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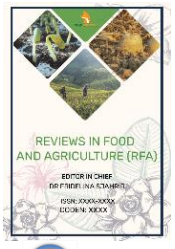

RESEARCH ARTICLE

COMPARATIVE ADVANTAGE OF ARECA NUT OVER RICE IN JHAPA, NEPAL

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ABSTRACT

This study was conducted to assess comparative economic analysis of the areca nut and rice production. This study also aimed to assess the major governing factors and overall economy involved in the production, major problems leading to shift rice farming, key determinants of areca nut production in the study area. Seventy areca nut growers were selected by simple random technique and thirty rice growers were selected by purposive sampling technique. Three potential areas of Jhapa district: Mechinagar municipality 1, 2, 3, 4; Buddhashanti and Arjundhara were selected as the survey site where there is major shifting of rice cultivation for commercial areca nut farming. The data collection was done from both primary and secondary sources. Descriptive statistics benefit cost analysis, resource use efficiency through Cobb-Douglas economic model was used to analyze data using SPSS. It was found that areca nut production had significantly higher gross return in comparison to rice whose production was affected by factors viz. labor, manure, chemical fertilizers, pesticides and irrigation in areca nut while machineries use, chemical fertilizers, seeds, manure and labor for rice production. The major reason for adopting areca nut cultivation was easier in cultivation practice, low cost of cultivation and high economic return. The B/C ratio of areca nut and rice was 2.02 and 0.99 respectively which was statistically significant. The productivity of the areca nut can be increased by adopting improved cultivation practices and scientific technology. Since, agro climatic conditions favors the production of areca nut cultivation, it should be shifted from small scale to commercialized form.

KEYWORDS

Areca nut, growers, production, rice, shifting.

1. BACKGROUND

1.1 INTRODUCTION

Jhapa is an inner Terai district in Mechi zone of South – eastern Nepal. Jhapa observes moderate climate complexion as it lies in the Indo-Gangetic plain and Churia low hills. Seasonal monsoon is well distributed across the district with annual rainfall is about 2000 mm and maximum temperature is recorded 42ºC in summer and 10ºC in winter. Geographically it covers the area of 1606 square kilometers and ranges from the elevation of 701 m to 3639 m. According to Food and Agriculture Organization (FAO), the total area covered by areca-nut in Nepal is 3918 hectare and total production is 14390 tons. Eastern region of Nepal is the leading area for the areca-nut production which contributes 99.68% of total production. Among this Jhapa district lies in the top most rank on the basis of production. The total area under areca-nut cultivation is 2660 hectare and total production is 9773 tons. Out of total production of areca nut, 68% of production is from Jhapa district (MoAD, 2017)revealing the great opportunity of improving livelihood of farmers. Betel nuts rank eighth among culinary nuts by worldwide production (1,033,691 tones). In Nepal the total production area of areca nut is 3918 hectare and the production from the total area is 14390 metric tons (FAO, 2017) . Mostly it is cultivated in eastern part and its production in eastern part is 14328 metric tones which is 99.57 % of the total cultivation. Commercially it is cultivated in Jhapa, Morang , sunsari and out of total production topmost production comes from Jhapa.

Areca nuts are small in size and are round to oblong in shape. The fleshy outer husk is coarse and matures from green to yellow-orange and may also contain patches of red. Within the husk, there are layer of fibrous pale yellow strands surrounding a hard light brown seed or nut, which is the dried endosperm. (Staples & Bevacqua, 2006). Areca nut is a tropical crop. It is mostly confined to 28˚ North and South. It is grown at an altitude of 1000 MASL. Required range of temperature for areca nut cultivation is between 14˚ to 36˚ and is adversely affected by temperatures below 10˚ and above 40˚ c (Dhakal K. p., 2016) . Generally lateritic soil, red loam soil and alluvial soil is regarded good for its cultivation (Bhat & Sujatha, 2009).Soil should be deep and well drained (soil depth should fall below 1m), which should be slightly acidic soil to neutral soil (Ramappa B. T., 2013). Areca nut is grown under different agro climatic conditions; it is very sensitive to extreme climatic conditions. In general areca nut is mainly grown in low attitudes. Major areca growing area is in plains, since at higher elevations the winter temperature would be too extreme for the crop. Through the evaluation of indigenous accessions, the variety Mohitnagar (from West Bengal) with highest yield potential has been released during 1991 (Ananda, 2002).

The cultivated rice plant, Oryza sativa, is an annual grass of the Graminae family. It grows to about 1.2meters (4 feet) in height. On the inside, it presents a stem in the form of a hollow cane, except for the knots. The leaves are lanceolate, with tapered endings and parallel venation. The harvested rice kernel, known as paddy, or rough rice, is enclosed by the

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hull, or husk. Rice is the starchy seeds of an annual south East Asian cereal grass (Oryza sativa) that are cooked and used for food.

Most rice in the eastern Asia is presently grown in lowland paddy fields and that grown in upland fields may be considered as marginal. In Nepal rice is grown in three agro-ecological regions (Terai and Inner Terai-67 to 900; Mid Hills-1000 to 1500 MASL; and High hills-1500 to 3050 MASL) and three major production environments (irrigated, rain-fed lowland and upland).

Although Nepal exported substantial quantities of rice in 1970s and mid 1980s, the country stopped exporting it from 1987/88 onwards. Rice is cultivated in Jhapa in 87500 ha with the production of 338000 metric tones per annum (MoAD, 2017).

Due to Knowledge about areca nut importance and more comparative advantage farmers engaged in rice as well other cultivation are now shifting towards areca nut cultivation. It is considered that the profitability is four times more in areca nut cultivation than the rice cultivation. Due to easy cultivation practice, more economic returns, low cost of production, long term returns after a time of cultivation, low labor requirement, easy management practices farmers are more attracted towards areca nut cultivation rather than rice. Rice is highly sensitive to climatic condition whereas areca nut being the perennial crop is less sensitive compared to rice. The strong evidence is that the migrant households shift into more land intensive crops (Brauw, 2012). So, farmers are slowly leaving the conventional farming of rice cultivation and migrating to areca nut. Areca nut Development Committee released the authentic data about areca nut where the production was 40460 mt., productivity was 20 mt /ha and area was 2808 ha. With the development of increasing farmers towards areca nut at recent more than 40 cooperatives and 30 groups are active in areca nut development. Out of which 37 cooperatives and 28 areca nut groups are registered (PM-AMP, 2018/19) in the areca nut zone, Jhapa.

Labor cost from nursery establishment, transplanting, weeding, manuring, harvesting, threshing is much higher than areca nut (Prasad, 2002). Due to irrigation problem, farmers need to depend upon monsoon for the plantation of rice whereas for areca nut frequent irrigation is not required. Irrigation facility is not affordable by the poor and needy farmers. Unavailability of fertilizers during the peak requirement is also a great problem. Majority of the farmers in Jhapa district planted Ranjit Mansuli which diminishes the productive capacity of the soil.

People of Jhapa district mainly cultivate Ranjit Mansuli that gives good production in beginning years which degrade the quality of soil. Being annual crop rice is more sensitive to diseases and pests.

Although the agro climatic condition is much favorable and cost of cultivation as well more return and cultivation practice is easier in areca nut, farmers still cultivate rice in order to fulfill their daily requirement and more farmers follow the subsistence type of agriculture. Rather to buy from market, they prefer to cultivate rice for their own daily need. Return from rice is very low in comparison to areca nut. However, lack of technical knowledge of areca nut and subsistence living behavior of farmers they are still cultivating rice. Jhapa district, which once used to export paddy to Indian border markets, has now become large importer of rice. Areca nut is cultivated using simple and traditional method without consuming modern inputs like fertilizer, pesticide, hybrid seed, irrigation etc. therefore, there is a chance of increasing areca nut production if they would have adopted modern's agriculture input (Jayasekhar, Jose, Thamban, & Muralidharan, 2012). Areca nut is an important source of livelihood for the rural peoples whose lands are not suitable for other food crops cultivation. Thus, areca nut becomes important source of livelihood and acts as the dominant source of income to the cultivators. The system of other agriculture commodity cultivation declined owing to the scarcity of water, labor, inputs required; areca nut cultivation among the farmers became another best vocation alternative to earn livelihood (Vanlalrema & Halam, 2016).

Jhapa district, which once used to export paddy to Indian border markets, has now become large importer of rice. According to Mechi custom office, Paddy import is swelling annually. In the last fiscal year, Jhapa imported paddy worth Rs30 million.

Comparative advantage is an economic term that refers to an economy's ability to produce goods and services at a lower opportunity cost than that of trade partners. A comparative advantage gives a company the ability to sell goods and services at a lower price than its competitors and realize stronger sales margins (Koch, 1961)

1.2 STATEMENT OF PROBLEM

Jhapa is one of the leading districts in rice cultivation. Being more labor intensive crop, the cost of rice cultivation is much higher than net benefit from it. Due to rapid outmigration of economically active population, finding labor during the peak planting season is a main problem. Paddy production in Jhapa district's paddy super zone and paddy block failed to meet expectations of many due to low soil quality, floods and lack of rain during the plantation season. More cost of cultivation is required in rice than areca nut though it is annual crop. Irrigation, fertilizers and quality seeds are the major scarce input of farmers. The return from rice is very low in comparison to areca nut. However, lack of technical knowledge of areca nut and subsistence living behavior of farmers they are still cultivating rice for their basic daily requirement as the staple crop. Rather to buy from market, they prefer to cultivate rice for their own daily need. Rice is highly labor intensive as compared to areca nut. Low price of rice, fertilizers problems, plant protection constraints, weed problems, lack of labors and processing are the constraints as perceived by rice farmers. Being annual crop rice is more sensitive to diseases and pests. Jhapa district, which once used to export paddy to Indian border markets, has now become large importer of rice.

1.3 OBJECTIVE OF THE RESEARCH

The primary or the main objective of the research is to study the overall comparative advantage of areca nut over rice. The others specific objectives of this research are to find the cost of production and benefit from production of both areca nut and rice as well calculate their B:C ratio and to make the comparison between them. This research is also done to find the different factors affecting the determinants of areca nut cultivation. This study also aims to find the different production problems faced by the farmers during cultivation of rice and different factors that led the rice farmers to shift their cultivation to areca nut cultivation.

2. METHODOLOGY

This paper aimed to study the status of areca nut and rice cultivation in Jhapa and the overall comparative advantage of areca nut cultivation over rice in the study area. Jhapa is one of the major areca nut producing terai region of Nepal lying in the Province Number 1 of Eastern Development region. Jhapa was selected because it is the potential district of areca nut cultivation and majority of farmers are engaged in areca nut farming. Jhapa district was selected purposively because it was the first district starting areca nut plantation in Nepal. Thus, information was drawn from some of the major areca nut producing areas of Jhapa district such as Buddhashanti rural municipality, Arjundhara municipality and Mechinagar municipality 1, 2, 3 and 4. The study areas were purposively selected because of the following reasons-a) the Selection of these sites was due to the involvement of most of the farmers in the areca nut plantation for a long time; b) in these areas there is major shifting of rice cultivation into areca nut cultivation and c) these three local bodies are also beneficiaries of the areca nut zone of Prime Minister Agriculture Modernization Project.

The formal survey was undertaken through interviews with the randomly selected farmers using the questionnaire for both the farmers separately. Household survey was done using pre-tested, semi-structured interview schedule. The data collection was done from both primary and secondary sources. Descriptive statistics benefit cost analysis, resource use efficiency through Cobb-Douglas economic model was used to analyze data using SPSS. Preliminary field visit, Field survey, Focus Group Discussion and Key Informant Interview (KII) were the primary source of data collection.

A definite numbers of respondents or producers were selected as sample which was representative of the whole population as a primary source of data during April and May 2019. 70 households cultivating areca nut from three selected areas were selected by simple random sampling techniques as well 30 households cultivating rice were selected by purposive sampling technique to meet the objective. The list of areca nut growers in the selected site was obtained from Prime Minister Agriculture Modernization Project, Areca nut zone, Jhapa.

For informal primary data was collected from the farmers of the site who are involved in areca nut cultivation and who are shifting rice farming towards areca nut cultivation. The formal survey was undertaken through interviews with the randomly selected farmers using the questionnaire for both the farmers separately.

3. Results and Discussion

3.1 Landholding comparison between areca nut and rice growers

Land is one of the integral parts of agricultural system. In economics, land is the resource that encompasses the natural resources used in production. The study revealed that the total land holding of areca nut growers (1.29 ha) and rice growers (1.12 ha) are not significantly different. Similar is the case for the leased land. Among the 5 areca nut and 2 of the rice leasehold farmers' 0.03 hectares and 0.02 hectares area on an average is respectively farmed. Among the irrigated land, 58.2% irrigated land is of areca nut whereas 10.0% land is of rice growers which is statistically significance at 1% level of significance.

Table 1: Landholding comparison between areca nut and rice growers

Variables	Areca nut growers	Rice growers	Mean difference	Chi square or t value
Total Land Holdings(ha)	1.29(1.18)	1.12(1.04)	0.17	0.714
Leased on land(ha)	0.03(0.135) (n=5)	0.02(0.08) (n=2)	0.01	0.50
Irrigated land(ha)#	37(58.2%)	3(10.0%)		16.07***

Figures in the parenthesis indicate the standard deviation. #indicates the categorical data. *** indicates statistically significant at 1% level of significance.

3.2 Willingness of the farmers to expand the area of cultivation

Farmers will expand the area of cultivation if return or profit from the farming will be more. Among the 70 respondents of areca nut 68.57% of the respondents are willing to expand the area of cultivation while 31.42% of farmers are not willing to expand the area. The reason behind not expanding the area is due to the unavailability of land. Reverse is in the case of rice growers. Among 30 rice farmers, only 10% are willing to expand and 90% are not willing to expand, rather they want to decrease the area. Farmers in the surveyed area explained that majority of the rice growers will expand their rice field into areca nut farm. Significant difference at 1% level of significance was observed on the willingness of farmers to expand area of cultivation between areca nut and rice cultivation.

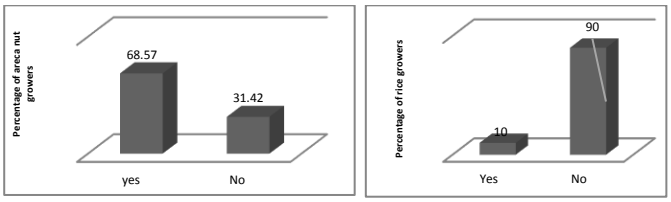

Figure 1: Farmer's willingness to expand the cultivation by type of farmers

3.3 Access to agricultural services and facilities

Community based organizations like cooperatives are the assets of the community that strength the unity among the farmers and provide economic and social help, as well help to get governmental subsidy from different zones. The farmer's involvement in the farmer's group or cooperative were found to be 36 (51.4%) for areca nut growers and 3 (10%) for rice growers out of 70 and 30 respondents respectively in each category. The comparative study showed statistically significant difference at 1% level of significance. The farmer involved in areca nut cooperative got subsidy and different training organized by areca nut zone only. Rice being the traditional crop, people pretend as if they know everything about the cultivation practices rather being enthusiastic since its return is very low compared to the cost of production, but people are interested towards areca nut being higher income crop.

The farmers who received training for areca nut growers were higher (31.4%) than rice growers (13.3%) reflecting significant difference at 5% level of significance. Mainly the areca nut growers received training from areca nut zone, Jhapa and from Mohitnagar, India. Areca nut is cultivated using simple and traditional method without consuming modern inputs like fertilizer, pesticide, hybrid seed, irrigation etc. therefore, there is a chance of increasing areca nut production if they would have adopted modern's agriculture input (Jayasekhar, Jose, Thamban, & Muralidaran, 2012).

Table 2: Access to agricultural services and facilities by type of farmers

Variable	Areca nut growers	Rice growers	Chi square value
Training received			
Yes	22(31.4%)	4(13.3%)	3.574**
No	48(68.6%)	26(86.7%)	
Involve in cooperatives			
Yes	36(51.4%)	3(10%)	15.15***
No	34(48.57%)	27(90%)	

Figure in the parentheses indicates percentage of growers. *** and **indicates statistically significant difference at 1% and 5% level of significance.

3.4 Intercropping

Mixed cropping in areca nut plantation has promoted more growth and yield of main crop of areca nut as indicated by increased number of leaves and increased yield per palm compared to sole crop (Sharma, Chaudhary, Sharma, & Anjanawe, 2020). A mixed approach is often viewed as sustainable alternative farming system particularly on small and marginalized lands and it can provide great economic return per unit area (Nimbolakar, Awachare, Chander, & Husain, 2016). The study revealed that about 60% of the areca nut respondents practiced intercropping with areca nut in three areas and remaining 40% of areca nut farmers followed mono cropping. Black pepper was the major crop that they practiced as intercropping. Besides black pepper farmers plant banana, turmeric, ginger, grass, tea, lemon, cinnamon, vegetables, cardamom as intercrop. The intercrops which love shade and can even grow in between the plants grows very well and increase the overall income from the areca nut. So, people involved in the areca nut cultivation are slowly attracted towards intercropping day by day knowing its value.

Table 3: Multistoried cropping adopted by areca nut growers by their location

Cropping pattern	Mechinagar	Buddhashanti	Arjundhara	Total
Intercropping	15(53.6)	16(57.1)	11(78.6)	42(60.0)
Mono cropping	13(46.4)	12(42.9)	3(21.4)	28(40.0)

Figure in the parentheses indicates the percentage of farmers.

3.5 Materials and labor cost required per hectare by type of cultivation

In the study area, human labor was largely used input in the production of rice which was computed in terms of total value in monetary terms including the family members used as labor in the field. The study revealed that in an average the total labor cost required per hectare in areca nut (NRs.34552.72) was half than the average labor cost required in the cultivation of rice (NRs.71701.37) which was statistically significant at 1% level of significance. The average cost of chemical fertilizers and pesticides needed in the rice farming (NRs 7191.94) per hectare was much more higher than needed in areca nut (NRs. 1028.90) which was statistically significant at 1% level of significance. Manure is only fertilizer that majority of the areca nut growers uses, so its average cost in areca nut (NRs .27584.45) was slightly higher than in rice farming (NRs.22439.12) which was statistically significant at 10% level of significance.

Most of the rice farmers had rainfed type of land. And the areca nut farmers had irrigated land so the average cost of irrigation in the areca nut grower (NRs.5667.13) was slightly higher than rice growers (NRs.2522.61) which was statistically significant at 10% level of significance. But in the overall scenario the total benefit of areca nut exceeds than the rice farming by huge difference.

Table 4: Total materials and labor cost required in cultivation per hectare by type of farmers

Variable	Arecanut growers(n=70)	Rice growers (n=30)	Mean difference	t-value
Manure cost	27584.45(10838.61)	22439.12(16950.8)	5145.32*	1.82
Chemical fertilizer cost	1028.90(4828.80)	7191.94(3838.86)	-6163.04***	-6.19
Irrigation cost	5667.13(6822.96)	2522.61(3389.04)	3144.51*	2.39
Total labor cost	34552.71(9857.3)	71701.37(27772.76)	-37148.66***	-9.48

Notes: Figure in the parentheses indicates standard deviation. ***, * indicates statistically significant at 1% and 10% level of significance.

3.6 Total number of labors required in areca nut and rice growers

The study revealed that the average number of labor required in areca nut growers was 72 whereas the average number of labor required in the rice growers were 132. Highly significant result was obtained at 1% level of significance, where mean difference was -60.00 and t-value was -5.507. Somehow, double labors are required per hectare in the cultivation of rice as compared to areca nut. Since rice is more labor intensive crop, labor are required from nursery establishment to marketing in case of rice whereas areca nut requires very low manpower compared to rice cultivation. Inspite incase of harvesting the one who owns the areca nut, they themselves cover all the harvesting cost.

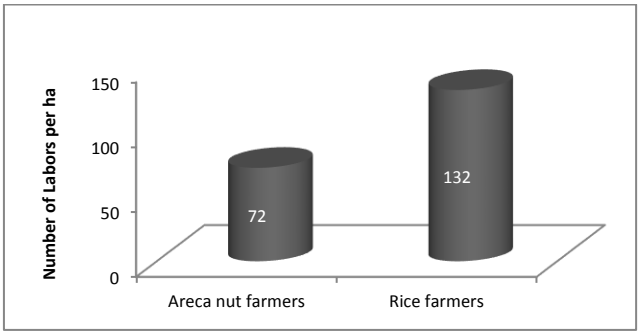

Figure 2: Numbers of labors required per hectare by type of growers

3.7 Gross margin analysis

Gross margin was analyzed among two categories of sampled farmers of the study area. Gross margin is the function of productivity, per unit price of output and total variable cost. Productivity and per unit price have positive relationship and total variable cost has negative relationship with gross margin. The per hectare gross margin of areca nut was found higher than rice which is statistically significant at 1% level of significance. This was because of high productivity of areca nut and low cost of inputs. The gross margin provides simple and quick method of analyzing a farm business. For any enterprises gross margin is the difference between the gross return and the variable cost incurred. For the analysis of gross margin, only the variable costs were considered. The variable cost must be specific to single enterprise and vary approximately in proportion to the size of the enterprise. The gross margin of the areca nut and rice cultivators in this study was calculated as;

Gross margin = Gross return – Total variable cost

Total variable cost = Summation of cost of all variable items

Table 5: Gross margin analysis by using total variable cost

Variable	Areca nut growers(n=70)	Rice growers (n=30)	Mean difference	t-value
Gross return	260299.51(94309.67)	15805.51(27418.32)	244494.48	13.91***

Figures in the parenthesis indicates the standard deviation and*** indicates statistically significant at 1% level of significance.

3.8 Total cost required in the cultivation of areca nut and rice

Areca nut being perennial crop, the additional cost is required for areca nut along with the maintenance cost. In case of areca nut amortized establishment cost, rental value of land and maintenance cost (labor cost, manure cost, chemical fertilizer cost, irrigation cost and pesticide cost) as refer to the base year of rice cultivated year was taken in account. Whereas in case of rice cultivation only rental value and maintenance cost (Tractor cost, manure cost, chemical fertilizer cost, labor cost and seed cost). In table no.10 it is seen that the total cost incurred in areca nut is slightly higher (NRs.162983) compared to rice (NRs 141936.4), the reason behind that is being perennial crop the establishment cost was also taken into account.

Table 6: Total cost incurred per hectare in areca nut and rice cultivation

Variable	Establishment cost (NRs./hectare)	Amortized Establishment cost (NRs./hectare)	Rental value (NRs./hectare)	Maintenance cost (NRs./hectare)	Total cost (NRs./hectare)
Areca nut Cultivation	501775	63976	30000	69007	162983
Rice cultivation			16000	125936.4	141936.4

3.9 Benefit cost Ratio comparison of areca nut and rice

The average total return of areca nut (NRs.329306.68) is higher than rice (NRs.141741.45) which is statistically significant at 1% level of significance. B:C ratio of areca nut (2.02) is also more than double of the rice (0.99) which is also significant at 1% level of significance. The cost of areca nut is slightly higher than rice being perennial crop in nature but the net return from areca nut is much higher leading to make the B/C ratio high.

Establishment cost: Areca nut being perennial crop the cost of production is not as similar to that of rice. In areca nut the gestation period is seven years. Manure, manuring and weeding are only the cost till bearing period. Seedlings and labor cost for pit digging, planting and manuring were found to be the main cost for establishment of orchard.

Amortized Establishment cost: An amortization schedule normally show us how much interest and principle we are paying each period, and also helps to calculate total interest paid over the life of the loan. The basic amortization formula relies on three variables, identified by three letters P, R and N where p is loan, R is rate and N is number of years.

Amortized Cost= TEC {(1+i) AL*i/ (1+i) AL-1 (Merritt, 2013)

Where,

TEC=Total establishment cost

i =interest rate of 12 % is taken

AL= Average life span of areca nut which is taken to be 25 years.

Maintenance cost was labor cost, chemical fertilizer cost, irrigation cost, manure cost and pesticide cost. And annual land rental value was taken as NRs.30000 per hectare though maximum farmers had their own land.

Benefit cost ratio of areca nut is calculated by dividing total return by total cost (Amortization cost, rental value of land and maintenance cost)

Benefit cost ratio of rice is calculated by dividing total return by total variable cost (labor cost, tractor cost, chemical fertilizer cost, manure cost and pesticide cost) plus land rental value.

- B/C Ratio=Gross return/ Total cost

Table 7: Benefit Cost Ratio comparison of areca nut and rice per hectare

Variables	Areca nut Growers (N=70)	Rice Growers (n=30)	Mean difference	t-value
Total returns	329306.68 (109062.29)	141741.45 (49072.46)	187565.2***	9.01
B:C ratio	2.02(0.51)	0.99(0.24)	1.03***	10.746

Figures in the parenthesis indicates the standard deviation and*** indicates statistically significant at 1% level of significance.

3.10 Contribution of different agriculture crops to the total income of areca nut growers

Figure Number 3 indicates the contribution of different agriculture crop in the total household income of areca nut growers. Here it is clear that 43% of the total income of areca nut growers were contributed by areca nut followed by other occupation as governmental services, remittance, business by 29% etc. Only 12% of the total income is contributed by rice followed by 5% maize,5% black peeper,3% tea and 3%lemon. It indicates that the areca nut plays very important role in the contribution of total income of areca nut growers.

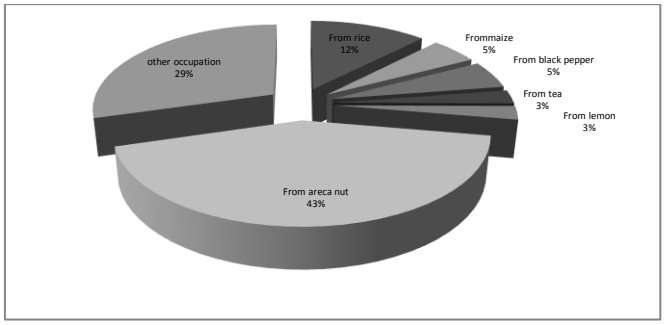

Figure 3: Contribution of different agricultural crops to the total income of areca nut farmers

3.11 Farmer's involvement in various other crops cultivation before areca nut farming

Majority of farmers were involved in rice cultivation prior to the areca nut cultivation. In the figure 6 it is seen that 71.42% of farmers were involved in rice/maize cropping system before areca nut cultivation followed by 17.14% of finger millet growers. 11.42% were involved in bamboo, vegetables cultivation, tea cultivation prior to areca nut cultivation. Due to different constraints factors and being more laborious shifting of annual crops to the areca nut cultivation.

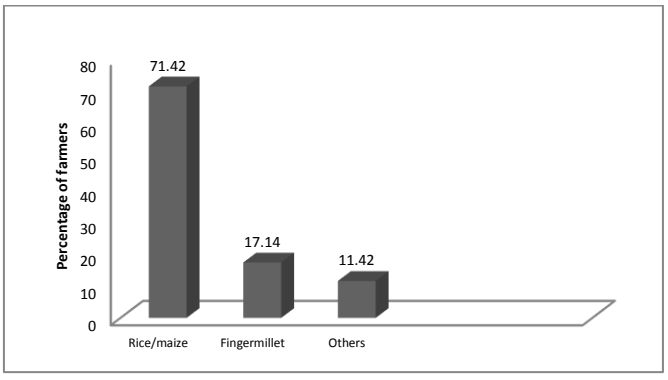

Figure 4: Involvement of farmers in various cultivation before farming of areca nut.

3.12 Factors affecting the gross income of areca nut and rice growers

A cobb-Douglas production function was run based on the cross-sectional data to find out the effects of different factors on gross income of areca nut and rice farming in the study area. The explanatory variables of areca nut included in the models were labor cost, manure cost, chemical fertilizer cost, irrigation cost and pesticides cost whereas variables of rice included in the models were chemical fertilizer cost, tractor cost, manure cost, labor cost and seed cost incurred during areca nut and rice cultivation respectively. Gross revenue is the total revenue acquired by marketing of all the produced products in term of market price. The gross revenue of areca nut may be affected by manuring cost, weeding cost, cost of manure, irrigation cost and chemical fertilizers cost whereas gross revenue of rice is affected by chemical fertilizer, labor, manure, planting material, tractor cost and irrigation cost. In order to know the factors affecting the gross income of areca nut and rice production, cobb-Douglas type of production function was used. The model specified and used was represented by:

$$Y=aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}\,e^{u}$$

Above equation was linearized into logarithm form, which is expressed as,

$$\text{Log } Y= \text{Loga}+ b_1 \text{LogX}_1+b_2\text{LogX}_2+ b_3\text{LogX}_3+ b_4\text{LogX}_4+ b_5\text{LogX}_5+u$$

Where,

For areca nut production

Y=Gross revenue from areca nut production (NRs.)

a =constant

X_1=Labor cost (NRs.)

X_2=Manure cost (NRs.)

X_3=Chemical fertilizer cost (NRs.)

X_4=Irrigation cost (NRs.)

X_5=pesticide cost (NRs.)

For Rice production

Y=Gross revenue from rice

a =constant

X_1=Chemical fertilizer cost (NRs.)

X_2=Tractor cost(NRs.)

X_3=Manure cost (NRs.)

X_4=Labor cost (NRs.)

X_5=seed cost (NRs.)

e =Base of natural logarithm

u =Error term

b_1, b_2, b_3, b_4, b_5 are coefficients for labor/chemical fertilizer cost, manure/tractor cost, chemical fertilizer/manure cost, irrigation/labor cost, pesticide/seed cost respectively in areca nut and rice production. Gross return was the dependent variable in the production function whereas different cost incurred was the independent variables. Cost of labor of rice was obtained by adding different cost incurred from nursery establishment to threshing. All the costs were average cost per sampled household and were expressed in rupee (NRs.)

3.12.1 Areca nut Production

R^2 (coefficient of determination) explains how nicely the sample regression line fits the data. The explanatory power of the model showed that the model was best fit as the R^2 value obtained was 0.542. It means 50.42% variation is explained by the variable present in the model. The value of adjusted R^2 was 0.507 indicating that after taking into consideration the degree of freedom (df), 50.7% of the variation in the dependent is explained by the explanatory variable included in the model. The measure of overall significance of the estimated regression F value was15.41 which was significant at 1% level of significance, so that we can say the model is best fit. The estimated coefficient for chemical fertilizer showed no significant effect on gross income from areca nut growers. The regression coefficient for human labor cost was 0.65 which had depicited that with 100% increase in cost of human labor, gross income could be increased by 65%. Likewise other inputs used in areca nut cultivation namely manure cost, irrigation cost and pesticide cost could increase the gross return by 24.2%, 1.3% and 2.9% respectively with the increase in their use by 100%. The human labor cost showed statistically significant effect at 1% level of significance, pesticide cost showed significant at 5% level of significance whereas manure and irrigation cost showed significance at 10% level of significance.

Further, production function exhibited decreasing return to scale which implies that if all the inputs specified in the function are increased by 100% then the gross income will increase by 87.6%.

Table 8: Regression estimates for factor affecting gross income of areca nut growers				
Variables	Estimated coefficients	Standard error	t-value	p-value
Constant	3.282	1.224	2.681	0.009
Labor cost	0.65***	0.139	4.730	0.000
Manure cost	0.242*	0.107	2.256	0.027
Chemical fertilizer cost	0.008	0.013	0.624	0.534
Irrigation cost	0.013*	0.007	1.894	0.062
Pesticides cost	-0.029**	0.014	-2.020	0.047

R square=0.542 Adjusted R square=0.507 F-value=15.41*** Return to scale=0.876

***, ** and* indicate level of significance at 1%, 5% and 10% level of significance.

3.12.2 Rice cultivation

The R^2 value obtained was 0.637 which means 63.7% variation is explained by the variable present in the model. The value of adjusted R^2 was 0.562 indicates that after taking into consideration the degree of freedom (df), 56.2% of the variable is explained by the explanatory variable included in the model. The overall significance of the estimated regression F value was 8.44 which were significant at 1% level of significance, so we can say that the model is best fit.

The human labor cost showed statistically significant difference at 1% level of significance and tractor cost showed significant effect at 10% level of significance on gross income from rice. The regression coefficient for human labor cost was 0.637 which had depicted that with the 100% increase in the cost of labor; gross income could be increased by 63.7%. Likewise tractor cost could increase the gross return by about 15.6% with the increase in its use by 100%.

Further, production function exhibited decreasing return to scale which implies that if all the inputs specified in the function are increased by 100% then the gross income will be increased by 78.

Table 9: Regression estimates for factor affecting gross income of rice growers				
Variables	Estimated coefficients	Standard error	t-value	p-value
Constant	0.515	2.628	0.196	0.846
Chemical fertilizer cost	0.062	0.103	0.606	0.549
Tractor cost	0.156*	0.085	1.821	0.080
Manure cost	0.043	0.030	1.434	0.164
Labor cost	0.637***	0.169	3.772	0.000
Seed	0.203	0.231	0.879	0.387

R square=0.637 Adjusted R square=0.562 F-value=8.444*** Return to scale=0.78

*** and * indicate level of significance at 1% and 10% level of significance.

3.13 Satisfaction from Cultivation

The graph in the figure 5 shows the satisfaction level of the respondents by type of cultivation i.e areca nut cultivation and rice cultivation. In the areca nut cultivation, 68.5% of households were highly satisfied, 24.28% of households were moderately satisfied and 7.14% of the farmers were least satisfied. Reverse is in the case of rice cultivation. 6.66% of the households were highly satisfied, 10% of households were moderately satisfied and 83.33% of the households were least satisfied. This was due to different problems faced by rice growers in the study area.

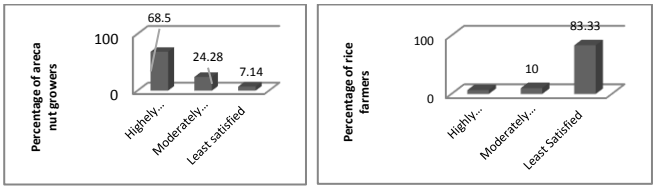

Figure 5: Satisfaction levels of the respondents

3.14 Production problems in rice

Rice is cultivated in Jhapa in 87500 ha with the production of 338000 metric tones per annum (MoAD, 2017).The details of the production problems faced by the rice growers in the study area are shown in the table. The result showed that, rice farming is more laborious and that is the major production problem of the sample farmers in the study area. The second major problem indicated by sampled farmers was less profitable, the cost of cultivation is higher than the return from it. Majority of the sampled household had Rainfed type of land due to which they need to depend upon rainfall for their production. Farmer's perception towards the production problems can be presented in the five point scale comprising most severe, severe, moderate, mild and most mild. The scale values of 1, 0.8, 0.6, 0.4 and 0.2 was used to most severe, severe, moderate, mild and most mild problem respectively. It was computed using the following formula:

Mathematically,

$$I_{imp} = \sum = (Sifi / N)$$

Where,

I_{imp}=Index of importance

Si=Scale value

fi=Frequency of respondents

N=Total number of respondents

Table 10: Production problems of rice in study area		
Problem	Index	Rank
More laborious	0.87	I
Less profit	0.71	II
Lack of irrigation	0.5	III
Lack of fertilizer and quality seed	0.42	V
Infestation of disease	0.48	IV

However, it was realized that being laborious and finding labor in the peak period was difficult and crucial problem in the rice cultivation. Unavailability of fertilizers and quality seed during planting season was also problem to farmers because input suppliers such as agro vets, fertilizers distributors and cooperative were not distributing the quality inputs to the farmers. Due to lack of technical knowledge regarding the disease pest control, infestation of disease problem was also observed in the rice growing farmers in the study area. Farmers perceived dependence on the monsoon as the most important constraint. The farmers depend mostly on monsoon to sow their rice crop every year and most farmers cultivate one season per year due to this constraint. Despite of most of them have pumps, they could not be able to tackle this constraint due to lack of water and increase in cost of production leading to the loss in their farming business (Nguyen, 2006).

3.15 Perception of farmer to adopt areca nut cultivation

Majority of the sampled households in the study area preferred to cultivate areca nut over other crops. They are slowly shifting rice cultivation to areca nut farming. Due to suitable agro ecological condition for areca nut, the production is much higher than other crops. Farmers in the study area revealed that the main reason for adopting this cultivation was the income from this cultivation was much higher than other annual crops as rice. The second main reason indicated by sampled farmers in the study area was this crop is easier in cultivation, once it is transplanted farmers only practice the process of weeding; farmers need not to engage daily in the field for its cultivation. Brauw (2007) explored that in majority of the household the young generation people are out migrated and the migrant households decrease rice production. The strong evidence is that the migrant households shift into more land intensive crops (Brauw, 2012). The unavailability of principal men and adult sons for ploughing, spraying of pesticides, carrying rice seedlings, hauling paddy after harvest and transporting farm inputs – all of which are time- and energy-intensive – can translate into a marked increase in workload for principal women. Moreover, a labour shortage or depletion can lead to worsening poverty if outmigration of principal men is dominant and is coupled with low or no remittance (Rola-Rubzen, Interrelationships between labor outmigration,

livlihood, rice productivity and gender roles, 2010). Areca nut is an important source of livelihood for the rural peoples whose lands are not suitable for other food crops cultivation. Thus, areca nut becomes important source of livelihood and acts as the dominant source of income to the cultivators (Rajasree, Akhter, & Nurul, 2019).

According to the sampled farmers the main third reason behind adopting this cultivation was low cost of cultivation. They themselves prepare planting material from their previous year seed, manure they allocate is the manure from their own livestock, and farmers rarely put fertilizers in their field. So, the cost incurred in the field is much less compared to other crops. As well the land is not suitable for other crop production in many of the sampled household and areca nut can adopt in such land. Respondents also explained that their grandparents bought the planting material from Assam, India and following this tradition they are adopting this cultivation.

Table 11: Farmer's perception to adoption of areca nut farming

Adoption due to	Index	Rank
Higher income than other	0.87	I
Easier in cultivation	0.73	III
Low cost of cultivation	0.73	II
Land not suitable for other crop	0.24	V
Following tradition	0.61	IV

4. Conclusions

Though areca nut is perennial crop, the total benefit per hectare obtained from it by subtracting all the establishment, maintenance and rental value of land is higher than rice production. The intercropping process in areca nut leads to high benefit and maximize total output. Areca nut cultivation can be increased by adopting improved cultivation practices and mechanization is one of the important prerequisites of areca nut. Although farmers are aware about the loss that they are facing in rice cultivation, they cultivate rice in order to meet their daily basic requirement. The major reason to adopt areca nut cultivation was higher income than other crops followed by easy in cultivation practices, low cost of cultivation; land is not suitable for other crops and following the tradition of their forefathers. 68.5 % of areca nut growers were highly satisfied whereas only 6.66% rice growers were highly satisfied indicating that in the coming future we can predict that there will be more shifting of rice growers towards areca nut farming. So, people can grow the particular species in the mass amount where there is high production of that species that could fetch good amount than the subsistence level of farming. The problem ranking of rice farmers was done by calculating index value of each problem by ranking them based on the weightage provided by the farmers. The major problem for rice production was laborious farming followed by less profit, lack of irrigation, lack of fertilizers quality seeds and infestation of diseases.

Easy cultivation practice, low cost of cultivation and high return from areca nut, people are slowly attracted towards this cultivation as well B/C ratio of areca nut was found double to that of rice. Areca nut requires half labour compared to rice which reduces the burden of non availability of farmers during peak period of cultivation.

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