize and sorghum (M&S) were cultivated.[4] Total yield of M&S. Note: All units are in parentheses.

rice cutting, rice-straw loading, and threshing. Notably, rice cutting is generally regarded as male labor. Cut rice is placed in the middle of a paddy field in donut-shapes about 5 m in diameter and left for about three days. Thereafter, threshing work is carried out in the “hole” of the donut. A vinyl sheet is placed on the ground; if the rice straw is struck against stone, it can easily be threshed in a nylon bag.

Percentage of wage labor use

This study investigated the extent to which wage labor is used in each of the 12 work steps. Awach used a higher percentage of family labor to perform specific tasks, such as the first plowing, transplanting, and the first weeding, whereas, in Ahero, about 90% of the labor was completed by wage laborers, with the exception of the second weeding and bird-scaring work (Figures 2a and 2b). A big difference was found between the two areas (Figures 2a and 2b). A total of 48 households cultivated 51 paddy fields in Ahero during 2015; more than 80% used wage labor for all 12 types of work (Figure 2a). In particular, the rate of wage labor use was high, at about 95%, for first plowing, first weeding, and harvesting (Figure 2b). In Awach, 40 households cultivated 63 paddy fields (Figure 2a). There was less wage labor used in Awach than in Ahero, although a higher proportion was used in Awach during first plowing and transplantation (about 80%). At first weeding, the proportion of wage labor used in Awach was 65% (Figure 2a). In total, wage labor used in paddy fields accounted for less than 50% (Figure 2a) of the total labor input in Awach.

Differences in labor input for rice cultivation between the two schemes

Among the various operating expenses of rice farming, land rental fees comprise the highest proportion. In Awach, the ratio of wage labor is smaller than that in Ahero, as shown in Figure 2. However, labor costs also put pressure on rice farm management. To understand these costs, this study analyzed how much labor was used per household. This study calculated how much labor time was spent on each type of work. The total labor input per household amounted to 269 people days for Ahero and 266 people days for Awach, showing little difference between the two regions. Regarding labor input by work type, weeding incurred the largest amount of labor, requiring 122 people per day per household for Ahero and 91 people per day per household for Awach.

Table 2. Averages of cultivation area, rice yield per household, sales volume, and sales value of the two rice cultivation schemes.

Year		Number of households investigated (Households)	Area of paddy fields (ha/household)	Yield (kg/household)	Production (kg/ha)	Sales quantity (kg/household)	Sales value (KSh/household)
2012	Ahero (NIB)	77	1.02	4.290	4.560	3.540	145.586
	Awach	77	0.55	1.500	3.190	850	34.813
2015	Ahero(NIB)	49	0.65	2.935	5.140	2.382	115.516
	Awach	40	0.47	768	3.215	569	19.260

All units are in parentheses.

Table 3. Rice-farm income composition per household for each scheme in 2012 and 2015.

Income composition	NIB				Awach			
	2012		2015		2012		2015	
	77*		49		76*		37	
	Ksh/household	%	Ksh/household	%	Ksh/household	%	Ksh/household	%
Sales amount	145,590		115,516		34,810		19,260	
Management expenses *	54,170		27,779		25,900		22,206	
Payment rent	2,080	4	2,044	7	2,410	9	445	2
Wage expense	33,510	62	14050	51	20,600	80	18,369	83
Seed dues	2,620	5	2,260	8	1,230*	5	1,360	6
Irrigation fee	3,620	7	3,241	12	240	1	1,418	6
Pesticide purchase cost *	2,050	4	968	3	280	1	88	0
Herbicide purchase cost	70	0	0	0	10	0	0	0
Fertilizer purchase cost	9,880	18	4,427	16	1,26	5	524	2
Man fair purchasing cost	340	1	789	3	110	0	2	0
Compost purchase cost	30	0	0	0	0	0	0	0
Agricultural income	91410	100	87,737	100	8780	100	-2,946	100

*Rent payment, wage expenses, seed fees, irrigation fees, agricultural chemical purchase cost, herbicide purchase cost, fertilizer purchase cost, manure purchase cost, and compost purchase cost total. The input goods price was also included in 2016. **Since an abnormal pesticide purchase value was deemed to have been recorded for one household, this household was excluded from all calculations.

The next most labor-intensive activity was bird scaring, requiring 49 people per day per household for Ahero and 73 people per day per household for Awach, followed by harvesting and transplanting at 20 and 40 people per day per household, respectively. Wage labor accounted for more than 80% of all work carried out in Ahero, and wage labor costs accounted for 60% of management expenses, yet farmers there still managed to earn a profit because the yield was high. However, although it seems that Awach was attempting to minimize labor job requirements and wage labor costs as much as possible (Figure 3a), it was difficult to do so for labor-intensive work, such as transplantation and weeding. Wage labor was frequently used for intensive work that needs to be concentrated in a short period of time, such as harvesting. For these tasks, especially weeding, a labor force of approximately 100 people per household was required. Considering that only about two people were engaged in agriculture per household, it is evident that these tasks could not be covered by family labor alone. It was also observed that family labor covered work with relatively low labor input, such as leveling (Figure 3a).

How farmers pay for wage labor

In Ahero, a farmers' organization manages a revolving fund and has a scheme to lend individuals funds for rice cultivation. Beginning with the first cultivation, 30 to 50% of households in the surveyed area were supported by loans to fund all 12 work steps (Figure 3b). Many households in Ahero (20 to 30%) paid for wage labor costs with funds obtained from selling rice the previous year (Figure 3b). In addition, some households, albeit not many, sold livestock and used small-scale business financing (Figure 3b). On the other hand, in Awach, many households sold livestock to secure cost of wage labor or other earned money by doing wage labor for another

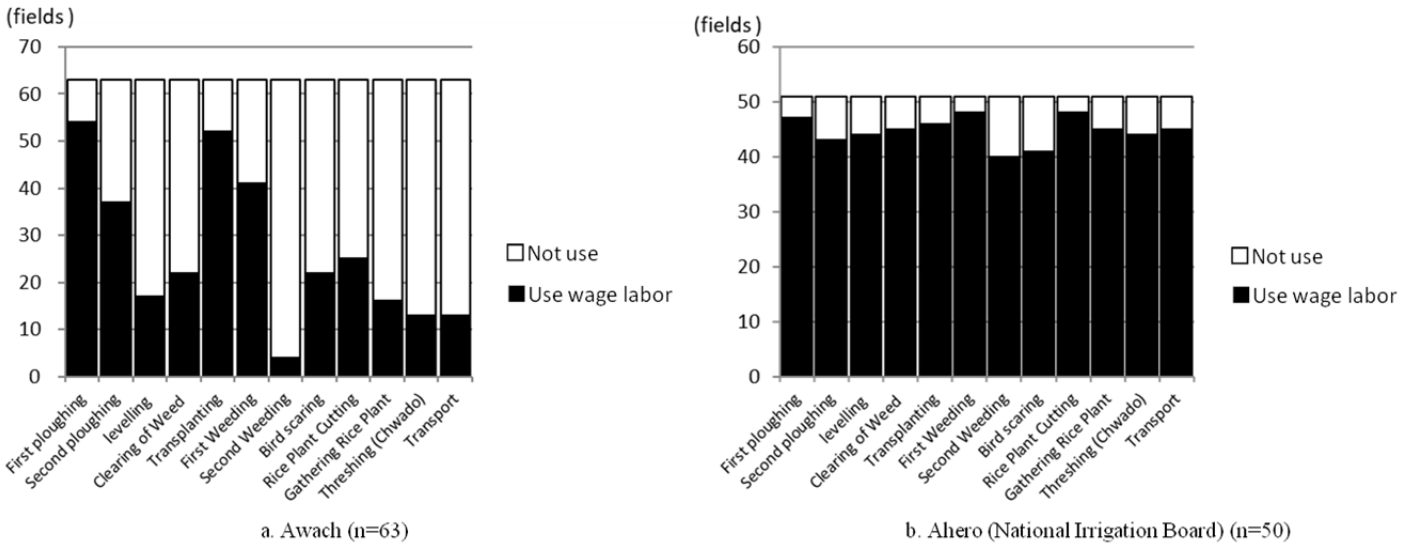

Figure 2. Ratio of paddies that used wage labor by area in 2015.

(Figure 3a). Few households paid for wage labor by selling rice (Figure 3). In addition, one or two households received funds obtained from the profit of their own small-scale business (Figure 3a). However, 12 households reported that their rice was dried up before harvesting, even though they invested money for rice cultivation.

Who works as wage laborers?

Figures 4a and 4b show where wage laborers hired in Awach and Ahero reside. While a small proportion of laborers hired in Awach came from the Gemrae and Nyachoda schemes that border Awach (Figure 4b), 80% of the labor was supplied by people who live in Awach (Figure 4b). For the first and second plowings (which, in other schemes, are often carried out using cattle or tractors), since an ox plow requires ownership of bulls (Okkidi, 1990), the equipment was rented from the people of Gemrae (Figure 4b). However, more than 90% of Ahero's wage earners were from the Ahero scheme (Figure 4a). Therefore, similar to the situation in Awach, in Ahero, some people living in the scheme provided the labor necessary for the scheme's rice cultivation, whereas in other cases, labor incurred a wage cost.

Relationship between farmers and wage laborers

People who live in the same scheme may work as wage laborers, but what kind of relationship do they have with the rice farmers who employ them? The survey included questions about the relationship between rice farmers and wage laborers. In Awach, about 30% of employees were neighbors or relatives (Figure 5a), and more than 60% were either acquaintances or close friends of the rice farmers who employed them (Figure 5a). In Ahero, a higher proportion of people were employed (more than 40%) who were unknown to the rice farmers (Figure 5b). The remaining 60% comprised relatives and friends. These results demonstrate a 10% difference in the proportion of neighboring people who were hired as compared with Awach (Figure 5a).

These differences are thought to be due to differences in the makeup of local villages. Ahero was forcibly settled in a specific way when the scheme was created. It seems that many people living in each place of residence belong to the same clan, but due to the large scheme, they often do not know people in different places of residence. Water is circulated through 12 blocks in the scheme over the course of a year, so people from different blocks often come to earn wages as laborers, often hiring themselves to strangers. On the other hand, Awach is cultivated mainly by people of the same clan centered around two patrilineal extended families. Neighbors are often relatives. It is highly probable that these regional differences lead to the differences in wage labor between the two survey sites.

Role of wage labor in rice farming households in Awach

Awach's rice-growing revenue per household was very low as compared to Ahero's. Although the yield may be low, the management cost is very high, and the wage cost accounts for 80% of the management cost. One of the goals of rice cultivation support was to devise and disseminate a method for improving rice cultivation

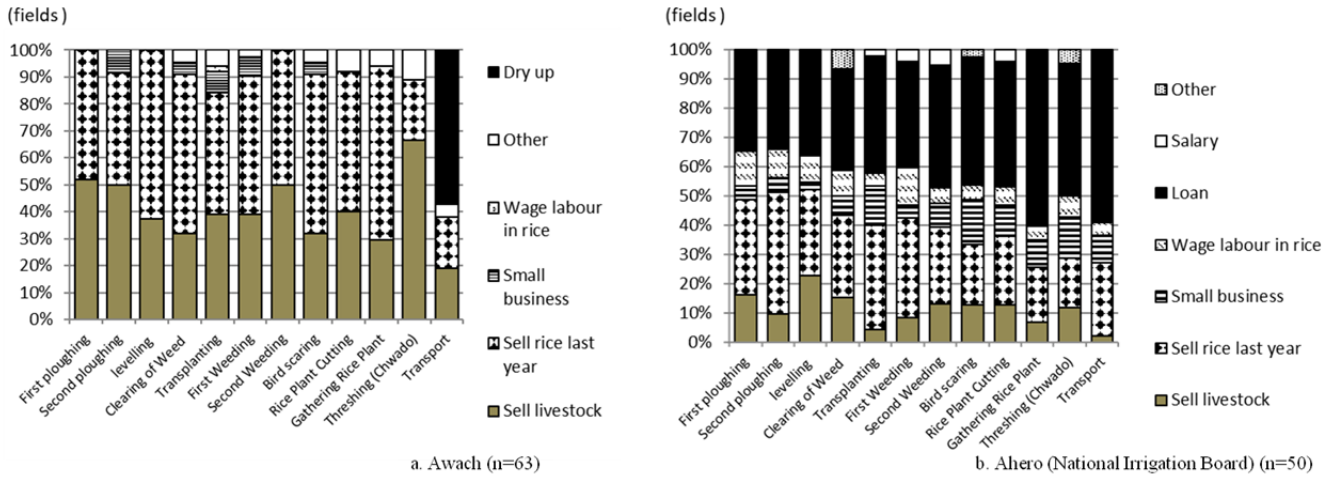

Figure 3. Method of accounting for wage labor costs in 2015.

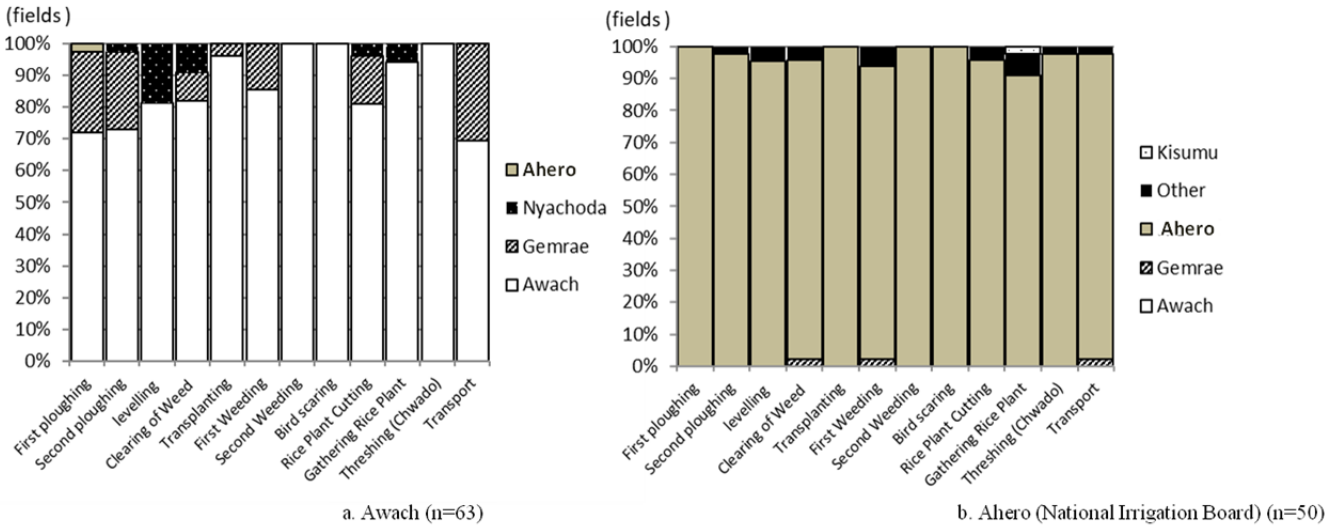

Figure 4. Residences of wage laborers in 2015.

management. In the two rice-growing areas targeted, therefore, trying to reduce wage labor costs is considered to be the most effective way to improve rice farming. However, wage labor in rice cultivation is carried out by people in each region, and improving rice farming by considering only the profits of rice farmers will affect the income of other households in the region. This possibility was considered, and we attempted to clarify the role of wage labor costs in households. Therefore, we will clarify the annual income of household A, who also operates rice cultivation but also earns income as wage laborers, and compare it with the total income earned from wage labor and rice cultivation.

The example of this household (household A) was used to examine the ratio of income between wage labor and the household expenses. This household had an average area of land (for Awach) for cultivating rice and other crops for self-sufficiency, and the amount of livestock owned by the household was also about average. Of the household members, only the adult woman was paid for her labor when rice farming.

A daily record showed that she had multiple income sources (Table 4). The main income was earned through the sale of firewood and charcoal; firewood was collected from the neighborhood, while the charcoal was resold from earlier purchases. She also earned income from wage labor and by stockpiling a portion of rice to sell throughout the year. A record of food purchases was also collated. The women in this area have a mutual assistance system called the Merry-go-round system, a

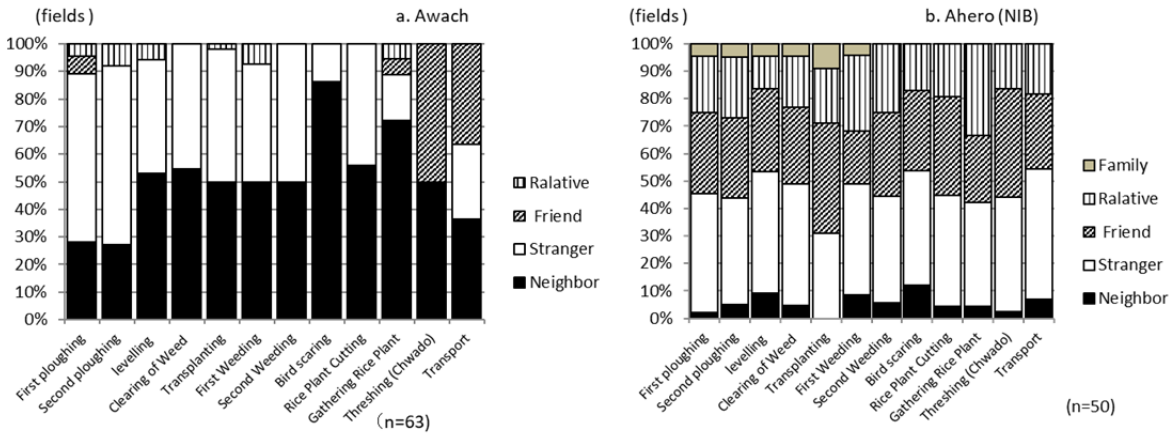

Figure 5. Relationship between wage labor and rice farmers employed by area in 2015.

savings club that is used to help support household budgets. The housewife was found to have some form of income nearly every day. Based on the number of days in a month that she earned income, her most frequent source of income was the almost daily sale of charcoal (Table 4); she sold charcoal on 20 to 25 days per month. The third biggest source of income was wage labor for other people, mainly for those living near her village. Her income from wages fluctuated slightly depending on the season. Specifically, it increased considerably from March to May, when the housewife earned income for about 20 days of labor per month. Between June and July, when preparation for the cultivation of rice generally begins, there is a reduced chance of being hired; during this time, the housewife earned income on less than 10 days per month (Figure 5).

The amount of income earned by this woman from various income sources was 375,828 KSh/year (Table 4). Her combined income from the sale of charcoal and firewood exceeded 30% of her total. The income she earned from wages in employment in rice production was also relatively high, accounting for 16% of her total income, second only to charcoal and firewood sales (Table 4). It was considered to be a very large source of income, which was larger than the income (23910KSh/ household) she obtained by selling rice.

Conclusion

A comparison of rice cultivation in two areas in western Kenya showed differences. In Ahero, a large-scale irrigated rice-growing area, profits of nearly 100,000 KSh have been generated in multiple years; similar results were reported for rice management in Mwea, the largest irrigation scheme in central Kenya (Ito, 2017). On the other hand, in a small-scale irrigated area, Awach, which is one-tenth the size of Ahero, farmers got smaller profit from rice cultivation for multiple years. Despite the fact that Awach makes little profit, it was necessary to hire workers for jobs where timing was important, such as transplantation and herbicide application; wages paid accounted for approximately 80% of management costs. There are also differences in how to secure management costs, and while many homes sell valuable livestock and use them for wages in Awach, Ahero has a mechanism for enabling smooth financing. Considering these facts, rice cultivation and rice farm management are consistently better in Ahero than in Awach.

The goals of JICA's support of rice cultivation in Kenya (2013) have been listed as follows: (1) establish a profitable farming system; (2) strengthen water management, production, and post-harvest treatment systems for establishing the farming structure; and (3) extend the farming system to local farmers [11,12]. Awach's rice cultivation income was lower than Ahero's, and the ratio of wage costs to management costs was high. Considering the economic disparity among rice farmers in the region, it would be better to support Awach more. Considering the priority of improving the rice cultivation of individual farmers, it would be possible to reduce wage costs, which account for a large part of the management costs, by providing more efficient labor, especially for Awach. Such an approach can also benefit Ahero, as their wage labor costs also reach 60% of management costs. In terms of rice farm management, it is considered better to improve the efficiency of wage labor, which accounts for most management expenses.

However, in this case, it must be considered that wage laborers hired within each scheme are people living in that same scheme. The percentage of farmers hiring neighbors and people they knew was higher in Awach than in Ahero. In Awach, members of the same extended patrilineal family continue to live in proximity and form a village, and the scheme is mainly cultivated by members of two extended patrlineal families, with the same family's paddy

Table 4. Woman's sources of annual income and expenditure for Household A.

Year	Month	Charcoal		Firewood		Merry-go-round		Working for others		Rice sales		Other family member		Total income	
		KSh/month	%	KSh/month	%	KSh/month	%	KSh/month	%	KSh/month	%	KSh/month	%	KSh/month	%
	Aug	6,160	20	3,270	10	6,080	19	4,360	14	3,190	10	8,350	27	31,410	100
	Sep	5,790	18	2,980	9	5,200	16	5,160	16	2,010	6	10,890	34	32,030	100
2017	Oct	6,720	23	2,890	10	5,400	18	3,900	13	1,920	7	8,660	29	29,490	100
	Nov	5,970	20	4,170	14	4,630	15	2,550	8	2,400	8	10,300	34	30,020	100
	Dec	5,100	18	3,300	12	2,680	9	4,740	17	2,570	9	10,130	36	28,520	100
	Jan	5,490	11	2,930	6	9,960	21	4,640	10	3,920	8	21,500	44	48,440	100
	Feb	7,090	21	2,790	8	6,500	19	6,300	18	2,080	6	9,650	28	34,410	100
	Mar	7,270	25	3,299	11	1,550	5	7,090	24	1,950	7	8,190	28	29,349	100
2018	Apr	8,369	31	3,140	12	0	0	7,730	29	1,120	4	6,350	24	26,709	100
	May	10,840	39	1,890	7	0	0	5,390	19	0	0	10,000	36	28,120	100
	Jun	10,510	37	3,250	11	600	2	5,460	19	800	3	7,700	27	28,320	100
	Jul	9,860	34	3,840	13	0	0	4,360	15	1,950	7	9,000	31	29,010	100
Total (KSh/year)		89,169	24	37,749	10	42,600	11	61,680	16	23,910	6	120,720	32	375,828	100

All units are in parentheses.

fields nearby.

In addition, a survey of the account book of a farmer also engaged in wage labor in Awach indicated that her income from wage labor was higher than her income from the sale of rice during that year. This demonstrates the possibility that wage labor is greatly helping to support daily life of other farmers in the scheme. The current support was aimed at establishing and disseminating a mechanism to increase the profit efficiency of rice farming on a household basis, but it is not necessarily good support, considering society as a whole in the rice farming area.

In Asia, the livelihoods of rural residents have become totally dependent on the market economy as land-intensive technological innovation has successfully spread. At the same time, mutual aid practices among residents are said to have declined, and social relations have been disrupted. Because households often hire neighbors for paid employment, and considering the importance of wages to household income, support in the form of mechanization and other labor-reducing solutions is not recommended.

However, the relationship between rice farmers and workers was different in the two regions. In Ahero, a high percentage of members of the same scheme hired strangers. In Ahero, residents were forcibly resettled when large-scale irrigation was developed, and they did not maintain the traditional form of a village; rather, there was a tendency for people belonging to the same extended patrilineal family to cultivate rice in the same block.

In the available literature about labor supply structures for rice farmers in Southeast Asia, there are divergent views as to whether the mechanism of farm household labor supply can be explained by the community or economic principles (Yamada, 1996).Therefore, in the case of Ahero, it can be inferred that the mechanism of wage labor is based on economic principles, whereas, in the case of Awach, the structure of wage labor takes into account the additional factor of community principles. However, hiring an unknown person means that risk is taken, as the farmer does not know his or her ability to work; thus, there is a need to evaluate the efficiency of his or her work objectively.

Based on the findings above, it can be said that even rice cultivation support may have an impact on the local economy through wage labor,

depending on the method of support. Therefore, to support local rice cultivation while maintaining existing social and economic structures in the region (Ellis, 2000; Davis et al., 2008; Davis and Bezemer, 2004), it is necessary to understand those structures, including the actual conditions of wage labor. However, in this paper, we have only shown that support focusing solely on rice farming may affect the structure of the local economy and local communities, but we have not been able to clarify details of the structures or how much support will affect them. Therefore, it will be necessary to devise appropriate rice cultivation support after conducting surveys on local communities and livelihoods beyond rice cultivation.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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