# IMPACT OF REMITTANCES ON RICE PRODUCTIVITY

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## ABSTRACT

Remittances have the potential to enhance rice production. This retrospective study was carried out to assess the impact of remittances on rice productivity in the Chitwan valley of Nepal. This approach differs from the existing evidence as it studies the impact of the remittances on socioeconomic outcomes related to rice productivity as well. The multivariate linear regression analysis was used to predict the outcome of independent predictors on the dependent variable. The result showed a significant increase in rice productivity having an increase in engagement of both male and female household members (p<0.001). Similarly, there was an increase in rice productivity with an increase in one unit of land owned, use of irrigation, tractor, and thresher/harvester. The study depicts the significant contribution of remittances to rice productivity. This contribution can be ensured in the long term if migrant households are encouraged to utilization of remittances for various agricultural purposes to increase rice productivity.

### **KEYWORDS:** Land Ownership, Remittances, Rice Production, Technologies.

### INTRODUCTION

*Oryza sativa* is the major staple food crop of Nepal, a low and middle-income country (LMIC) with per capita gross national income (GNI) of US \$1090, and a Human Development Index (HDI) of 0.574 (The World Bank, 2020). The slow progress behind the development of this country is challenges brought by geographical disparity, and frequent political instability (Khatri, 2018). The situation has been aggravated after the 2015 earthquake and COVID-19 pandemic that caused a huge loss in the economic sector of the country (Adhikari et al., 2020).

About 60.4% of the population is engaged in agriculture with a contribution of 27.7% of gross domestic product (GDP) (Gauchan & International, 2018). Nepal has been transitioning from an agricultural country to a remittance-based economy. More than 32% of GDP in Nepal is contributed by remittances from migrant workers (Shrestha, 2008). Migration tends to affect rice production through induced labor shortage while remittances relax household's credit and risk constraints but impact the agriculture sector in long run (Kapri & Ghimire, 2020a). Considering the critical situation of the country, remittances have become an essential part that has been supporting the backbone of the country's economy (Adhikari, 2021).

Households in India were found to be utilizing remittances for the advancement of technologies which brought improvement in rice varieties (Singh et al., 2012). But remittances were found to

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be commonly used for foods and goods in another study (Jaquet et al., 2016). In Nepal, only 5% of the remittance was used for agriculture purposes while the remaining was for the consumption of foods (Khanal et al., 2015). Household income can be significantly impacted by the remittances in Nepalese families (Sapkota, 2017).

Technological advancement has been brought into the agricultural sector through remittances that saves time and labor cost (Pant, 2011). But instead of utilizing remittances for agricultural products such as rice production, migrant households are increasing their expenditure on sedentary lifestyles. In addition, people are influenced by western culture which makes them feel that farming is an outdated occupation carried out by uneducated people (Banerjee, 2017). The negative effect of migrant income on hired rice labor depicts that remittances have been less used in buying the hired labor substituting inputs such as labor-saving technology, chemical fertilizer and pesticides/herbicides. This leads them to use remittances for the fulfillment of materialistic aspects rather than for advancement in agricultural technologies. There is existing literature on remittances that focuses on the transformation of rural spaces due to an increase in off-farm income and no observable changes in agriculture (Maharjan, 2013). However, the information on the utilization of remittances in rice productivity specifically is not much known. Thus, this study aimed to find out the impact of remittances on rice production.

## **RESEARCH DESIGN AND METHODOLOGY**

## 1. Study Setting/Study Area

The setting for this study is the Chitwan Valley situated in the southern plain of Nepal. The Chitwan valley is surrounded by the Rapti River and the Chitwan National Park on the South, the Narayani River on the West and North, and Nepal's East-West highway and Barandabar Forest on the East.



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Until the early 1950's, the Chitwan Valley region was covered by jungle. Cataclysmic flooding of 1954 affected many places in Nepal. Mainly this natural disaster affected adjoining hill districts Dhading, Gorkha, Lamjung and Makawanpur. In 1955, Nepalese government opened this valley for settlement to resettle affected people from those districts (Sharma and Malla, 1957) and the population grew rapidly due to in-migration first from adjoining districts and later from all over the countries.

Before the 1950's, the valley was primarily covered with dense forests and was infamous for malarial infestation where few indigenous people used to live. The government, with the assistance from the USA, initiated a rehabilitation program in the valley during the 1950's that cleared the dense forests. Since, then, the valley has witnessed a rapid inflow of migrants. People were attracted by the free distribution of land for agricultural purposes at the beginning of the settlement, and by lately by development of modern amenities and services in recent decades.

Currently, the valley is inhabited mostly by in-migrants, especially from pahad, i.e, the Hill and mountain and other adjacent Terai districts including India. Further, Chitwan's central location and relatively well-developed transportation network have been the catalytic forces for turning into a

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hub for business and tourism. This has resulted in a rapid proliferation of government services, business, and wage labor opportunities in the district (Shivakoti et al., 1999; Bhandari 2006).

Due to rapid growth of population, physical development also taken place fast compare to another part/district of Nepal. Since, people from different types of culture and thoughts are living together, it is a kind of mixed community and people who living here influence by each other. Hence, people's culture, lifestyle, education level has been changing very fast. Moreover, their religion, practices of culture has been changed. A rapidly expanding population, growing wealth and productivity and exposure with nonfamily services have changed people attitude too. These large changes in the Chitwan accompanied any social changes in the organizations of people's lives. People attracted by each other's culture and they are ignoring their traditional tribe culture and strong interest on their own culture might be less. Along these social changes people's perception towards inter-caste marriage has also changed.

## 2. Sampling Process

This study used the Chitwan Valley Family Study (CVFS) sample, more than 25-year ongoing panel study of communities, households and individuals from Western Chitwan Valley located in south central part of Nepal. CVFS employed a stratified systematic random sampling procedure to draw sample. The sample is stratified into three strata. Stratum 1 includes only areas near the urban center, city of Narayangarh. Stratum 3 includes only areas far from Narayangarh and stratum 2 includes the areas in the middle, between stratum 1 and stratum 3. The samples were selected at two stages (Barber et al. 1997). In the first stage, in each stratum 10 settlements were randomly sampled based on probability proportionate to size, thus making a total of 30 settlements. These settlements were then divided into non-overlapping clusters called neighborhood or tole that consist 5-15 households. In the second stage, four neighborhoods from each settlement were chosen randomly using a systematic random sampling technique selecting a total 120 neighborhoods. Since, the Chitwan Valley is home to multiple ethnic groups, 31 other neighborhoods were added for ethnic representation. Finally, 20 other rural neighborhoods were included in strata 2 and strata 3 to make a final sample of 171 neighborhoods. However, after 1996, the 20 additional neighborhoods added to maximize sample size were dropped resulting the CVFS panel sample of 151 neighborhoods. Once the neighborhoods were chosen all households with in those neighborhoods and all of the individuals within those households were included in the CVFS panel.

Although originally drawn in 1995, CVFS sample is continually refreshed resulting in live sample of residents of western Chitwan. The representativeness of this sample is maintained in three ways. First, through tracking all the households and individuals included in the sample. Second, including the individual who are aged in the sample age group, turn 15 years old and finally including all the households as they come to live within the boundary of sample neighborhoods. Thus, CFVS sample continues to provide representative sample of the Western Chitwan Valley.

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### Sampling Procedure showing in chart:



### 3. Research Design

Chitwan valley Family Study (CVFS) has a case control comparison design. The basic principle of design is to collect multilevel and longitudinal data. Based on research design principles, different surveys have been implemented in the same study setting and the data has been refreshed time to time. It provides sufficient evidence to do even comparative studies. Therefore, I believed that the data what I was going to use in my research was potential for scientific study.

### 4. Data Sources and Analytical Strategy

The main purpose of this study was to access the consequences of recent remittances for agricultural activities basically focusing on rice production in the past year of 2015. Both remittances and productivity data were of the same year 2015. A baseline survey of 3332 households were carried out before the data collection of the study (DFID Agriculture Survey, 2015) which was narrowed to 2214 households that was completed in five seasons of data collection. Out of the agricultural survey, 1462 (66.6%) rice producing households in two seasons only were selected for this study. So, this study was only focused on impact of remittances on rice producing households. The major predictor's value remittances were primarily derived from retrospective data of DFID Agriculture Survey, 2015 the amount sent in Nepali Rupees by the household members of age 15 and above to 63 years in 2015. All control variables used in two models were from data 2015. The main objective of the study was on the consequences of recent

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remittances for recent agricultural activities considering rice productivity as the dependent or outcome variable. With using the large number of control variables those account for many household characteristics were included as predictors to interpret the cause nature of the effects of the study (Gray, 2009).

So, this study implemented household and community surveys collected by Chitwan Valley Family Study (CVFS). Various surveys used in the same setting of my study were household registry (refreshed in every six months), Agriculture and remittance calendar, 2015 (baseline survey of recent last ten years back from 2015), Department for International Development (DFID) Agriculture Survey, 2015 (the major source of my survey data), neighborhood history calendar, 2015 and household assets and income (2006 baseline household interview). The only one outcome variable productivity of rice was calculated on the basis of conversion of given area kattha into hectare and production kg into tons i.e. the ratio of production to the area as tons per hectare. The productivity calculated was further improved by power transformation as IDF Normal (Inverse distribution function normal) to make distribution normal. In case of major explanatory variables, the remittances received in year 2015 by household in Nepali rupees was converted into idf. Normal. Demographic measures such as male per hectare (idf. Normal) and female per hectare were calculated as the ratio of living male and female (15 and above to 63 years) to the farm size in hectare. So, the unit of labor power was labor per hectare during analysis of data.

In case of socio-economic characteristics farm income was the aggregate income in Nepali rupees gained from crop production (income gained from total crop production like rice, maize, wheat, mustard, lentil and commercial vegetable production) and livestock production (income gained by selling cattle, buffalo, swine, hen, ducks and commercial poultry). Livestock ownership was calculated on the basis of standardized LSU coefficient for cattle (0.82), sheep and goat (0.161), Pig (0.275) and poultry (0.017). Both farm income and Livestock owned came from Agriculture and remittance calendar, 2015. Ethnicity in which scholar categorized into five major groups for analytical purposes as Brahmin/Chhetri, Dalit, Newar, Hill Janajati and Terai Janajati (Ghimire et al., 2021). I coded household 1 if members were of a specific category and 0 if not. The ethnicity came from household registry. Technology use (irrigation, pesticides/herbicides, vitamins, tractor, chemical fertilizer, hybrid seed and harvester/thresher) in production, (coded 1) for a household use any technology versus did not use any (coded 0). Technology use in production came from DFID Agriculture Survey, 2015. Similarly, access to community services such as health, bus, market, bank, employment and distance to Narayangarh came from neighborhood history calendar, first launched in 1995 and repeated in 2005/2006 and 2015 (Axinn et al., 1997). The accesses to community services were expressed as minutes on foot to the nearest service center except proximity to urban center was expressed in the form of hour's idf. Normal.

In case of wealth index, the base of the data came from 2006 baseline household interviews where the observations were done by the interviewers to measure house quality. The scholar coded household 1 if members were of a specific category and 0 if not. The wealth index is a measure of socioeconomic position. It is a composite measure of a household's cumulative living standard. It is an indicator of the level of wealth that is consistent with expenditure and income measures in households. During the interviews with households, data were collected on ownership of:

i) Durable assets (e.g. car, refrigerator, bicycle, radio, television),

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- ii) Housing characteristics (e.g. number of rooms, dwelling floor and roof materials, toilet facilities), and
- iii) Access to services (e.g. electricity supply, drinking water source).

The response rate of 30%-70% from each indicator related to wealth index which consisted ownership of housing characteristics, assets and access to services were considered eligible for the principle component analysis. The housing characteristics were recoded into good and poor housing components. Household having a concrete/cement and brick was considered a good quality and cane/mud, wood, stone etc. was considered as a poor-quality regarding household wall component. The cement/concrete material was considered as a good quality and Tin, thatch, stick and plastic was considered as a poor quality regarding household roof component. The cement/concrete, brick, marble was considered as good quality and mud, wood, stone etc. was considered a poor-quality regarding household floor component. Household having ownership of car or motorbike or scooter was considered as a good wealth status and those having nothing as a poor wealth status regarding the assets component. Household having access to the source of water from tap or well within the living area was considered as a good service access and household not having any access to the water source within the living area was considered as a poor service access regarding access to the service component. Using the scores from first principle component analysis (PCA), a wealth index (asset index) was constructed. Based on the value of this index, individuals were sorted and population quintiles were established using cut-off values. These quintiles were then ranked from bottom to top as poorest, poorer, middle, richer and richest (Filmer and Pritchett 2001).

## 5. Data Analysis and Interpretation:

### 5.1 Analytical section

- **1.** Unit of Analysis: Households
- **2.** Level of measurement for variables under study:

Nominal: Khet only, Bari only, Khet and Bari both, Ethnicity, Availability of irrigation, Pesticides/herbicides use, Chemical fertilizer use, Vitamin use, Tractor use, Improved seed use, Thresher/harvester use, Poorest, Poorer, Middle, Richer and Richest.

Ratio: Remittances, Productivity, Number of dependents, Number of working age male and female per hectare, Number of working age female per hectare, Number of working age female per hectare, Age of the household head, Family size, Farm size, Average of education, Livestock ownership, Farm income, Health service, Bus service, Market service, Bank service, Employment service and Proximity to urban center (distance by bus from neighborhood to Narayangarh).

Tools for Analysis: The analysis for this study was done through SPSS version 26.

## **3.** Analysis:

Univariate Analysis: Mean, Standard deviation, Minimum, Maximum and Range.

Multivariate Analysis: The multivariate linear regression analysis was used to predict the outcome of independent predictors on the dependent variable

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## RESULTS

Table 1. Descriptive statistics of variables (N=1462 Households)								
		Descriptive Statistics						
Variables	Definition			Std.	Minimu			
		Ν	Mean	Deviation	m	Maximum	Range	
Independent variable								
Remittances sent in		1462	62661.61	139024.196	0	1700000	1700000	
2015	Amount in Rs							
Dependent variable								
Productivity in 2015	Tones per hectare	1462	4.3284	1.56751	0.78	19.10	18.32	
Confounding								
Variables (Control)								
Demographic								
Number of dependents	Age group 5 to 14	1462	1 73	1 374	0	9	9	
Trumber of dependents	and above 64 years	1402	1.75	1.374	0	,	,	
Number of working	Labor per hectare							
age male and female	(living15 and above)	1462	12 12661	10.96	0.025	205 858	204 022	
Number of working	Male per hectare	1402	15.12001	10.00	0.923	293.838	294.933	
age male per hectare	(living15 and above)	1462	5.20991	9.60	0	177.515	177.515	
Number of working	Female per hectare			,	, , , , , , , , , , , , , , , , , , ,			
age female per hectare	(living15 and above)	1462	7.91670	12.32	0	236.686	236.686	
The Age of household	Age for household							
head (15 and above)	head in years	1462	36.311	7.61	20.7	77	56.3	
Family size	Total household	1460	6.00	0.77	1	20	10	
Socia Feanamia	members	1462	6.33	2.11	1	20	19	
Characteristics								
Land owned (Farm	Hectare							
size)		1462	0.4085	0.45	0	3.38	3.38	
Quality of Cultivated								
land								
khet Only	1 if Yes, 0 otherwise	1462	0.761	0.43	0	1	1	
Bari only	1 if Yes, 0 otherwise	1462	0.157	0.36	0	1	1	
Khet_Bari_both_72	1 if Yes, 0 otherwise	1462	0.082	0.27	0	1	1	
Number of the parcel	Parcels in number	1460	1.50	0.01	1	6	~	
of cultivated land	Average of	1462	1.58	0.81	1	6	5	
Average of Education	education (15 to 59							
	years age group)	1426	7.78	2.79	0	16	16	
Livestock ownership	Number of							
	standardized units in							
	LSU	1462	1.69958	1.66	0	31.980	31.980	
Farm income	Income in Rs.	1462	12104.06	120559.04	0	4006194	4006194	
Fthnicity								
Brahmin Chhetri	1 if Yes. 0 otherwise	1462	0.4222	0.50	0	1	1	
		1462	0.4323	0.50	0	1	1	

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Hill Janajati	1 if Yes, 0 otherwise	1462	0.1710	0.38	0	1	1
Dalit	1 if Yes, 0 otherwise	1462	0.1265	0.33	0.00	1	1
Newar	1 if Yes, 0 otherwise	1462	0.0451	0.21	0.00	1	1
Terai Janajati	1 if Yes, 0 otherwise	1462	0.2250	0.42	0.00	1	1
1 hectare =1.5 bigha = 30 kattha							
Table 1 continued							
	Descriptive Statistics						
Variables	Definition			Std.	Minimu		
		Ν	Mean	Deviation	m	Maximum	Range
Technology use in rice production							
Availability of	1 if Yes, 0 otherwise						
irrigation	1.01	1462	0.7216	0.4484	0	1	1
Pesticides/Herbicides	1 if Yes, 0 otherwise	1462	0 3064	0 46117	0	1	1
Chemical fertilizer use	1 if Yes, 0 otherwise	1462	0.7127	0.45265	0	1	1
Vitamins use	1 if Yes, 0 otherwise	1462	0.1984	0.39890	0	1	1
Tractor use	1 if Yes, 0 otherwise	1462	0.9897	0.31	0	1	1
Improved seed use	1 if Yes, 0 otherwise	1462	0.21	0.41	0	1	1
Thresher/Harvester use	1 if Yes, 0 otherwise						
during production		1462	0.90	0.30	0	1	1
Access to community							
Health service	Minutes on foot to	1462	12 52	9.545	0	45	45
ficulti_service	the nearest health	1402	12.32	2.545	0		-т.
	care facility						
Bus_service	Minutes on foot to	1462	3.01	3.886	0	15	15
	the nearest bus						
Market service	Minutes on foot to	1462	6.94	7.041	0	30	30
	the nearest market	1.02	017 1	,	Ŭ		20
Bank_service	Minutes on foot to	1462	34.85	25.969	0	120	120
Envelopment comice	the nearest Bank	1460	10.00	0.102	0	(0)	(0)
Employment_service	the nearest place of	1462	10.86	9.182	0	60	60
	employment						
Distance by bus from	Distance by bus to	1462	68.48	34.245	0	240	240
neighborhood to	Narayangarh						
	(minutes)						
wealth Index		1462	0.4.40.0				
Poorest	1 if Yes, 0 otherwise	247	0.1689	0.37483	0	1	1
Poorer	1 if Yes, 0 otherwise	167	0.1142	0.31820	0	1	1
Mid	1 if Yes, 0 otherwise	530	0.3625	0.48089	0	1	1
Richer	1 if Yes, 0 otherwise	182	0.1245	0.33025	0	1	1
Richest	1 if Yes, 0 otherwise	336	0.2298	0.42086	0	1	1
	1 he	ctare =1	.5 bigha = 3	0 kattha			

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This study comprises remittances as a major independent indicator and rice productivity as an outcome indicator. Household background information such as demographic characteristics, Socioeconomic characteristics, quality of cultivated land, use of technology, access to community services and household wealth index are confounding predictors' in this study.

Table 1 shows the descriptive analysis of the indicators. The average remittance sent by migrants in 2015 was NRs 62661.61±139024.196. The average rice productivity in 2015 was 4.32±1.56 tons per hectare. The average number of dependents in the household was 1.73±1.374. The average number of total working males and females per hectare was 13.12±18.86. The average number of working males per hectare was 5.20±9.60. The average number of working Females per hectare was 7.91±12.32. The age of household head (15 and above) was 36.11±7.61 years. The average family size of the household was 6.33±2.77. The average land owned (farm size) among the household was  $0.40\pm0.45$  hectares. The khet owned among the household was 76.1 percentage of total land owned. The Bari owned among the household was 15.7 percentage of the total land owned. The average number of the parcel of cultivated land was 1.58±0.81 among the overall households. The average level of education among the household was 7.78±2.79 completed among the household. The average livestock ownership among the household was 1.69±1.66 standardized livestock unit (LSU). The average farm income among the households was NRs 12104.06±12059.04.

The population of Brahmin/Chhetri from the ethnic group among the households were 43.23 percentage. The population of Hill Janajati from the ethnic group among the households were 17.10 percentage. The Dalit population from the ethnic group among the households were 12.65 percentage. The population of Newar from the ethnic group among the households were 4.51 percentage. The population of Terai Janajati from the ethnic group among the households were 22.50 percentage.

The availability of irrigation among the household was 72.16 percentage of the total households. The households using pesticides/herbicides during rice production was 30.64 percentage of the total households. The households using chemicals during rice production was 71.27 percentage of the total households. The number of households using tractors as a technology for rice production was 98.87 percentage of the total households. The number of households using improved seed during rice production was 2.1 percentage of the total household. The number of households using a Thresher/harvester during rice production was 90 percentage of the total population.

The number of households having access to the nearest health services was 12.52±9.54 minutes on foot. The number of households having access to the nearest bus services was  $3.01\pm3.88$ minutes on foot. The number of households having access to the nearest market services was 6.94±7.04 minutes on foot. The number of households having access to employment services was 10.86±9.18 minutes on foot. The average proximity to urban center (Narayangarh) was 68.48±32.245 minutes from the neighborhood.

The number of households from the poorest group of wealth index was 16.89 percentage of the total households. The number of households from the poorer group of wealth index was 11.42 percentage of the total households. The number of households from the middle group of wealth index was 36.25 percentage of the total households. The number of households from the richer group of wealth index was 12.45 percentages of the total households. The number of households from the richest group of wealth index was 22.98 percentage of the total households.

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## TABLE 2 ESTIMATION OF THE EFFECT OF REMITTANCES AND STATUS ON RICE PRODUCTIVITY IN CHITWAN, NEPAL

Variables	Model 1	Model 2
Productivity tons per hectare (idf. Normal)		
Remittances		0.00000067(1.886) *
Demographic Characteristics		
Number of dependents (Recoded)	-0.015(-0.409)	-0.009(-0.227)
Number of working age male per hectare (IDF normal)	0.014(2.944) **	0.016(3.3) **
Number of working age female per hectare	0.013(3.956) ***	0.013(3.93) ***
Age of the household head (years)	-0.006(-1.88) *	-0.006(-1.871) *
Family size (Recoded numbers)	-0.062(-1.391)	-0.079(-1.727) *
Socio-economic Characteristics		
Land _ownership (Hectare_IDF Normal)	0.291(2.673) **	0.287(2.631) **
Quality of cultivated land (Ref= Khet and Bari Both)		
Khet only (Yes=1)	0.392(2.616) **	0.39(2.6) **
Bari only (Yes=1)	0.59(3.327) **	0.587(3.311) **
Number of Parcels of cultivated land (Recoded)	-0.171(-2.717) **	-0.162(-2.564) **
Farm income (in Rs-idf. Normal)	0.014(0.658)	0.014(0.66)
Average of Education (years)	-0.023(-1.353)	-0.021(-1.221)
Livestock ownership (Recoded)	0.046(1.303)	0.048(1.378)
t-static ***=p<0.001; **=p<0.05; *=p<0.1 Figure in the parenthesis are B(t) values		
Table 2 Continued		
Variables	Model 1	Model 2
Productivity tons per hectare (idf. Normal)		
Ethnicity (Ref=Brahmin/Chhetri)		
Hill Janajati (Yes=1)	-0.243(-2.106) **	-0.246(-2.126) **
Dalit (Yes=1)	-0.677(-4.997) ***	-0.697(-5.129) ***
Newar (Yes=1)	-0.019(-0.1)	-0.004(-0.021)
Terai Janajati (Yes=1)	-0.327(-2.838) **	-0.325(-2.818) **
Technology use in rice production		

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Availability of irrigation any (=1)	0.3(3.37) **	0.3(3.37) **	
Pesticides/Herbicides use any (=1)	0.143(1.334)	0.138(1.281)	
Vitamins use any (=1)	-0.039(-0.313)	-0.027(-0.212)	
Tractor use any (=1)	1.178(2.969) **	1.192(3.008) **	
Chemical fertilizer use any (=1)	0.148(1.668) *	0.147(1.661) *	
Hybrid seed use (Yes=1)	-0.025(-0.245)	-0.037(-0.368)	
Thresher/Harvester use during production (Yes=1)	0.357(2.505) **	0.353(2.481) **	
Access to community services			
Health service (Minutes on foot)	0.003(0.675)	0.003(0.604)	
Bus service (Minutes on foot)	-0.022(-1.937) *	-0.021(-1.862) *	
Market service (Minutes on foot)	0.015(1.909) *	0.015(1.93) *	
Bank service (Minutes on foot)	-0.005(-2.156) **	-0.005(-2.207) **	
Employment service (Minutes on foot)	-0.015(-2.667) **	-0.015(-2.626) **	
Proximity to urban center Narayangarh (Hours-idf. Normal)	-0.087(-0.84)	-0.088(-0.844)	
Wealth Index (Ref=Middle Class)			
Poorest group of wealth index (Yes=1)	-0.23(-1.892) *	-0.211(-1.731) *	
Poorer group of wealth index (Yes=1)	-0.281(-2.082) **	-0.267(-1.977) **	
Richer group of wealth index (Yes=1)	0.087(0.662)	0.072(0.546)	
Richest group of wealth index (Yes=1)	0.003(0.024)	0.006(0.054)	
Intercept	3.178 (6.388) ***	3.106 (6.231) ***	
Model F	7.301	7.200	
Regression degree of freedom	33	34	
Residual degree of freedom	1390	1388	
Adjusted R square	12.7%	12.9%	
t-static ***=p<0.001; **=p<0.05; *=p<0.1 Figure in the parenthesis are B(t) values			

Table 2 shows the multiple linear regression analysis from two different models. Model 1 consists of the overall prediction indicator and Model 2 consists of remittances as an added measure in the overall predictors. From model 1 there was a significant increase in rice productivity having a 0.014 increase in tons per hectare having increase in one individual male from a household working in the field (p<0.05). Similarly, there was a 0.013 unit increase in tons per hectare in rice productivity having an increase in one individual female from a household working in the field (p<0.001). Remittances had a significant increase in rice productivity having a 0.00000067 unit in tons per hectare increase in productivity with the increase in NRs one rupees remitted from a household (p<0.10) in Model 2. There was a significant increase in rice productivity by 0.014 unit in tons per hectare from model 1 and a 0.016 increase in tons per hectare from model 2 having increase in one male working in the field from the individual household (p<0.05). There was a

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significant increase in rice productivity by 0.013 in tons per hectare from Model 1 and 2 having increase in one female working in the field from the individual household (p<0.001). There was a significant increase in rice productivity by 0.291 unit in tons per hectare from model 1 from one household having an increase in 1 unit of the land owned (p<0.05). Similarly, rice productivity increased by 0.287 unit in tons per hectare from Model 2 having an increase in 1 unit of the land owned by individual household (p<0.05). The parcel of cultivated land had a significant decrease in rice productivity from both model 1 and model 2 analyses (p<0.05).

There was a significant decrease in rice productivity by -0.243 unit (Model 1) and -0.246 unit (Model 2) in tons per hectare among Hill janajati having a decrease in one-rupee remittance from the household (p<0.05). Similarly, Dalit ethnic group had a significant decrease in rice productivity by -0.677 unit (Model 1) and -0.697 unit (Model 2) in tons per hectare having one rupee decrease in household remittance (p<0.001). Terai Janajati from the ethnic group had a significant decrease in rice productivity by -0.327 unit (Model 1) and -0.325 unit (Model 2) in tons per hectare with a decrease in one rupees remittance from household (p<0.05).

In terms of technology, the use of irrigation, tractor, and thresher/harvester had a positive and significant increase in rice productivity in an overall model (p<0.05). There was a significant decrease in rice productivity in the overall model by -0.005 unit in tons per hectare having decrease in one unit of the household access to the bank services to that of household having overall remittances (p<0.05). Similarly, there was a significant decrease in rice productivity in the total model by -0.015 unit in tons per hectare having decrease in one unit of the household access to employment services to that of household having for total remittances (p<0.05).

The poorer among the group of wealth index had a significant decrease in rice productivity by -0.281 unit decrease in tons per hectare from Model 1 and -0.267 tons per hectare decrease from Model 2 having one rupee decrease in remittance from an individual household (p<0.05). Similarly, the poorest among the group of wealth indexed had a significant decrease in rice productivity by -0.23 unit (Model 1) and -0.211 unit (Model 2) having one unit decrease in remittances from an individual household (p<0.1).

## DISCUSSION

This study examined the impact of remittances on rice productivity. Overall findings from this study depicted the positive influence of remittances on rice productivity.

The present study found that there is a significant increase in rice productivity when one individual male and female from a household worked in the field. The finding was somehow different in the study conducted by (Ayanwale & Amusan, 2014) which showed that hiring additional female labor during planting improved the total output but hiring additional males during land clearing, and harvesting reduced the output. This difference might have existed due to the different cultural contexts.

This study showed that remittances had a significant increase in rice productivity. However, findings from (Tuladhar et al., 2014) depicted that remittance-receiving agricultural households did not show improvement in agriculture productivity despite having increased incomes. The differences might have existed because the study area is already a rich area (inner-terai) for rice production which may have been a factor in the increase in rice production. The remittance here

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was considered as total remittances gained from both domestic and international migration which might lead to increase in rice production.

There was a significant increase in rice productivity in the household having an increase in 1 unit of the land owned. Similar findings have been observed in a study where remittances increased the land ownership among migrant households and the vital role of land ownership in rice production (Ayanwale & Amusan, 2014; Hidayati, 2020). Similarly, the parcel of cultivated land had a significant decrease in rice productivity in this study. The finding was similar to the study by (Dhakal & Khanal, 2018).

The rice productivity was negatively impacted by ethnicity when remittance was decreased. This implies that ethnic groups such as Hill janjati, Dalit, and those from the terai region had a significant decrease in rice productivity when their remittance was decreased. This might have resulted because the decrease in remittance could have limited the capacity of farmers to buy rice seeds or use chemical fertilizers and pesticides. This is supported by (Kapri & Ghimire, 2020) who showed that households receiving remittances have a higher level of productivity. Similarly, the household with a poor wealth index had a significant decrease in rice productivity.

Use of irrigation, tractor and thresher/harvester had a positive significant increase in rice productivity. Similar findings were observed in the study which showed that irrigation facilities increased crop production (Paudyal, 2011). Households with a lack of access to bank services had a decrease in rice productivity in this study. (Jimi et al., 2019) also showed a significant decrease in the yield of rice productivity due to a lack of access to credit.

Considering the limitation of the study, it is unclear whether the increase in rice productivity in this study is due to the full utilization of remittances income to improve rice productivity or not. The remittances considered in the study are of aggregate remittances received from both domestic and international migration. So, it is unclear that which type of remittances has played crucial role for overall significant changes in rice productivity. Similarly, it is not clear that it is due to remittances that household land sizing is increased. Chitwan valley (inner-terai) itself is a large producer of rice crops due to which the actual impact of remittances in increase or decrease in rice production may not be ensured as there are other factors such as bad weather which can impact agriculture productivity. These would be interesting areas for further research.

# CONCLUSION

Remittances generated due to household out-migration has been a significant factor in uplifting the economic status of the family as well as the nation. The present study has depicted the positive contribution of remittances to rice productivity. Remittances have been utilized in agricultural investments such as the purchase of inputs, and the purchase of land leading to an increase in agricultural productivity. Remittances had a positive influence on the use of pesticides, and an increase in household land sizing which might have contributed to the rice production. Further, the promotion of the agricultural sector through the encouragement of the households with migrants in the utilization of remittances for the agricultural purpose such as the use of technologies (irrigation, pesticides/herbicides, vitamins, chemical fertilizer, varieties of seeds and thresher/ harvester) and hiring labor can benefit the rice production sector of Nepal.

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Conceptualization, GBKC and Dr, DJG.; Methodology, Dr. DJG and GBKC; Data curation, GBKC; Writing, GBKC; Original draft preparation, GBKC; Writing Review and editing; GBKC Along with this, author had read and agreed to the published version of the manuscript.

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