Economic analysis of spring rice production at Rinchengang, Wangduephodrang

Thinley Gyem[p], Ngawang Chhogyel[p] and Tanka Maya Pulami[p]

ABSTRACT

An economic analysis of spring rice cultivation at Rinchengang, Wangdue District was carried out to determine the cost effectiveness of spring rice cultivation. A total of 45 households engaged in spring rice cultivation with input support in the form of free seeds, polythene sheets and fertilisers from the ARDC Bajo were interviewed. An analysis of cost and returns of the practice indicated that spring rice cultivation is indeed not economical owing to low yield and high production costs. Rice is a labour intensive crop and the spring rice production costs do not vary much with that of the main season crop, however the yield is quite low leading to comparatively lower economic returns for spring paddy. Attack from birds was found to be the main reason behind the lower yield in spring rice causing up to 60-80% of yield damage. This was also identified to be one of the main reasons behind farmers decreasing interest in spring paddy. Other factors such as labour shortage, high labour costs and low levels of farm mechanization were found to be restraining spring rice in the region. In order to enhance spring rice cultivation and to encourage more farmers, the study identified the need for a sustainable bird control mechanism, without which spring rice promotion initiatives may not succeed.

Keywords: *Double cropping; costs, labour; material; yield*

1. Introduction

Rice is the most important crop in Bhutan in terms of production and is often equated with food security of the country (Chhogyel et al 2015). The Department of Agriculture (DoA) with the mandate of enhancing agricultural production to meet the domestic food demand has put in concerted efforts towards the realization of self-sufficiency objectives. The various developmental interventions over the years have resulted in enhanced production and productivity. However, Bhutan continues to import more than 50% of its rice requirement from India. The domestic rice productions hardly meets 50% of the total rice requirement (Shrestha 2004). According to the latest statistics, rice is cultivated on 49,325 ac of land with a total production of 80,261 tonnes (DoA 2015).

Limited land holding is identified as the major constraint to the country's rice production enhancement (Chhogyel et al 2015, Shrestha, 2004). Of the total geographical area of 38,394 sq. km, the arable land comprises 7.8% (LUPP 1995) and the actual cultivated land comprises only 2.93% (NSSC and PPD 2010). The presence of mountains and rugged terrains renders most of the land unsuitable for cultivation (Hussein 2009; Neuhoff et al 2014). Crop intensification interventions such as double cropping, cultivation of fallow lands, mechanized

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farming and crop diversification are needed to enhance rice self-sufficiency. The global rice demand and trade outlook highlights the need to intensify rice production in Asia to meet the rising demand as there are limited possibilities of expanding the cultivation area (FAO 2014).

The double cropping practice can play an important role in achieving food self-sufficiency by doubling production through offering an opportunity to utilize scarce wetlands twice a year (Andrews and Kassam 1976). In china, rice double cropping contributes to 34.6% of country's rice production (He et al 2017). The spring rice concept was first introduced in the country in the early 1980s under the IFAD project to enhance paddy production for household self-sufficiency. The initiative continued for over a decade until it ceased in 2002 with the termination of the project (Chhogyel et al 2014a). In 2012-2013 the Research and Development Centre (RDC) Bajo took the initiative to revive the spring rice cultivation at Rinchengang, Wangdue, which has been one of the prime cultivators of spring rice ever since the inception of the practice in the country (Chhogyel et al 2015). Currently the farmers of Rinchengang cultivate spring rice on about 30 ac land belonging to forty-four households (HHs). Despite various government interventions to promote spring rice, the practice has not picked up. According to records maintained at ARDC Bajo, the area under spring rice continues to lag below 100 acres although the initial projection was to bring entire rice fields of Rinchengang under double cropping system (RNR RDC-Bajo 2013-2014).

With many practical issues raised by the growers, it is difficult to substantiate if the spring rice cultivation is economical for the farmers. This study is an attempt to understand the costs and returns involved in growing spring rice to help determine cost-effectiveness of the practice. The other objectives of the study are to quantify inputs, labour and materials required for spring rice cultivation and to determine the drivers and constraints of spring rice production. Such an understanding on cost and returns of the crop production would also help to assess the economic impacts of any new technologies.

2. Materials and Methods

2.1. Sampling

Rinchengang chiwog (sub-block) under Thedtsho Geowg (block) of Wangdue Dzongkhag was identified as the study site (Figure 1). The chiwog has 44 HHs involved in spring rice cultivation with 28.49 acres under cultivation. Employing a purposive sampling method, 100% sampling of all the 44 HHs was done. The respondents constituted 16 men and 28 women.

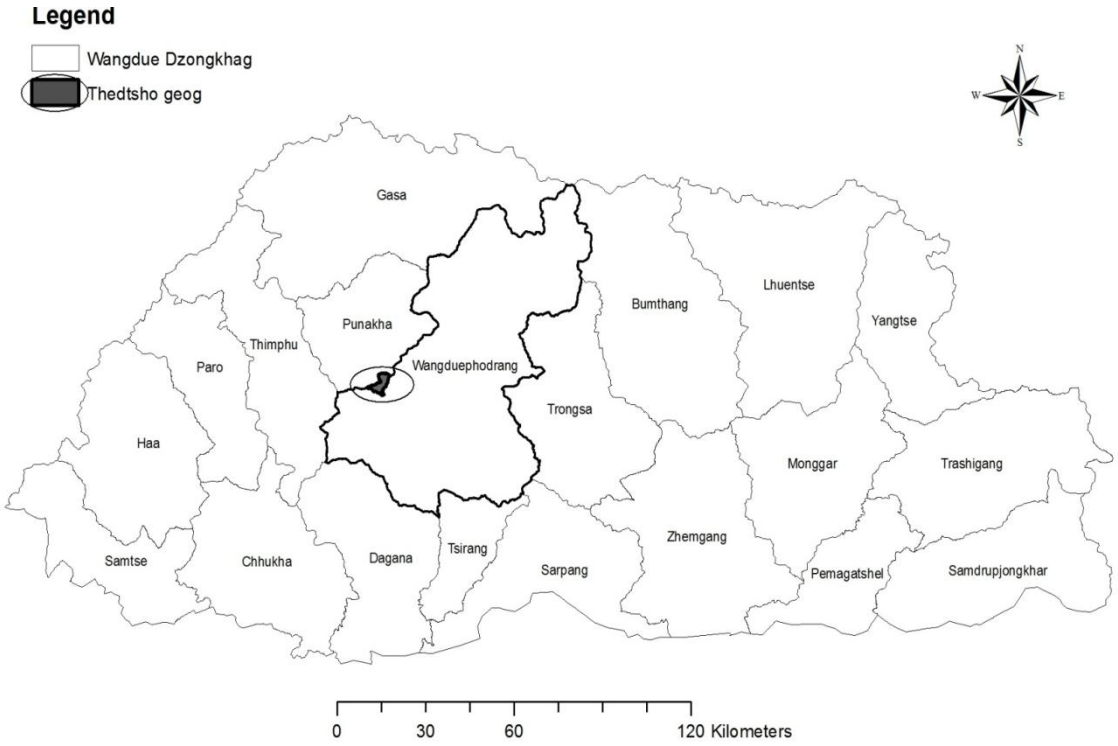

Figure 1. Map of Bhutan showing Rinchengang village (study site) under Thedtsho geog

2.2. Data collection

An open-ended survey questionnaire was designed to collect data. Farmers were asked about their labour and material inputs and outputs from their fields. Individual interviews with each of the 44 HHs were conducted. Subjective questions on farmer's attitude towards the technology and major issues with regards to the technology were asked. Data on farm machine hiring rates, hours of power tiller, thresher and rotovators required for a given plot of land were traced from the Agriculture Machinery Centre (AMC).

2.3. Data analysis

Data was entered in a data entry form in MS EXCEL, which consisted of several worksheets linked together. Data analysis was done in MS excel.

3. Results and Discussion

3.1.Labour distribution

The study showed that there were variations in labour requirement for different farm activities from nursery to harvesting of the crop. Spring rice cultivation requires a total of 45 men-days per acre of land (Table 1). Maximum labour was required for weeding and transplanting operations which constituted 19.5% and 15.9% men-days respectively. Harvesting activity with 6 men-days closely followed transplanting. The least labour requiring activities were terrace wall clearings, bund maintenance and grain cleaning with just one labour per acre.

Table 1. Labour days required for different farm activities

Farm activities	No. of Days	Percentage (%)	Std. deviation
Nursery	4	8.6	1.5
FYM	5	10.8	2.1
Terrace wall Maintenance	1	2.3	1.1
Ploughing	4	8.8	5.7
Irrigation	2	4.4	1.0
Bund Maintenance	1	3.2	0.6
Transplanting	7	15.9	2.3
Weeding	9	19.5	3.9
Harvesting	6	14.0	2.3
Threshing	4	7.9	1.5
Winnowing	1	2.0	0.5
Spraying of fertilizers/pesticides	1	2.4	0.2
Total	45	100	23

In rice farming, weeding and transplanting are considered the toughest activities and often portrayed as a backbreaking experience. Weeds form a major biotic constraint in Bhutan's farming system and increased labour input for rice transplanting is a major disadvantage (Ghimiray et al 2008). As in most Asian countries, the study found that labour requirements are largely met through household and exchange labour (Wang et al 2012). Only few farmers cultivating more than one acre of land practice labour hiring to meet the need for the additional farm activities. The labour requirement will be higher if post-harvest activities such as grain cleaning, grading, packing and transporting the produce to their houses which are often located away from the fields are included. The high labour requirement is directly attributed to low farm mechanization (Tobgay 2005). Most of the rice fields in the country are narrow and are not machine friendly. The smaller land holdings of Rinchengang farmers also offer limited option for farm mechanization. However, the use of power tillers is getting popular in land preparation activity (Chhogyel et al 2014b).

3.2. Labour costs

Amongst the farm activities, weeding takes the highest share of labour cost (20%) followed by transplanting (16%) and harvesting (14%) (Figure 2). The precent shares of farm labour cost for farmyard manure application; land preparation and nursery operations were 11%, 10% and 9% respectively. Activities such as terrace wall clearing (2%), bund maintenance (3%), threshing (8%) and winnowing (2%) had the lowest cost. The 45 labour days required for an acre of spring rice production is equated in terms of monetary value to a total cost of Nu.19, 967/acre. Similarly, weeding and transplanting activities are valued at a cost of Nu 3,983.90/acre and Nu 3204/acre respectively. Harvesting activity costed Nu 2842.5/acre, closely followed by manure application at Nu 2500/acre (Figure 3).

The farm labour is getting scarce and the daily wage rate has been increasing in the recent years. Currently, the labour wage rate at Rinchengang is Nu 350/day plus Nu 150 accounted for food and refreshment. Although there are not many studies on labour cost trends in

Bhutan, experiences showed that the daily labour wage would be anywhere between Nu 300 to 600/day depending on types of activities and cropping season. This daily wage rate depicted in the current study is fairly similar to the wage rate in Sri Lanka at USD $ 5/day/person which is amongst the highest in South Asia (Wang et al 2012). This shows that the labour wage in Bhutan is high and more initiative and interventions would be required to mechanize rice farming. The DoA has set targets to bring increased area under mechanization in the 11th Five Year Plan (PPD, 2013).

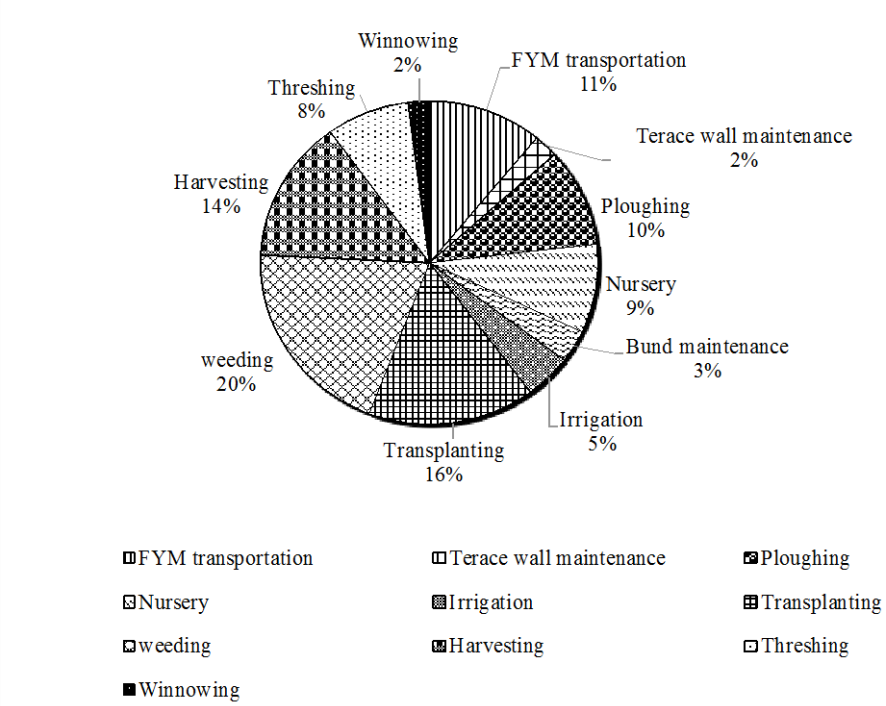

Figure 2. Percent share of costs for different farm activities

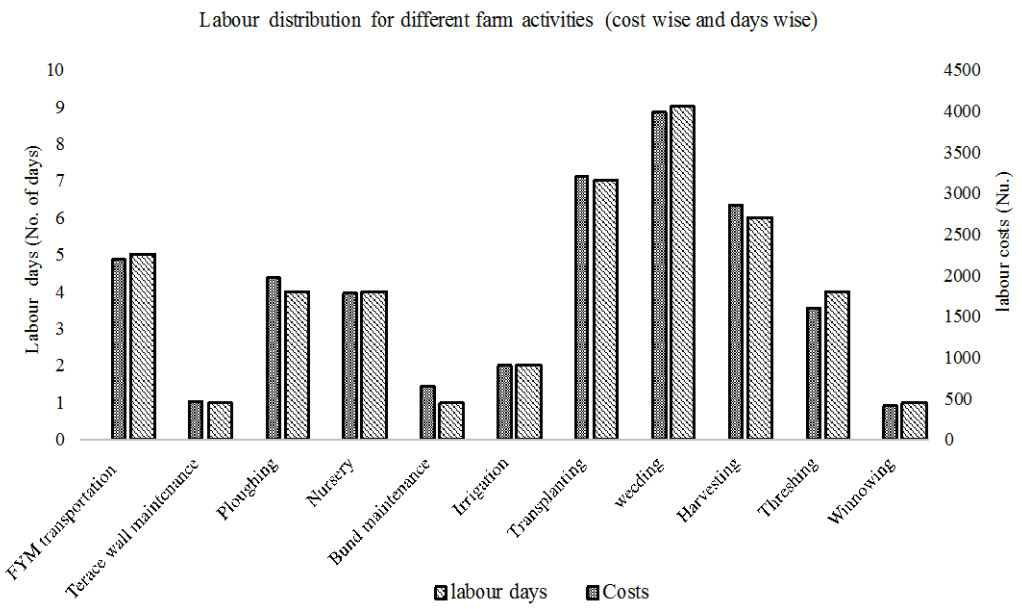

Figure 3. Labour requirement for different activities and its corresponding costs

3.3. Material inputs

In the main field, 53% of the total cost is constituted by power tiller hiring, followed by fertilizers costs at 19% (Figure 4). Cost of hiring thresher constitutes 14% and weedicide 7% of the total inputs costs. It was observed that all farmers produce and use their own FYM. For cost computation, Nu 0.5 per kg of FYM was taken which constituted 7% of the total material costs. In the nursery, seed and polythene sheet constituted more than 90% of the total material costs. According to Chhogyel et al (2014b), for spring rice production, nursery must be developed under protected condition (poly tunnel) due to low temperatures during seedling production. Thus, to encourage rice double cropping, subsidy in the form of poly tunnels and seeds are being provided by the government.

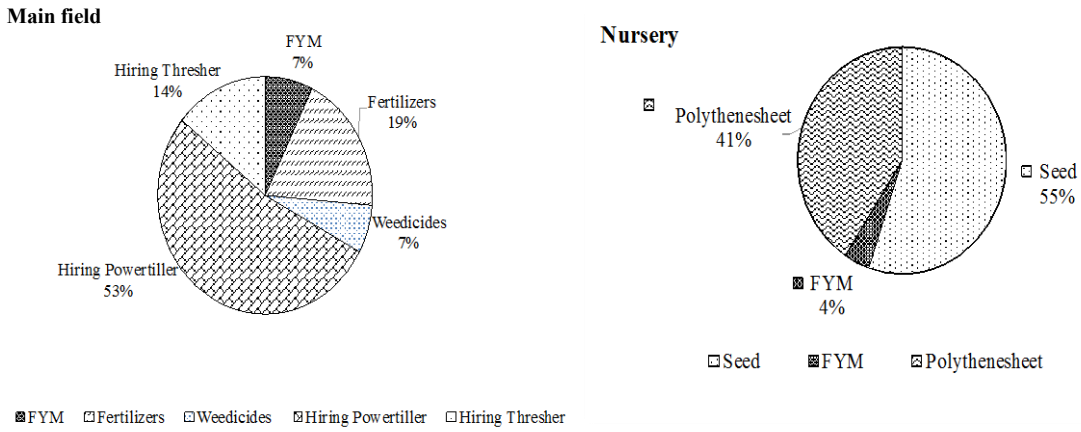

Figure 4. Material costs in the main field and nursery

3.4. Total costs

The two components determining the costs are material and labour costs. The main inputs in spring rice include seeds, polythene sheets, herbicides and farmyard manure. Other inputs such as irrigation water and rental cost of land are overlooked since these have no direct implications in the production cost. The cost of labour constituted 64% of the total cost in the main field while it contributed 6% of the total costs in the nursery (Table 2). Cost of input materials in the nursery was 6% as against 24% in the main field. As shown in Table 2, labour cost constituted major share (64%) of the total costs which translated to a total cost of Nu19967.5/acre. Material costs comprise the remaining 30% of the total costs valued at a sum of Nu 8526.4/acre. The wide variation between labour and input cost shows that there is need for major intervention to reduce the drudgery of rice farming through farm mechanization.

Table 2. Proportion of total labour and material cost

Activities	Costs (Nu)	Percent share (%)
Nursery inputs	1658.1	6
Inputs in the main field	6868.3	24
Labour costs (Nursery)	1774.4	6
Labour costs (Main field)	18193.1	64
TOTAL COSTS	28493.9	100.0

3.5. Crop guarding

Bird attack is a major issue in spring rice that results in significant yield losses. Spring rice is an off-season crop and being cultivated on a smaller tract of land, makes it highly vulnerable to bird attack. An ideal guarding requires farmers to spend about 10-11(from dawn to dusk) hours in the field for nearly1.5 months protecting their crop from bird attack. Birds are seen attacking the crop from early morning till dark and from grain filling stage till harvesting. This works out to a total of 30-40 men-days per acre which is very high. In most cases, elderly persons or younger children are engaged in crop guarding. In the absence of such people at home, farmers leave their fields unguarded. The absence of crop guarding is one of the main reasons for low yield of spring rice. The cost of production computed in this study does not include the crop guarding cost.

3.6. Yield, costs of production and net returns

The study showed that the average paddy yield without crop guarding was 0.65 ton/ac. Based on this, the average cost of production per kg of paddy averaged at Nu. 48.5*(SD=13.1.* Total average cost of production per acre was Nu. 28784.2 *(SD=8065.1).* The crop data maintained at ARDC Bajo showed that the average yield was higher at 1.42 ton/acre. Using this figure, the average cost of production per kg worked out to Nu. 20.56 Per kg. The difference in the cost of production is mainly attributed to difference in yield, which was noted to be quite low in the current study (extremely low in few cases due to bird attack problem). The net returns

to land is Nu.3039.8 *(SD=20959.3)* per acre. If not for spring rice, farmers leave the land fallow from Feb-June (spring rice duration), hence the net returns to land is justifiable. However, the net returns to labour is Nu.400.5 *(SD=343.5),* which is below the prevailing wage rate of Nu. 450 per day. Net returns to household labour per acre is Nu. 23007.3 *(SD=21321.1*). The lower net returns to labour indicates that spring rice cultivation is economically inefficient unless farmers have adequate household labour available.

Table 3. Production costs and net returns

Labour costs variation	Total costs (Nu)	Standard Deviation
Labour costs for Nursery (Nu /acre)	1774.4	669.6
Labour costs (main field Nu /acre)	18193.1	6136.0
Total labour costs (Nu /acre)	19967.5	3402.8
Total costs (Nu/acre)	28784.2	8065.1
Total production (Kg/acre)	646.5	269.3
Costs of production (Nu/Kg)	48.5	13.1
Net returns to land (Nu/acre)	3039.8	20881.0
Net returns to all HH labour (Nu/acre)	23007.3	21321.1
Net returns to labour (Nu/person)	400.5	344.1

3.7. Qualitative analysis

3.7.1. Reasons for spring rice cultivation

The rate of technology adoption and its success is dependent on the users intentions behind the adoption of the technology (Mathieson, 1991). The study aimed to get a glimpse of the farmers' motive behind the adoption of the spring rice. As shown in Figure 5, the study revealed that 57% of respondents (25 HH) cultivated spring rice for household food self-sufficiency and for earning extra income from the sale of surplus amount, while 27% of respondents (12 HH) cultivated spring paddy due to the availability of government subsidy. According to the assessment, government's subsidy of free inputs such as seed, fertilizers and polythene sheet have become an encouraging factor for adopting spring rice. A total of 14% of respondents 6 HH) cultivated spring paddy due to the sheer influence of their previous Gup, who had an influential personality in the community. Some 2% of the respondents expressed that they cultivated the crop as all their neighbours were cultivating. Loss of yield to bird attack is one of the major reasons behind farmer's lack of interest in spring paddy. Others factors such as lack of household labour and already food self-sufficient also contributed to farmers decreasing interest in spring rice.

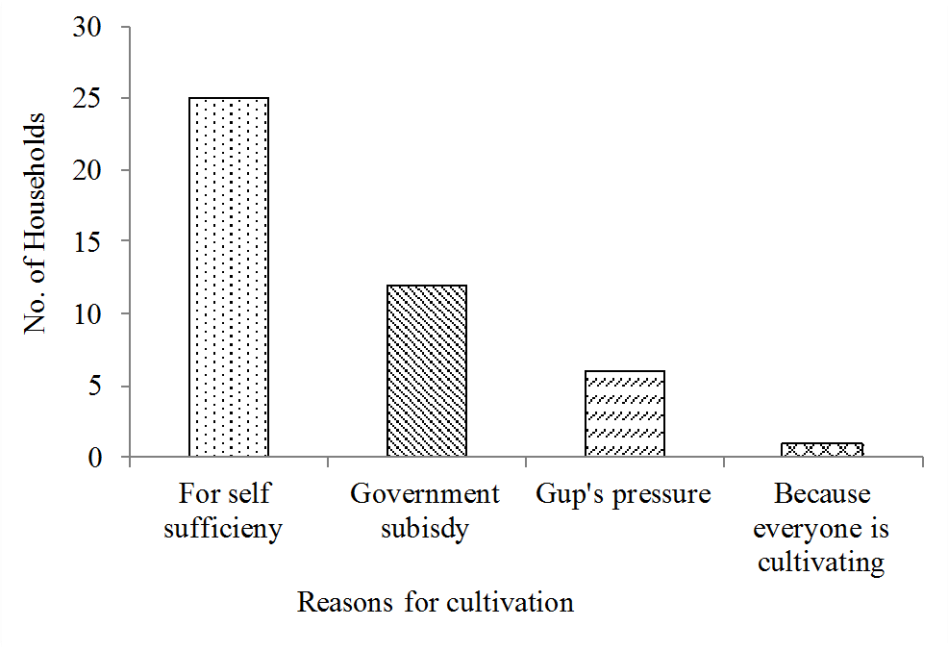

Figure 5. Reasons for spring rice cultivation

3.7.2. Major issues with spring rice

The results from the study revealed three major issues with regards to spring rice cultivation: bird attack, labour shortage and low productivity. These three factors were also identified as the main reasons behind the decreasing spring rice area in the community. Bird attack stood out to be the most prominent issue faced by all the growers. According to the growers, the incidence of the bird attack is increasing over the years. According to Subramanya (1994) foraging by bird pest in crops is dependent on the presence of favourable habitations with predator avoidance behaviour. The second issue of low yield (expressed by 8 HHs) is interlinked to first issue of bird attack. Low yield is also attributable to agronomic factors such as poor soil, poor crop management, lack of timely and proper intercultural operations, etc. The third issue of labour shortage and corresponding high labour costs (expressed by 6 HHs) is a concerning factor observed in all most all parts of the country. According to Tobgay (2005)low farm mechanization in the country is chief cause of high labour cost. Besides, the increasing rural-urban migration particularly the educated youths moving to the cities for better opportunities is creating extreme labour shortages in the rural regions (NSB 2015). As such rice is a highly labour intensive crop, and with the issues of labour unavailability and high labour costs, paddy is becoming an economically unsuitable crop for the low-income farmers.

Farm equipment and machineries make labour intensive operations easier and efficient thereby making rice production economically viable and sustainable (PhilRice 2012). The Government's initiative on the introduction of the farm machine hiring system is observed to have positive impacts in the lives of farmers. The farm machinery hiring services has also resulted in recultivating lands that were previously left fallow due to labour shortage. However, the current hiring system is faced with many challenges such as lack of trained

operator, frequent break-down of machines with no repair services on time and lack of enough machines affecting timely availability that often leads to disputes and conflicts.

3.8. Sensitivity analysis

A sensitivity analysis was conducted to assess the effect of a change in labour and material costs on the cost of production.

3.8.1. *Change in labour costs*

When the labour cost is valued at 100%, the cost of production is Nu.48.5 per kg of paddy. The opportunity cost of all household labour is 75% of the total labour cost. Hence, if the price of all labour is valued at 75% of the hired labour price, the cost of production drops from Nu 48.5 to Nu 35.3 per kg paddy, showing a drop of 27.2%. Correspondingly, the net returns to land, labour (per day) and all households labour increases as shown in Table 3.If the price of labour is further decreased to 50% of the hired labour costs, the cost of production further drops to Nu 29.1 per kg showing a drop of 40%. The net returns to land, labour (per day) and all households labour increases as depicted in Table 3.

Table 3. Costs of production at varying labour costs

Labour costs variation	Real price	at 57% of hired labour cost	at 50% of hired labour cost
Labour costs for Nursery (Nu/ac)	1774.4	1242.1	887.2
Labour costs for main field (Nu/acre)	18193.1	12735.2	9096.6
Total labourcosts (Nu/acre)	19967.5	13977.2	9983.7
Total costs (Nu/acre)	28784.2	22794.0	18800.5
Total production (Kg/acre)	646.5	646.5	646.5
Costs of production (Nu/Kg)	48.5	35.3	29.1
Net returns to land (Nu/acre)	3039.8	9113.7	23007.3
Net returns to all HH labour (Nu/acre)	23007.3	28997.5	32991.0
Net returns to labour (Nu/person)	400.5	505.7	575.9

3.8.2. Change in material costs

Under the current production system, government supplies free inputs such as seeds, fertilizers and polythene sheets, which constitute 37% of the total material costs (13% for seed, 15% for fertilizers and 9% for polythene sheet). Thus, if a reduction of 37% in the material costs is considered, the cost of production per kg of paddy will decrease by 18.6% to Nu. 39.5. Subsequently, net returns to land, labour (per day) and all household labour increases as shown in Table 4.

Table 4. Cost of production at 37% reduction in input costs

Input costs variation	-37.0	At Real price
Total input costs	5554.5	8816.7
Total costs (Nu/acre)	25522.0	28784.2
Total production (Kg/acre)	646.5	646.5
Costs of production (Nu/Kg)	39.5	48.5
Net return to land (Nu/acre)	9564.2	3039.8
Net returns to all HH labour (Nu/acre)	29531.7	23007.3
Net returns to labour (Nu/person)	522.8	400.5

4. Conclusion

The results from this study showed that on an average 45 labour days per acre is used for growing spring rice with over 45% of the labour use accounted for planting, weeding, harvesting and transportation of FYM. While farm mechanization has picked up over the last few years (particularly use of power tillers and threshers), there are still large opportunities to be explored in the areas of planting, harvesting and weeding.

The market price of paddy is Nu 32.3 per kg which is lower than the average production costs of Nu 48.5 per kg. The high production cost above the market price makes spring paddy economically unviable for the growers. The high cost is mainly attributed to low yield due to bird attack problem and high labour costs. Thus, the enhancement of area under spring rice calls for the development of a bird control device/mechanism or a bird-free production strategy. Research in the areas of bird pest management and development of bird repellent rice varieties needs to be done. The other area of focus would be farm mechanization to help bring down the labour costs in the farming operations.

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