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Production economics and technology adoption of spring rice at Eastern Chitwan of Nepal

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Abstract
This study was conducted to know the production economics and modern agro-technology adoption by the farmers of the Eastern Chitwan who grow spring rice prior to main season rice. Altogether 48 samples were taken by simple random sampling technique which includes 24 from Rapti municipality and other 24 from Khairahani municipality. Survey method was used to collect primary information through a semi-structured interview schedule. The analysis showed that the average age of the household head was 43.62 and 53.29 in Rapti and Khairahani municipality respectively. Insect pest, storage and disease infestation were top three major problems reported by the farmers of Rapti municipality whereas disease infestation, insect pest and labour scarcity were of Khairahani municipality The average production cost and average net return per ha in Rapti municipality were found Rs. 99099 ± 6147 and Rs. 110546±4293 respectively and in Khairahani municipality was Rs. 86349 ± 3885 and Rs. 104420±4958 respectively. The average benefit-cost ratio of the spring rice was found higher in Khairahani municipality (1.26) than in Rapti municipality (1.15) indicating the more efficient production practice in Khairahani municipality. The Technology of soil testing, herbicide application, zinc dose and mechanical harvesting were significantly influenced by the location whereas education, gender and training received had not significantly influenced the age of seedling, herbicide application, seed replacement, NPK dose, zinc dose, seed rate, mechanical harvesting and mechanical threshing.

Keywords: spring rice, production, technology

1. Introduction
Rice is the most important cereal crops in agriculture and economy of Nepal contributing 7 percent to GDP. Among the cereals, rice comes first contributing about 42 percent of the total area under food crops of 1.36 million ha. It is the widely produced crop with 53percent of total edible cereal production and about 18percent to Agricultural Gross Domestic Product (AGDP) in the country. About 75 percent of the working population is engaged in rice farming for at least six months of the year with the production of about 4.29 million Mt. ton. (MoAD, 2016) [8]. It is grown in three agro-ecological zones, namely the Terai and Inner Terai (67 to 900 masl), mid-hills (1000 to 1500) masl and high hills-1500 to 3050. About 69.7 percent of the total rice area is located in the flat plains of Terai. The mid-hills and high hills occupy only about 25.8 percent and 4.4 percent, respectively. About 92 percent of rice area falls under main (*Barkhe*) season while 7 percent is under spring (*Chaite*) season. Boro rice and *Bhadaiya* rice is also practiced in few districts of Terai occupying less than 1percent of the total area (CDD, 2015) [3].
Spring rice is sown in the last week of February to the first week of March and follows transplanting of 30-40 days old seedlings. The month of transplanting coincides with the Nepali month "*Chaitra*" and so is named as C*haite* rice. This crop also needs assured irrigation from various sources. The coverage area of spring rice for mountain, hill and Terai is found to be 5.48, 24.85 and 69.67 percent, respectively. The crop is also called "*Hiunde*" rice as it is sown in winter months (first to second week of February) (CDD, 2015) [3]. In Chitwan 29,700 ha is covered by monsoon rice and 4600 ha is covered by spring rice (4000 ha in eastern Chitwan and 500 in western Chitwan.) The total production of spring rice is 20,240 tons. with the productivity of 4.4 t ha^{-1}. The productivity of spring rice in Chitwan is higher in comparison to monsoon rice which is only 3.49 t ha^{-1} (DADO, 2016) [4].
Spring paddy is resistant to many diseases and pests besides being more efficient in terms of lesser quantity of loss percentage during production. Around 11 varieties of spring paddy have

already been released for the Terai, inner Terai and river basins areas and similar climatic regions (Spring paddy to mega rice yield). According to the District Agricultural Office (DAO), spring paddy used to be the second most important crop in the district. Many farmers used to plant spring paddy on the fields in Madi, known as the district's grain basket, which lies near the Tinau River. More than 50 percent of the farmers around Rampur, Jhadewa, Arun River, Purba River, Lamdi River, Argali and Nisdi River used to cultivate spring paddy because there was adequate water for irrigation. Currently, only about 10 percent of the farmers plant spring paddy. The government has come up with schemes in the past to expand the acreage of spring paddy by 200,000 hectares in a bid to increase output and make the country self-reliant in food grain.Most farmers do not prefer spring paddy as it bears a larger grain. However, it has higher productivity than regular paddy. According to a governmental source, the productivity of spring paddy is 4 tonnes per hectare compared to 3.17 tonnes for regular paddy.

Despite of being the major rice producer, Chitwan still lags the maximum production up to its potentiality. The average productivity of irrigated rice of Chitwan district is 3.47 t ha^{-1} whereas average national productivity is 3.887 t ha^{-1} (Krishi Diary, 2074) [5]. In spite having all other requirements for successful rice cultivation like irrigation facility and high yielding variety, land management and access technologies still resulting the stagnant production in rice. Farmers are still following traditional methods. They have not been able to upgrade themselves regarding spring rice cultivation techniques. Chitwan is potent for increasing its rice productivity if the proper method for its cultivation is disseminated among the farmer. This study will browse actual problem related with low adoption of two season paddy cultivation after adoption of suitable practices in the farmer field. The major objective of this study was to study the spring rice production system of eastern area of Chitwan. To reach this focal mission, the following specific objectives were considered.

- To determine production cost, return and benefit of spring rice,
- To identify problem of production of spring rice in study area,
- To calculate level of technology adoption of spring rice production and its determinants.

2. Research Methodology

2.1 Selection of study area

The site of study was the area of Eastern Chitwan which includes two municipalities (Khairahani and Rapti). Khairahani municipality is a block of rice under PMAMP program and Rapti municipality is an area where Mega rice project was launched in 2073/2074. The target populations were farmer from this area who grows spring rice along with main season rice.

2.2 Study design

Rice growers of Chitwan district of Nepal was study population. Altogether 48 respondents comparing 24 from rice block and other 24 from area of mega rice project. Questionnaires were prepared and selected households were interviewed with semi structured questionnaire for surveyor superiority. Method used was Random Sampling Method.

2.3 Sources of data and techniques for data collection

2.3.1 Primary data

The primary data were collected through conducting household surveys, key informant survey and focus group discussion. These data were supplemented by the information obtained through household survey and consultation with university experts.

2.3.2 Secondary data

The secondary information were obtained through review of different publication mainly produced by Department of Agriculture (DOA), Ministry of Agriculture and Co-operatives (MOAC), Central Bureau of Statistics (CBS), Agro-enterprise center (AEC), Nepal Agricultural Research Council (NARC), National Rice Research Program (NRRP), Rampur, Chitwan and District Agricultural Development Office (DADO) of Chitwan district.

2.4 Data analysis technique

The information collected from the field was coded first and entered into the computer. Data entry and analysis was done by using computer software packages like the Statistical Package for Social Science (SPSS) version 20 and Microsoft Excel.

Collected data were analyzed by more descriptive than inferential method. Cross tabulation, comparison of mean, frequency, percentage, chart, graph and indexing were done to draw conclusion.

3. Results and discussion

The results and discussion included production cost summary, factors affecting the technology adoption and constraints related to spring rice production in two different municipalities.

3.1 Socio-economic and demographic information

3.1.1 Age of respondents and household head

The average age of both respondents and household head was higher in Khairahani Municipality i.e. 48 and 53 respectively, than in Rapti municipality i.e. 38 and 44 respectively.

Table 1: Distribution of average age of respondent and HHS

Variable	Rapti Municipality	Khairahani Municipality
Respondent	38.0	48.0
Household head (HHs)	44.0	53.0

Source: Field survey 2017

3.1.2 Education status of household head

The education level was devised into five major categories. Majority of the household head in both the municipalities had attained the secondary level of education i.e. 45.80 percent. The literacy rate of Rapti municipality was found 100 percent and that of Khairahani municipality was 87.50. These figures are higher than the district average i.e. 73.98 percent and the national average i.e. 66.25 percent (CBS, 2011) [2]

Table 2: Educational attainment of household head in eastern Chitwan, 2017

Education level	Rapti Municipality		Khairahani Municipality	
	Frequency	Percentage	Frequency	Percentage
Illiterate	0	0	3	12.50
Literate	3	12.50	3	12.50
Secondary	11	45.80	11	45.80
College	9	37.50	5	20.80
University	1	4.20	2	8.30
Total	24	100	24	100

3.1.4 Household size

The average household size in both the Municipality was found higher than the national average which is 4.7 (CBS, 2011) [2]. Majority of the household size were from the age group 15-60 in both the Municipality followed by the age group 0-15 and age group 60 and above. The mean household size for age group 15-60 is 4.08 ± 0.46 in Rapti Municipality and 4.00 ± 0.28 in Khairahani Municipality which is higher than the national average 3.58 (CBS, 2011) [2].

Table 3: Distribution of household size

Age categories	Rapti Municipality			Khairahani Municipality		
	Female	Male	Total	Female	Male	Total
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
<15 years	0.63±0.20	0.88 ± 0.24	1.50±0.39	0.63±0.19	0.79±0.13	1.42±0.23
15-60 years	2.00±0.25	2.08±0.27	4.08±0.46	2.00±0.16	2.00±0.17	4.00±0.28
≥ 60 years	0.33±0.10	0.38±0.10	0.71±0.19	0.00±0.00	0.25±0.09	0.25±0.09
Total	2.96±0.42	3.33±0.50	6.29±0.86	2.63±0.31	3.04±0.23	5.67±0.45

SE = Standard Error Source: Field survey 2017

3.1.5 Family labor force for agricultural and non-agricultural activities

Family size is an important variable that determine the supply of labor to the farm operations. The average family size of the study area was found 5.6 and 6.3 in Rapti Municipality and Khairahani Municipality respectively which is higher than district average of 4.38 and national average of 4.38 (CBS, 2011) [2]. Average number of economically active family members was found similar in both the Municipality whereas average economically active family members in agricultural activities was found 2.6 in Rapti Municipality and 3.54 in Khairahani Municipality.

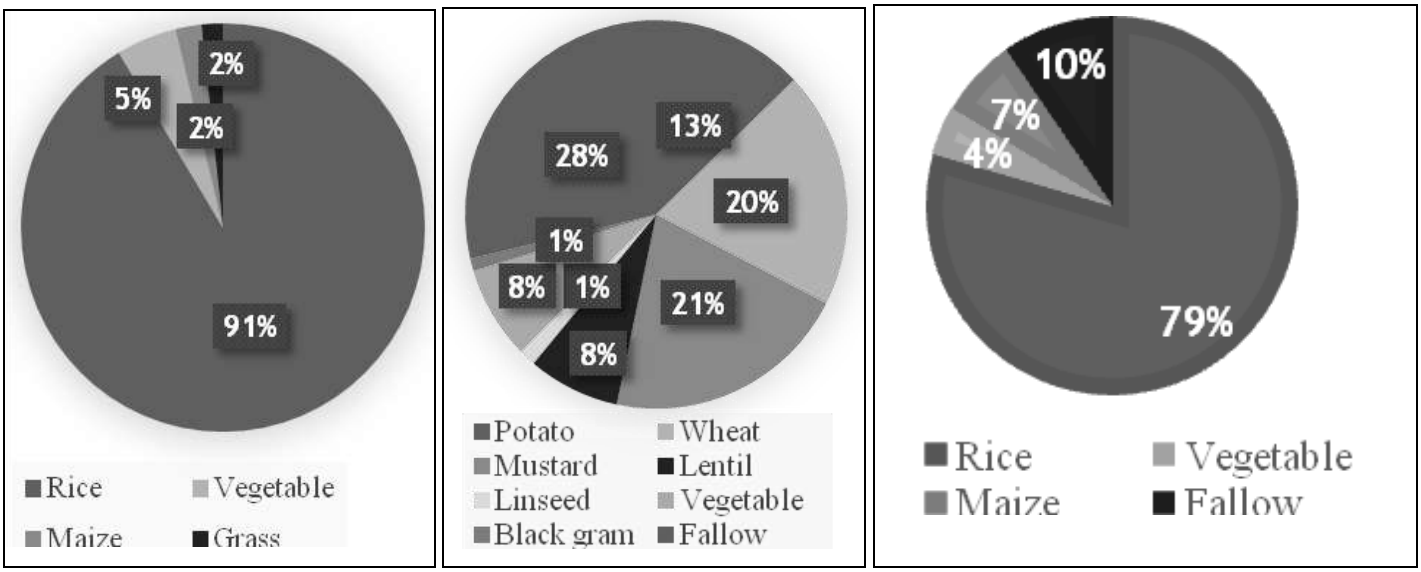
Table 4: Availability of family labor for on-farm and off-farm activities

Variables	Rapti Municipality	Khairahani Municipality
Average family size	5.6	6.3
Average number of economically active family members	4	4.08
Average economically active family members in agricultural activities	2.6	3.54
Average economically active family members in non-agricultural activities	1.4	0.54

Source: Field survey 2017

3.2 Cropping pattern

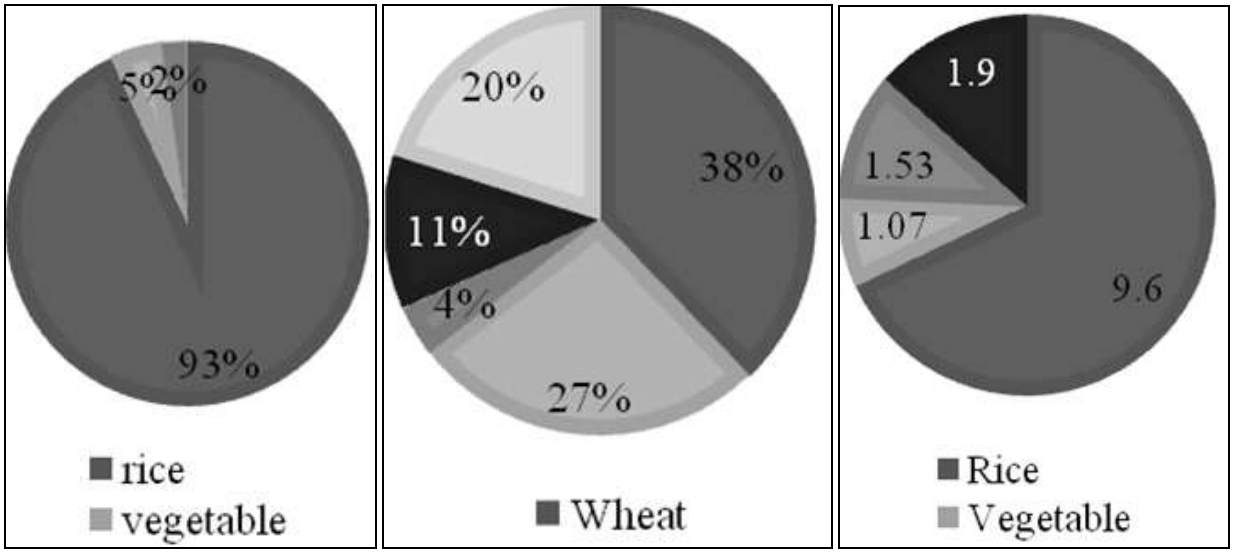
There were rice dominated cropping patterns in the study area. Majority of the farmers had adopted two seasons rice based cropping patterns and the area was almost fully covered by the crops round the year. Major cropping patterns were Rice-Wheat- Rice, Rice- Wheat- Maize, Rice- vegetable – vegetables and Rice-Mustard- Rice.



Summer Season Winter Season Spring Season

Source: Field survey 2017

Fig 1: Cropping pattern of Khairahani municipality



Mansoon Season Winter Season Spring Season

Fig 2: Cropping pattern of Rapti municipality Source: Field survey 2017

3.3 Problems in spring rice production

Insect pest, storage, disease infestation, labor scarcity and climatic variability are top five major problems reported by farmers Rapti municipality whereas disease infestation, insect pest, labor scarcity, storage and weed management are top five major problems reported by farmers in Khairahani municipality.

Table 5: Problems of spring rice production with severity level

Severity	Khairahani municipality	Rapti municipality
	Problems of disease infestation	Problems of insect pest
	Problems of insect pest	Storage problems
	Labor scarcity	Problems of disease infestation
	Storage problems	Labor scarcity
	Weeds and weed management	Climatic variability
	Climatic variability	Problems of transportation input
	Lack of irrigation management	Crop lodging
	Improved seed	Lack of fertilizers
	Crop lodging	Lack of draft power
	Lack of draft power	Improved seed
	Problems of transportation input	Weeds and weed management
	Nutrient management	Nutrient management
	Lack of fertilizers	Lack of irrigation management
	Problem of drainage	Problem of drainage

Source: Field survey 2017

3.4 Production Economics

3.4.1 Production cost summary per ha

The average production cost per ha was found higher in Rapti municipality (Rs 99099 ± 6147) than in Khairahani municipality (Rs 86349 ± 3885). These figures are higher than the national average i.e. Rs 64967.72 (Krishi Diary, 2074) [5]. Cost for harvesting and threshing shared highest share in Rapti municipality (24.03 percent) due to manual harvesting and threshing followed by cost on land preparation (13.91 percent), labor cost on intercultural operation (12.44 percent) of spring rice cultivation. Cost on manure shared highest amount in Khairahani municipality (14.64 percent) followed by cost on land preparation (13.42 percent) and cost on harvesting and threshing (13.38 percent).

Table 6: Production cost analysis per household and per ha

Variables	Khairahani municipality			Rapti Municipality		
	Per household	Per ha	percent share	Per household	Per ha	percent share
Seed and seed treatment	1960 ± 275	3544±205	4.10	1143±183	3224±182	3.25
Irrigation	2254±358	3935±40	4.56	1327±257	3311±149	3.34
Manure	8678±2104	12637±1935	14.64	2838±620	9563±2239	9.65
Chemical fertilizer	4284±704	6803±436	7.88	2799±654	6799±434	6.86
Pesticides and Herbicides	1803±382	3809±536	4.41	1114±248	2939±514	2.97
Nursery bed preparation and management	931±105	2218±326	2.57	796±100	2610±271	2.63
Cost on land preparation	5775±730	11587±1062	13.42	4966±779	13782±603	13.91
Seedling uprooting	1125±142	2495±291	2.89	967±115	2957±196	2.98
Transplanting	5854±956	9835±415	11.39	4031±762	10570±272	10.67
Labour for intercultural operation	6630±1164	11033±571	12.78	4365±695	12329±625	12.44
Harvesting and threshing	6494±1081	11554±1232	13.38	7230±903	23810±2713	24.03

Transportation and miscellaneous	3519±454	6899±659	7.99	2208±234	7206±872	7.27
Total cost	49306±7043	86349±3885		33783±4700	99099±6147	
	Output					
Return from grain	64819±20774	103287±4908		25045±9394	109205±4290	
Return from straw	967±286	1133±289		576±177	1342±245	
Total return	65785±20921	104420±4958		25621±9490	110546±4293	

Source: Field survey 2017

3.4.2 Production economics per ha

The average production cost per ha was found higher in Khairahani municipality (Rs 99099 ± 6147) than in Rapti municipality (Rs 86349 ± 3885). Similarly the average net returns per ha in Rapti municipality (Rs 104420) which is lower than Khairahani municipality (Rs 110546). These figures are higher than the national average i.e. average production cost Rs 64967.72 and average net return Rs 81273.45 (Krishi Diary, 2074) [5]. In both municipality B:C ratio was higher than 1.00 and higher in Rapti Municipality as compared to Khairahani Municipality.

Table 7: Production economics per ha

Variable	Rapti Municipality		Khairahani Municipality	
	Mean	SE	Mean	SE
Total cost of production per ha	86349	3885	99099	6147
Total return per ha	104420	4958	110546	4293
Net return per ha	18072	5791	11447	3468
BCR per ha	1.26	0.08	1.15	0.03

SE= Standard error **Source:** Field survey 2017

3.5 Technology adoption

3.5.1 Frequency of technology adoption

Soil test and seed replacement was found highest adoption in Rapti municipality whereas mechanical threshing and mechanical harvesting was found highest adoption in Khairahani municipality. Others all the recommended technologies were found more or less equivalently distributed among the both municipalities.

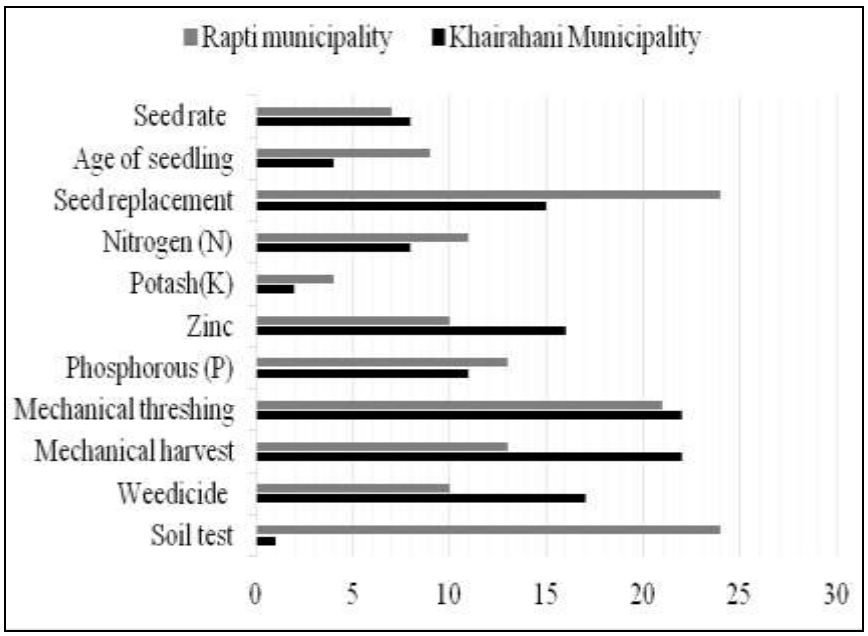


Fig 3: Frequency of recommended technology adoption Source: Field survey 2017

3.5.2 Factors affecting technologies adoption

The linear relationship between the adoption of recommended technologies and independent variables was sown in Table 8. Technology of soil testing, herbicide application, zinc dose and mechanical harvesting were significantly influenced by the location while age of seedling, seed replacement, NPK dose, seed rate and mechanical threshing were not influenced by the location. In the same way education, gender and training received had not influenced the adoption of age of seedling, herbicide application, seed replacement, NPK dose, zinc dose, seed rate, mechanical harvesting and mechanical threshing. It was found that the gender of household head had significantly influenced the adoption of zinc dose. This result contrast with the (Lionberger, 1960) [6] who stated that education was positively associated with the adoption of recommended practices. Especially more than eight years of schooling was found almost always associated with higher adoption rates and (Mathur, 1996) [7] who stated that training is an important part of the extension strategy followed in the entire agricultural development projects and with this there is better performance of the farmers.

Table 8: Regression analysis of adoption with dependent variable

Technology	Constant(intercept)	Independent variables			
		Municipality	Education	Gender of household	Training of household
Soil testing	0.92	-21.3***	0.48ns	0.16ns	1.13ns
Age of seedling	0.31	-1.15ns	0.61ns	-0.82ns	0.93ns
Herbicide	0.93	2.08*	-12.6ns	-1.22ns	1.60ns
Seed replacement	0.727	-3.01ns	1.49ns	-0.51ns	0.59ns
Nitrogen dose	-0.21	-0.46ns	1.23ns	0.81ns	1.55ns
Phosphorus dose	1.01	-0.56ns	-0.79ns	-0.97ns	0.25ns
Potassium dose	0.139	-0.51ns	0.38ns	-0.63ns	0.84ns
Zinc dose	0.88	2.186**	-0.15	-2.34**	1.19
Seed rate	-0.18	0.628ns	1.27ns	0.278ns	0.47ns
Mechanical harvesting	0.76	2.89***	-0.38ns	-0.58ns	-0.12ns
Mechanical threshing	1.07	0.46ns	-0.53ns	-0.78ns	0.45ns

Note: ns; non-significant, * significant at 10%, ** significant at 5%, *** significant at 1% **Source:** Field survey 2017

Conclusion

Majority of the farmers involved in agriculture in both the municipalities were of economically active aged group. The average land holding was found higher in both study site in comparison to the national scenario. The benefit cost ratio of spring rice cultivation was found higher in Khairahani municipality and lower in Rapti municipality in comparison to national scenario. The factors affecting the technology adoption was site specific rather than the gender, education of household head and participation on training. The production of spring rice cultivation can further be increased by addressing the problems of disease and pest, storage and labor scarcity whereas the production area can be increased by managing the proper irrigation facilities.

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