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RESEARCH ARTICLE

Effect of mechanized farming and the use of hired labour on rice farming in Kura Town, Kano State, Nigeria

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Abstract

The study looked at the impact of hired labour and mechanized farming on rice farming in Kura town; the samples for this study were fifty farmers who personally managed the cultivation of rice farming. For ploughing, threshing, and milling, the tasks were completed in fewer amounts of time, totalling 72.3, 37.1, and 58.9 hours per hectare, operations like threshing, harvesting, and ploughing have not yet been automated. The contributions of agricultural machinery were around 42%, 2%, and 65%, for ploughing, harvesting, and threshing respectively, small rice milling equipment handled the entire milling process. Farmers who were interviewed said that human effort will be needed for at least 20 to 30 working days to prepare the land. By using hand tractors, this period was considerably cut down to only 3-5 days, the amount of time needed for other tasks that machines substituted also decreased, as mechanical farming replaces human labor, the need for human labour will continue to shrink in the future. Before the introduction of machinery, hired labour was mostly needed for ploughing. While family labourers often performed light and simple tasks like planting, fertilizing, etc. Hired labour made up a much smaller portion of the transplanting, weeding, and harvesting processes, accounting for 22%, 17%, and 29%, respectively. The use of machines to perform agricultural work instead of manual tools not only reduced the amount of time spent working hard (drudgery) during rice cultivation but also decreased farming expenses and increased the farmer's revenue.

Keywords: Agriculture; Farm Mechanization; Hired labour; Rice farming.

1. Introduction

Two contrasting view points on the usage of farm machinery in less developed nations are presented. Farm mechanization, on the one hand, enables quicker, less laborious, and timely operations of farm activities that are believed to result in both higher yields and more intensive land usage. On the other hand, it is sometimes perceived as a direct substitute for labour, which is undesirable in regions with an abundant supply of labour, which is frequently the case in less developed countries. It is also said to boost labour productivity and income. According to Ahmed (2016), automation has frequently been criticized as being harmful for nations with densely populations and "labour surpluses" due to its negative impacts on agricultural labour in terms of labour displacement and tenant farmers.

Mechanization is potentially transformative of the production process through its effects on labour and productivity, however, modern agricultural equipment is likely more profitable on larger farms (Foster and Rosenzweig, 2017). Most of the agriculture production in poor economies is done by smallholder farmers, governments in the developing world are increasingly intervening in the agricultural sector to subsidize mechanization

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and modernize the sector (Adamopoulos and Restuccia, 2014). It could serve as a replacement for human labour and animal power, as in the case of tractors, a supplement as in the case of rotating weeders, fertilizer applicators, and insecticide/weedicide sprayers; and a complement, as in the case of irrigation pumps in rain-fed areas. The advent of new technology, particularly farm machinery and equipment, has accelerated the mechanization of agriculture today, changing the farming system in the majority of developing nations. The key step in the evolution of mechanization (farm machinery and equipment) is the substitution of mechanical devices for human labour and draught animalsin farming activities (Akinbamowo, 2013; Basu and Nandi, 2014; Chandrasekaran *et al.,* 2008; Paman *et al.,* 2018; Reddy *et al.,* 2014; Simalenga, 2000). Mechanization and other labour-saving technologies have increased agricultural production while simultaneously reducing labour use (Kay *et al.,* 2016).

The physical demands of agricultural labour are great, and the conditions are frequently difficult (Srivastava *et al.,* 2006). Mechanization technologies become crucial for agricultural production and processing in these circumstances (Mlengera *et al.,* 2015). In order to remove the tedium from such a laborious job that makes it difficult for family labourers to conduct the processes manually (Kienzle *et al.,* 2013; Mujawamariya and Kalema, 2017; Namdeo *et al.,* 2018; Sucharita and Bishnoi, 2018). At the moment, mechanization is necessary along the entire value chain, not just for improving crop productivity (Sims and Kienzle, 2017). Additionally, and perhaps most critically, mechanization can assist in completing extremely complex jobs in agriculture quickly and inexpensively (Basu and Nandi, 2014), Therefore, the introduction of mechanized tools and technologies allow for the reduction of labour requirements (Amare and Endalew, 2016). The displacement of labourers and tenant farmers as a result of the increased use of farm machinery has had major equity implications (Pingali, 2007). Because women produce less rice and are less productive than males, it is more crucial than ever to replace women's labour (Addison *et al.,* 2016). Paman *et al.* (2020) concludes that in rice cultivation, women have steadily been replaced by machinery, and laborers are now mostly engaged for labor-intensive tasks. The majority of the hours needed to complete manually laborious tasks like weeding and transplanting during rice farming operations were rather high. Because family and hired labourers using manual equipment predominated in these processes, they took more time. With more farm machinery being used, the number of hours that women and paid labor worked tended to decline. Even while some farmers continue work on non-rice farming and partially take a break at home, especially senior farmers, the reduced working hours of rice farming have led to limited off-farm activities.

Afridi *et al.* (2020) suggest that depending on the operation being automated and the amount of agricultural productivity, mechanization's effects on employment may vary. Mechanization can either have a scale effect by raising demand by enhancing overall productivity or expanding arable land, or it can have a substitution effect by directly substituting labour in some tasks (Caunedo & Kala, 2021). Utilizing empirical data, Caunedo and Kala (2021) demonstrate how access to rental services is influenced by subsidies for labour demand, while (Afridi et al., 2020) utilize an instrumental variable method to analyze how the use of tractors and power tillers during the tilling stage of land preparation affects labour utilization by gender throughout the years 1999–2011. Farm mechanization doesn't have to happen throughout all agricultural activities at once; it might happen gradually, depending on economic development and the accessibility of off-farm employment. Consequently, depending on the machine and operation being mechanized, the impact of farm mechanization on labour requirements may be positive or negative. Pingali (2007) emphasized that switching from draft

power to mechanical power reduces labour costs, especially during the land preparation phase of agriculture. However, it is anticipated that labour demand will shift from land preparation to weeding and harvesting when there is an increase in the amount of cultivable land, whether by bringing fallow or uncultivated land under cultivation or by increasing cropping intensity. This could result in a rise in the overall amount of labour needed.

Additionally, in developing nations, small-scale farmers frequently supplement their need for farm labour with family labour, as a result, farm mechanization's impact on hired and family labour may differ (Daum & Birner, 2020). Family labour will be employed more as a source of knowledge, management, and supervision as the opportunity cost rises rather than as a source of power (Pingali, 1997). Therefore, mechanization can result in the replacement of family labour with hired labour.

2. Materials and methods

The scope of this study is Kura town, which is the capital of Kura local government area (LGA), is domiciled in Kano state, North-west geopolitical zone of Nigeria. The headquarters of the local government area (LGA) is in the town of Kura and the local government area (LGA) shares borders with the GarunMallam, Madobi, Dawakan Kudu, and Bunkure local government areas (LGAs). Kura local government area (LGA) consists of several towns and villages and is populated majorly by members of the Hausa and Fulani ethnic groups. The estimated population of Kura local government area (LGA) is put at 213,884 inhabitants with the Hausa and Fufulde languages commonly spoken in the area. It has an area of 206 km^2 (80 sq mi) Coordinates; 11°46′17″N 8°25′49″E. The field studies would cover Kura town,both during the dry season and the rainy season, they are renowned for producing grains and vegetable crops. The dry season mostly starts from October to April while the rainy season begins from April to September with an average annual rainfall of 134.4m.

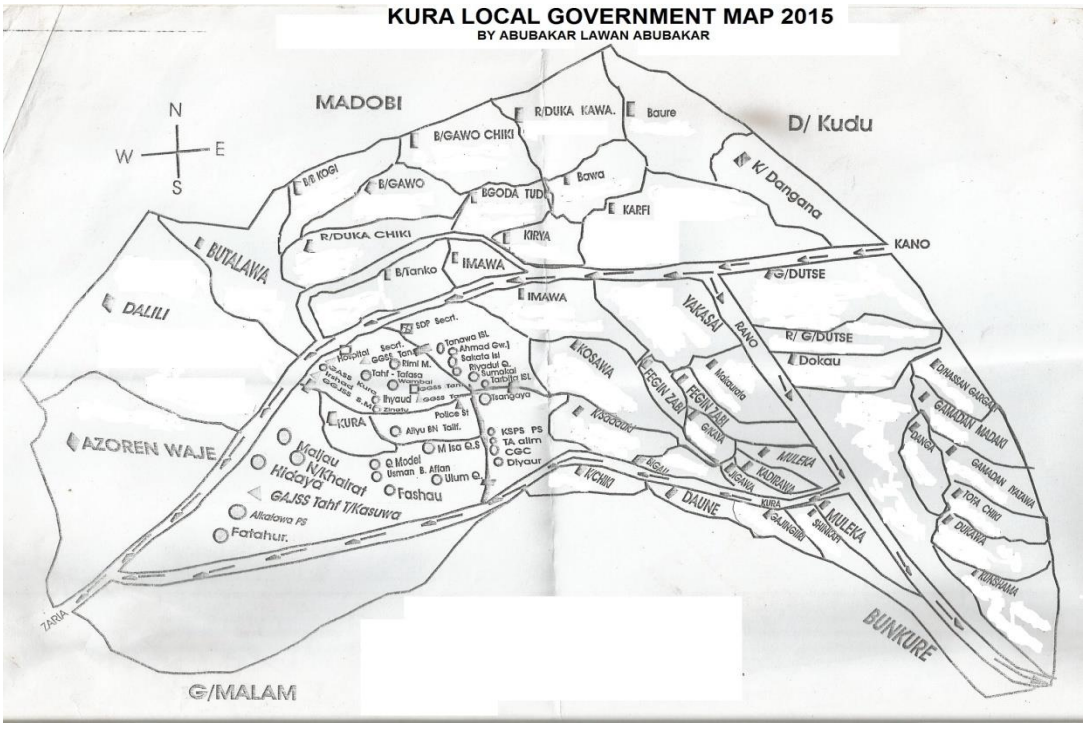

Figure 1. Map of Kura local government area (LGA)

70% of the population are farmers who engaged in mixed farming with extensive use of irrigation farming. Among the crops grown are rice, wheat, maize, millet, beans, tomatoes, cabbage etc. Therefore, it has a significant number of producers, processors and quality-oriented retail markets for both paddy rice and milled local rice across the town. Rice in this town is grown on both irrigated and rain-fed paddy field areas and cropping intensity is done twice a year. The wet (rainy) season is the main cropping season of ricei.e., from April to September. The second cropping season is during the dry season, i.e., from October to April. The duration of both seasons included 1 month for land preparation before rice transplanting. According to an interview with farmers, the entire rice-growing region is typically farmed during the wet season since rainfall provides an adequate water supply, particularly at the start of the growing season to help with field preparation operations. The population of the research consisted of small rice farmers from Kura town in Kura local government area (LGA). Fifty small rice farmers were randomly selected for samples. Some of the samples include women who are actively involved in the cultivation of rice. The core data for this study came from personal interviews with farmers who completed a structured questionnaire following the main farming season. The information gathered included sample characteristics, labour hours, hired labour, and equipment from various types of rice farming operations, rice farming regions, and rice yields. The data were then tabulated and quantitatively examined using descriptive terms like percentage, median, and simple regression.

3. Results and discussion

3.1. Rice farms and sample characteristics

The samples for this study were fifty farmers who personally managed the cultivation of rice. They averaged 6 years of formal schooling and were 35 years old. Rice farming has been practised hereditarily, passed down from generation to generation as the primary source of income and providing rice mostly for domestic use. With an average of 20 years of experience, farmers have a lot of knowledge about rice farming. There were typically 7 people in a family, including a parent and 5 kids. Most farmers' children attend school in their villages, they only engaged in a few farming rice farming activities. In managing their farms, husband and wife share duties and responsibility. The rice crop is grown as the main staple food crop to produce rice primarily for family consumption. In cases of excess production, farmers will sell rice to the market. Small family farms are used to carry out and coordinate this rice farming. During the peak period of the year, hired labour is supplemented by family members, primarily the wife and husband. The growing season has a significant impact on harvesting because the paddy fields are primarily rain-fed. Small-scale lands, ranging from 0.10 to 1.00 ha with an average of 0.5 ha, are typical of the rice farms owned by farmers in the survey areas. Due to the tiny size of their farm holdings, several farmers were unable to utilize the machinery to its full potential. With an average of 1.27 t (equivalent to 3.96 t ha^{-1}), rice production varied from 0.44 to 3.20 t. The majority of the produce went toward meeting the family's requirement for rice. Only 25% of rice farmers had enough to last for less than or equal to six months, and only 45% of them could meet the demand for less than a year. This indicates that around 52% of rice farmers could meet their needs for rice for more than a year and sell the extra to make extra money.

3.2. Use of Labour and Machines

Small-scale rice farmers in Kura town frequently employ hand tractors, power threshers, and rice milling equipment. They have progressively taken the place of common instruments like hoes, sickles, and pedal threshers, among others with farm machines. Because they have little purchasing power, few farmers purchase farm equipment. To work their farming operations, the

majority of small farmers utilized farm machinery service providers. In actuality, not only did different districts or rice-producing regions have different levels of machine application, but also different farmers used different levels of machine application. Farmers' level of use of equipment was influenced by their financial capacity to pay for such services, the availability of family labour, the size of their agricultural holdings, and their age.For instance, modest farmers with sufficient resources substituted field machinery for the majority of hired labour. The primary goals are to reduce operating time and raise the level of work quality in rice farming. Rice may be planted simultaneously by farmers in the same area thanks to the use of agricultural machinery, which prevents pest attacks by birds, rats, and other animals. Consequently, the use of hired labour steadily decreased in the survey region.

The amount of labour required to produce rice varies based on the type of farming operation. For the actual tasks of planting, harvesting, threshing, and milling, significantly more labour is typically needed. As a result, these tasks were replaced earlier than others, such as planting, weeding, controlling pests and diseases, transportation, and drying. These tasks were completed in study areas either by hired human labour or agricultural machinery. In contrast to the past, where field preparation was formerly done manually or by hired labour, it was discovered that almost 70% of farmers completely utilized farm machinery (hand tractors). Approximately 60% of farmers employed agricultural machinery for threshing and 45% of farmers employed agricultural machinery for harvesting tasks. Farmers only employed a few hired labour for the milling process in the study area since it has been entirely automated.

3.3. Effects on Hired labours

According to Table 1, the total amount of time needed for rice cultivating activities was roughly 733 hours per hectare. It indicates that during the past years, the amount of time needed for rice cultivation operations per hectare has decreased. Moreover, weeding took the longest (155.7 hours per hectare), followed by transplanting (140.5 hours per hectare), and finally harvesting (123.2 hours per hectare). These operations took longer since they were mostly carried out by human labour. The farm equipment needed to complete the aforementioned tasks has not yet been made accessible. Farmers in the study area no longer used seeding directly as a substitute for labour-saving measures. Ploughing, harvesting, threshing, and milling were four labour-intensive processes that were mostly replaced by agricultural machinery.

Table 1. Labour Requirement for Rice Farming Operations (hoursha^{-1})

TYPES OF LABOUR	FAMILY LABOUR	HIRED LABOUR	MACHINE	TOTAL
PLOUGHING	30	12	30.3	72.3
SEEDLING	11	5.1	0	16.1
TRANSPLANTING	110.5	30	0	140.5
FERTILIZING	50	15.2	0	65.2
WEEDING	130	25.7	0	155.7
PEST & DISEASE CONTROL	32.1	0	0	32.1
HARVESTING	86	35	2.2	123.2
THRESHING	13	0	24.1	37.1
TRANSPORTING	16.3	0	0	16.3
DRYING	8.5	7.2	0	15.7
MILLING	0	0	58.9	58.9
TOTAL	487.4	130.2	115.5	783.1

For ploughing, threshing, and milling, the tasks were completed in fewer amounts of time, totalling72.3, 37.1, and 58.9 hours per hectare. Operations like threshing, harvesting, and ploughing have not yet been automated. For ploughing, harvesting, and threshing, the contributions of agricultural machinery were around 42%, 2%, and 65%, respectively. Small rice milling equipment handled the entire milling process. Mouldboard ploughs, rotary tillers, and hydro tillers are the three types of hand tractors that are most frequently used for clearing land. The utilization of this farm equipment was influenced by field conditions, particularly the availability of water in the paddy field. Both rotary and hydro tillers were utilized in paddy fields when flooding was occurring and there was an adequate water supply. As a result, they were frequently employed during the rainy growing season. In the past farmers and hired labourers used sickles for harvesting and pedal threshers for threshing performed. As a result, the use of human labour in rice farming operations was considerably reduced as a result of the displacement of women and hired labourers by machinery. Farmers who were interviewed said that human effort will be needed for at least 20 to 30 working days to prepare the land. By using hand tractors, this period was considerably cut down to only 3-5 days. The amount of time needed for other tasks that machines substituted also decreased.

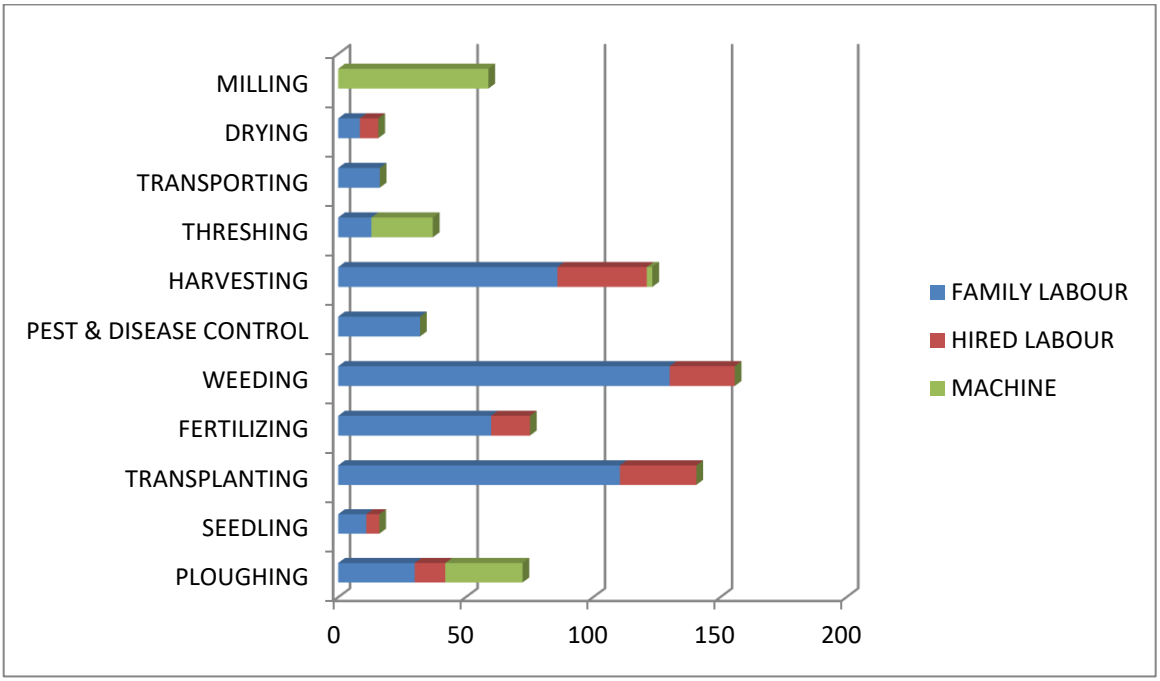

Figure 2. Machinery and hired labour contributions to rice farming operations

Family and hired workers were no longer used in the milling activity, which was now entirely run by rice milling equipment. This process was automated more quickly than others, and it is now entirely automated. It's because there are several milling service providers giving affordable prices in the study areas. Women's work will soon be replaced in survey areas by the recently introduced small tractors, except for transportation.

Before the introduction of machinery, hired labour was mostly needed for ploughing. While family labourers often performed light and simple tasks like planting, fertilizing, etc. Hired labour made up a much smaller portion of the transplanting, weeding, and harvesting processes, accounting for

22%, 17%, and 29%, respectively. The hired labourers typically worked seven hours each day and were paid on a per-working-day basis. The average daily wages in the survey areas are 3,500 Naira. These rates were determined by the farming community. As rice price increases so do the wages of the labourers.

The use of machines to perform agricultural work instead of manual tools not only reduced the amount of time spent working hard (drudgery) during rice cultivation but also decreased farming expenses and increased the farmer's revenue. Improving farm management efficiency and lowering the cost of growing rice were significant improvements. According to farmer interviews, the cost of human labour for land preparation reached 50,000 Naira per hectare. If this operation were carried out using a hand tractor, it would have cost 37,000 Naira per hectare, or around 26% less. This price represented the rate of the service fee for renting equipment from nearby farmers' equipment suppliers.

4. Conclusion and recommendations

The study comes to the conclusion that rice farming operations have steadily replaced hired labourers largely for labour-intensive tasks including clearing land, harvesting, threshing, and milling with machinery. Between individual farmers and the types of operations, the application rate of the farm machinery varied. The total amount of time needed to complete rice cultivation tasks was 783.1 hours per hectare. The majority of the time was spent physically carrying out tasks like weeding (155.7 hours per hectare), transplanting (140.5 hours per hectare), and harvesting (123.2 hours per hectare). These tasks took longer to complete since they were mostly carried out by family labour and hired workers using manual tools. In contrast, the number of hours spent using agricultural machinery decreased dramatically, accounting for 72.3, 123.2, 37.1 and 58.9hours per hectare for ploughing, harvesting, threshing, and milling. With the increased use of farm machinery, the number of hours that family labour and paid labour put in each hectare tended to decline.

The study suggests that future studies conducted in other regions take into account the investigation of the effects of farm leasing services. To solve the issue of funding and investible capital to buy expensive farm machinery, the government can think about creating users cooperatives and linking them to Self Help Groups (SHG) and Micro Finance Schemes (MFS). Additionally, this should ensure efficient maintenance of costly equipment and encourage mechanization among the farming community.

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Data presented in this study are available on fair request from the respective author.
Ethics Approval and Consent to Participate
Not applicable
Consent for Publication
Not applicable.
Conflicts of Interest
The authors disclosed no conflict of interest starting from the conduct of the study, data analysis, and writing until the publication of this research work.

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