Research Article

Supply Chain Analysis of Rice Sub-Sector in Dang District, Nepal

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Abstract

Nepalese economy is dependent on a slow performing agriculture sector with the majority of the population relying on subsistence farming. A study was conducted to access the supply chain, present marketing situation of rice subsector in Dang district during May-September 2017. For this study, rice traders were grouped into 5 categories Producers, seed suppliers, millers & traders, Wholesalers, and retailers. For the study, 105 respondents were selected which includes 75 rice producers, 5 seed suppliers, 5 millers & traders, 5 wholesalers and 15 retailers. A semi-structured questionnaire was used to collect data. Statistical Package of Social Sciences (SPSS) and Excel were used for data entry and analysis. The findings of the study revealed that about 94.70% of paddy farmers used improved seeds and only 5.30% farmers used hybrid seeds belongs to grain producers for only home consumption. Cooperatives were the major source of seed supplier for 90.90% of seed producers and 45.45% of marketed surplus grain producers and 57.14% of grain producers for only home consumption retained their own seeds for cultivation. The average benefit-cost (B: C) ratio of the paddy farmers was found to be 1.14:1 in the study area. Majority of the paddy selling farmers 87.88% sold their produce from the house and remaining 12.12% sold in the market. The market margin was higher in seeds supply chain NRs 27 per Kg and least was in grains supply chain NRs 25 per Kg. Similarly, producer share was higher in seeds supply chain (50.90%) and least was in grains supply chain, 44.44 percent.

Keywords: supply chain; market margin; benefit-cost ratio; marketed surplus

Introduction

Nepal is traditionally an agrarian country and about two-thirds (65.6%) of the economically active population is engaged in subsistence and semi-commercial agriculture. Rice (*Oryza sativa* L.) ranks first among cereal crops in terms of area, production and is also a vital source of livelihood of the people. Rice supplies about 40% of the food calorie intake. Likewise, rice plays a significant role in the Nepalese economy. It contributes nearly 20% to the agricultural gross domestic product (AGDP) and almost 7% to GDP (CDD, 2015). Rice possesses crucial cultural, religious, and traditional values in Nepalese society. It is an integral part of one's life right from the birth to the death rites. According to Nepal Rastra Bank (NRB, 2008), the average monthly expenditure of the household in Nepal is NRs 15,130; of which value of grains and cereal products accounted for 11.94%. About 104 Kg of milled rice is available per year per person in Nepal (MoAD, 2013/14). Being rice as a major staple food crop, the production and productivity are increasing slowly in Nepal in the past decades. The yield of rice was 2.4 Mt/Ha in 1990/91 and increased to 3.17 Mt/Ha in 2013/14. A total of 73 rice varieties have been released in Nepal. About 62 varieties

have been released for main-season and 11 for spring season paddy. Around 60% of the varieties released are for terai and inner-terai, 25% for the hills and 8% for mountains (CDD, 2015). However, until now Nepal has not been able to develop its own rice hybrids.

Nationally, Nepal is food insufficient due to the limited cultivable soil, low productivity growth and less control on climatic parameters. So the country depends substantially on foreign food supply. The demand of rice in Nepal is predicted to be more than double the domestic production in 2030 under the pessimistic set of conditions and under the optimistic scenario, production deficit is about 41 percent (Prasad et al., 2011). In the fiscal year 2016/17, there is an import of 590,198.15 Mt of rice which worth NRs 23, 878.58 million (DoC, 2016/17). Trade supply from India plays a significant role in food security as about 60% of the landless households depend on cheaper rice from India. The import of food grains from India has increased since the price of rice in India is 12% lower (mainly due to subsidies on fertilizers and electricity for irrigation) (WFP, 2008). Food supply in Nepal is predominately managed by the involvement of private sector and also by public intervention or international assistance. Difficult terrain and weak road connectivity from district headquarters to rural areas especially in mountain and hills are likely an underlying cause of high cost of the commodity and reduced influence of private sector. The Ministry of Industry, Commerce, and Supplies (MOICS) is the lead government agency responsible for food supply management in Nepal. It functions as a market operator or direct service provider, except in remote areas. In remote areas Nepal Food Corporation (NFC) plays a crucial role in providing food supply and supporting livelihood (FAO, 2007). Nepal exhibit lower extent of spatial integration of regional market with local markets. Similarly, fluctuation of paddy price disseminates across the Indian-Nepali border with some degree of short and medium- run convergence. Spatial market integration could destabilize rise in paddy price due to short supply which would increase accessibility of marginal household on food supply (WFP, 2008).

Materials and Methods

It includes Pre survey field visit, Study of population, sample size and sampling technique, Sources of data, Survey design and method of data collection, Methods and techniques of data analysis.

Dang district is located in mid-western terai region of Nepal is favorable for paddy production. It is located in the range 27°37′N to 28°29′N latitude to 82°02′ N to 82°54′ N longitude with total area of 2995 Km². The district headquarter is Ghorahi. Average temperature of this district is in the range of 22-34° C in summer and 10-25°C in winter. Average annual rainfall is 162 mm. About 37,800 ha land is under paddy cultivation.

All paddy growers of Rampur, Laxmipur and Dikhpur VDCs were selected purposefully for the study. Total 105 samples including 75 rice producers, 5 agro-vet & seed suppliers, 5 millers & traders, 5 wholesalers and 15 retailers were selected by cluster random sampling technique Data pertaining to the input supply, production, price status, marketing, processing, coordination and research over a period of time related to paddy were obtained towards the rice and rice market were collected from different market intermediaries. Data required for evaluating the objectives of the study were collected from both primary and secondary sources. Pre-testing was done with 6 paddy farmers (@ 2 from each VDC's) for the refinement of questionnaire before final survey. The primary data needed for the study were collected from the respondent by interview schedule using semi structured questionnaire, focused group discussion and key informant interview.

Raw data obtained from field were analyzed by using SPSS software version 16 and MS-Excel. Supply chain map was prepared based on primary data. Paddy producers were differentiated in to three categories based on production behaviors. Based on pre-testing survey, paddy producers were grouped in to seed producers and grain producers. Grain producers were further sub-divided into marketed surplus grain producers and grain producers for only home consumption. Different variables in this study were used on both quantitative and descriptive analysis.

Methods and Techniques

Benefit Cost Analysis
Cost benefit analysis was done after calculating total variable cost and gross return from paddy cultivation. Cost of production was calculated by summation of all variable cost items used during production. Income from product sale was accounted for determining gross return. So the benefit cost analysis was carried out by using formula:

$$\text{B/C Ratio} = \frac{\text{Gross return}}{\text{Total variable cost}}$$

Where,

Gross return (NRs) = (Total quantity of paddy sold (Kg) x Price per unit of paddy) + Revenue from sale of by product

Total variable cost = Cost incurred during production function (land preparation, transplanting, nutrient management, weeding, harvesting, threshing, transportation and storage).

Marketing Margin
The difference between farm gate price and retailer's price is the marketing margin which was calculated as follows:

Marketing margin (NRs) = Retailers price (P_r) – Farm gate price (P_f)

Producers Share

Producers share denotes possession of farmers in the price paid by consumers or in retailer's price. It is expressed in percentage which can be estimated by using following formulas

Ps = (Pf/Pr) x 100 %

Where,

Ps = Producers share

Pf = Producers price (Farm gate price)

Pr = Retailers price (Price paid by consumers)

Supply Chain Analysis

The supply chain describes all the activities required to create a product through different phase of production and its delivery to final consumers. It analyzes farm gate price of the product and price spread till it reaches to consumers. Various marketing channels and functions (storage, processing, packing etc.) were determined. Similarly, producers share was calculated in the study site.

Results and Discussions

This section includes brief discussion of the study area, general information on population characteristics, and findings pertaining to the objectives of the study.

Paddy Cultivated Area and Productivity

The average paddy cultivated area in the study site was 0.56 Ha and productivity of paddy was 4.45 Mt/Ha. The average allocated area in seed producers was 0.61 Ha, 0.80 Ha in marketed surplus grain producers and 0.42 Ha in grain producers for only home consumption. Likewise, productivity in seed producers, marketed surplus grain producers and grain producers for only home consumption was 4.12 Mt/ha, 4.70 Mt/Ha, and 4.41 Mt/Ha respectively. Statistically significant difference was detected between marketed surplus grain producers and grain producers for only home consumption at 1 percent level in case of paddy cultivated area where as seed producers were intermediate between them. Similarly seed producers, marketed surplus grain producers, and grain producers for only home consumption were insignificant in terms of productivity which is shown in Table 1.

Production Technology

Assessment of different production technology adopted by paddy producers is displayed in Table 2. Most of the paddy farmers (52%) have no access to irrigation facilities and 48% have access to irrigation facilities. About 59.09% of the marketed surplus grain producers have access to irrigation facilities followed by 52.38% in grain producers for only home consumption where as 90.91 % of seed producers have no access to irrigation facilities. Most of the farmers used improved seeds (94.70%) and only 5.30% used hybrid seeds of paddy. Similarly, 46.70% paddy farmers used their own seeds while 29.30% purchased from co-operatives, followed by 13.30% from DADO, and 10.70% from agro-vet. Only a small portion of paddy farmers (18.70%) have received training program on production technology and remaining 81.30% farmers have not participated such trainings. Likewise, 36.36% of seed producers, 18.19% of marketed surplus grain producers, and 14.29% of grain producers for only home consumption have participated in training program on production technology. All the paddy farmers were ignorant about practice of contract farming. About 85.30% of paddy farmers have no access to test seed quality and remaining 14.70% have access. Similarly, all seed producers have access whereas all marketed surplus grain producers and grain producers for only home consumption have no access to test their seed quality.

Statistically significant difference was observed between seed producers and marketed surplus grain producers & grain producers for only home consumption at five percent level in case of irrigation facilities. Also significant difference is observed between seed producers and marketed surplus grain producers and grain producers for only home consumption at one percent level in case of source of purchase of seed and access to test seed quality.

Table 1: Paddy cultivated area and productivity of farmers by production behavior

Variables	0verall (N=75)	Seed producers (n=11)	Marketed surplus grain producers (n=22)	Grain producers for only home consumption (n=42)	F-test value
Paddy cultivated area (Ha)	0.56	0.61^{ab}	0.80^{b}	0.42^{a}	8.517*** (P=0.000)
Productivity (Mt/Ha)	4.45	4.12	4.70	4.41	1.317 (P=0.274)

Note: *** indicates significance at 1 percent level

Table 2: Irrigation facilities, type of seeds and source of input (seed) of paddy farmers by production behavior

Variables	Overall (N=75)	Seed producers (n=11)	Marketed surplus grain producers (n=22)	Grain producers for onlyhome consumption (n=42)	Chi-square value
Irrigation type					
Irrigated	36 (48.00)	1 (9.09)	13 (59.09)	22 (52.38)	17.20 ** (at 2 df and P=0.018)
Unirrigated	39 (52.00)	10 (90.91)	9 (40.91)	20 (47.62)	
Type of seed					
Improved	71 (94.70)	11 (100)	22 (100)	38 (90.47)	3.320 (at 2 df and P=0.19)
Hybrid	4 (5.30)	0 (0.00)	0 (0.00)	4 (9.52)	
Source of purchase of seed					
Own seed	35(46.70)	1 (9.09)	10(45.45)	24 (57.14)	39.80 *** (at 6 df and P=0.000)
Agro-vet	8 (10.70)	0 (0.00)	0 (0.00)	8 (19.04)	
DADO	10(13.30)	0 (0.00)	8 (36.36)	2 (4.76)	
Co-operative	22(29.30)	10(90.90)	4 (18.18)	8 (19.04)	
Participation in production training					
Yes	14(18.70)	4 (36.36)	4 (18.19)	6 (14.29)	2.803 (at 2 df and P=0.246)
Contract farming					
No	75 (100)	11 (100)	22 (100)	42 (100)	
Seed quality test					
Yes	11(14.70)	11 (100)	0 (0.00)	0 (0.00)	75.000*** (at 2 df and P=0.000)

Notes: Figures in parentheses indicate percent. ***and ** indicate significance at 1 percent and 5 percent levels, respectively

Table 3: Benefit cost ratio of different paddy producers in the study area (in NRs)

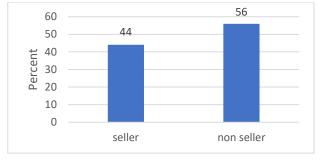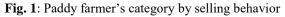| Farmers category	Overall (n=75)	Seed producers (n=11)	Marketed surplus grain producers (n=22)	Grain producers for only home consumption (n=42)
Total production cost (NRs /Ha)	116311	128625	106587.5	113721.5
Tillage cost (NRs/ Ha)	30051 (22.57)	19588 (3.41)	37000 (34.82)	33567 (29.48)
Harvesting cost (NRs/Ha)	16042 (13.54)	19588 (15.21)	12000 (10.91)	16540 (14.51)
Total revenue (NRs/Ha)	135729	185073	118250	103864
B:C ratio	1.14	1.43	1.10	0.91

Note: Figures in parentheses indicate percent

Cost Analysis of Paddy Seed and Grain

Different cost incurred during production of paddy is represented in Table 3. The average total cost of production was least in marketed surplus grain producers (NRs 106587.5 per hectare) whereas NRs 113721.5 per hectare in grain producers for only home consumption and was highest in seed producers (NRs 128625 per hectare). Similarly average total revenue was highest in seed producers (NRs 185073.5 per hectare) followed by NRs 118250 in marketed surplus grain producers and least in grain producers for only home consumption. The benefit-cost (B: C) analysis ratio was found higher in seed producers (1.43) and least in grain producers for only home consumption (0.91). The B: C ratio was 1.10 in marketed surplus grain producers.

Seed producers expensed 3.41% of total production cost on tillage operation. Likewise marketed surplus grain producers expensed 34.82% and grain producers for only home consumption expensed 29.48%. Seed producers expensed 15.21% of total production cost during harvesting followed by 14.51% in grain producers for only home consumption and least was in marketed surplus grain producers.

Market and Marketing of Paddy

Fig. 1: Paddy farmer's category by selling behavior

Selling behavior of paddy farmers in the study area was assessed and categorized into sellers and non-sellers. Figure 1 shows 44% (33) of paddy farmers sold their produce and 56% (42) farmers did not sold their produce.

Venues of seed sale by paddy selling farmers were determined. Figure depicted majority of the paddy selling farmers 87.88% (29) sold their produce from house whereas 12.12% (figure 2) of paddy selling farmers sold their produce in market.
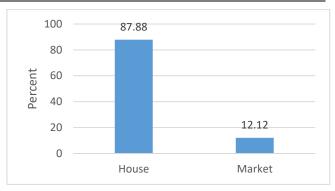

Fig. 2: Venue of seed sale by paddy farmers

Sale of grain by paddy selling farmers to different supply chain actor was studied. Figure reveals 33.33% (Fig. 3) of paddy selling farmers sold their produce to local traders followed by 33.33% (Fig. 3) to co-operatives, 24.24% (Fig. 3) to consumers and 9.10% (Fig. 3) to millers.

Satisfaction from Farm Gate Price

On the basis of level of satisfaction, majority of the paddy farmers (51.52%) in the study area were found to experience low level of satisfaction from farm gate price of rice. Satisfied and moderately satisfied farmers were found to be 36.36% and 12.12% respectively. All seed producers in the study area were found to be satisfied with farm gate price. In case of marketed surplus grain producers 4.54% were found to be satisfied followed by 18.19% were moderately satisfied and 77.27% realized low level of satisfaction. There was significant difference between seed producers and marketed surplus grain producers in satisfaction from farm gate price of their produce at 1 percent level (Table 4).
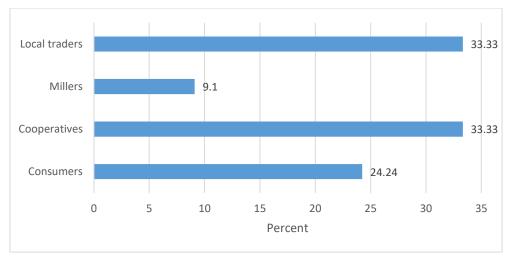

Fig. 3. Sale of grain by paddy farmers to various supply chain actors

Table 4: Satisfaction from farm gate price of rice by production behaviors

Satisfaction Level	Overall (N=33)	Seed producers (n=11)	Marketed surplus grain producers (n=22)	Chi-square value
Satisfied	12(36.36)	11 (100)	1 (4.54)	28.875***
Moderately satisfied	4 (12.12)	0 (0.00)	4 (18.19)	(at 2 df and P=0.000)
Less satisfied	17(51.52)	0 (0.00)	17 (77.27)	

Notes: Figures in parentheses indicate percent. *** indicates significance at 1% level

Supply Chain of Rice Sub-Sector in Local Market

Marketing Margin

The average cost of production for paddy farmers was NRs 28.62 per Kg in the study site. Seed producers sold their produce at NRs 28 per Kg to cooperatives whereas marketed surplus grain producers sold their produce (short and coarse grain) at NRs 20 per Kg to local traders and millers. Local traders sold their produce to millers at NRs 21 per Kg. Millers supplied their produce at NRs 33 per Kg for processed coarse grains and NRs 50-60 per Kg for processed fine grains to wholesalers, retailers and consumers. Wholesalers distributed processed rice at NRs 38 per Kg for coarse grains and NRs 55-62 per kg for fine grains depending on varietal quality. Local and regional retailers are supplied by wholesalers. Retailers dispensed their product to local consumers at NRs 40-45 for coarse grain and NRs 60-70 per Kg for fine grains. The average transportation was found NRs 50 per quintal at local level and NRs 100 per quintal at regional level. The average labor cost is NRs 24 per quintal for loading and unloading. The price of rice seeds is determined by board meeting between cooperatives and concerned government bodies. Similarly price of processed paddy grains at different level of supply chain is determined by district chamber of commerce and industry.

Thus market margin for rice seeds = NRs 55-28

= NRs 27 per Kg

Similarly, market margin for grains = NRs 45-20

= NRs 25 per Kg (coarse rice seeds)

Producers share of rice producers = (28/55) x 100%

= 50.90%

Likewise,

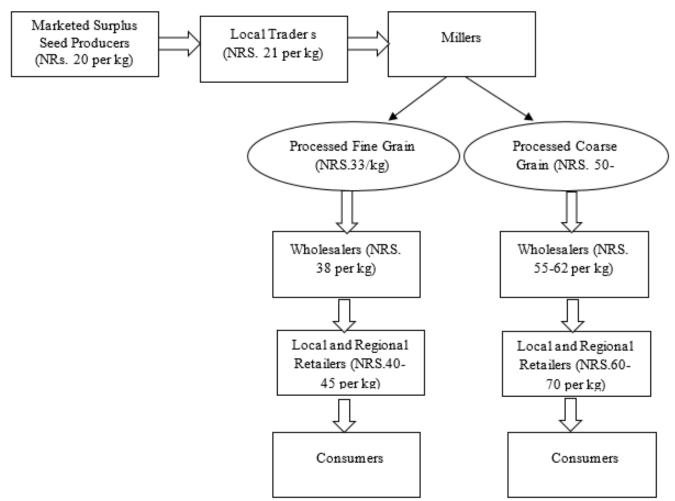producers share of grain producers = (20/45) x 100%

= 44.44%

Fig. 4: Marketing margin of the rice sub-sector in the local market

Supply Chain of Rice Seeds and Grains

Paddy supply chain includes all the activities involved during transference of farmer's product either fresh or processed form to consumers at domestic and regional level. Major paddy supply chain actors involved in the study area were found to be farmers, local traders, millers, cooperatives, wholesalers, retailers and agro-vets for input supply.

Marketing Chain in Seed Producers

Inputs for seed producers have been mostly supplied by co-operatives. Their produce is purchased by co-operative at NRs 28 per Kg after harvesting in October – November. Post-harvest functions such as processing, grading, storing is done by co-operative. Sample of seed is analyzed in regional laboratory (Khajura) for germinating ability, physical and genetic purity and then packed in label jute bags of 35 Kg each. Packed rice seeds is dispensed within Dang district and Rapti zone.

Marketing Chain in Marketed Surplus Grain Producers

Marketed surplus grain producers purchase seeds from cooperative and agro-vet. After harvesting their produce were sold to local traders (50%), millers (14%), or local consumers (36%). Local traders are connecting link between farmers and millers. Millers conducts all processing functions and about 50% of processed rice is distributed to wholesalers (Dang, Rolpa, Salyan, and Pyuthan), 35% to retailers (Dang district) and 15% to consumers (Dang district). Wholesalers were maintained 80% supply of processed rice to retailers (Dang district) and 20% supply directly to local consumers. Retailers dispensed all processed rice ultimately to local consumers within dang districts. Locally produced paddy grains did is not exported to international markets.

Marketing Chain in Grain Producers for Only Home Consumption

Agro-vets and cooperatives plays a vital role in supply of inputs (seeds, fertilizers, pesticides, credit) to grain producers for only home consumption. These farmers consume all their produce after processing in mills and not any portion of produce is supplied to market.
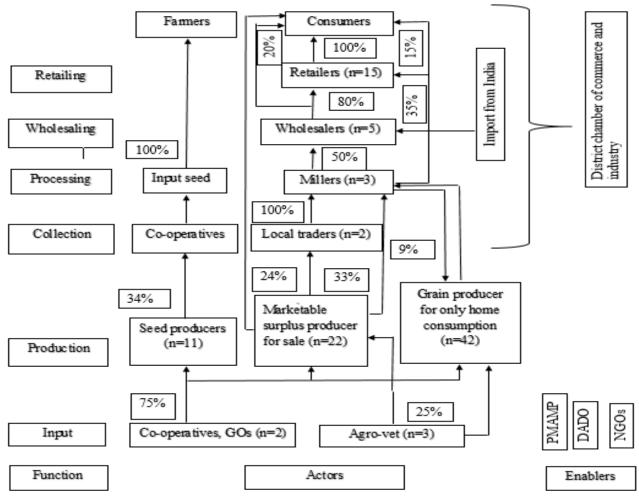

Fig. 5: Supply chain map of rice sub-sector in Dang district of Nepal.

Processing and Packaging

Co-operatives were major processor of rice seeds and millers process paddy grains. Roughing of seed producers is done by seed inspector from DADO and INGO's at vegetative and panicle emergence stage. Co-operatives collect harvested rice seeds from their member seed producers. Grading machine is used by co-operatives to grade collected rice seeds. Then sample of rice seeds is analyzed to determine germinating ability, moisture content and purities in regional seed laboratory (Khajura). Verified rice seeds are packed label jute bags of 35 Kg each.

Similarly, paddy grains is processed by local millers. Millers collect harvested paddy grains from producers within Dang district. Millers process about 130 ton of raw paddy grains annually. Generally large volume of coarse paddy grain and small volume of fine paddy grain is processed by millers. Processing of paddy grains involves grading of grains in automatic grading machine followed by de-husking, and polishing. Recovery % of refined grains was 65% and that of rice husk & barn was 25% and 10% respectively. The processed paddy grains is then packed label plastic bags of 25 Kg and 50 Kg. The transportation cost is NRs 200 per ton per trip. Labor cost is NRs 24 per loading and unloading and NRs 3 per weighing 25 Kg bag.

Conclusion and Recommendations

Paddy cultivation is one of the agro sub-sector significantly contributing in livelihood of the majority of the people. Majority of the farmers were resource poor compelled to rely on labor intensive, traditional cultivation practices with increased cost of production which seizes farmer's potential to achieve satisfiable farm return. The B/C ratio from seed production was higher in the study area due to high farm gate price of seeds as compared to grains. Most of the paddy selling farmers sold their produce from home without any value addition. Also, there was more involvement of middleman's in grain supply chain. This type of marketing behavior undermines farmers bargaining power and result in low producers share. Improvement in value chain of rice sub-sector and cooperative marketing system can increase producer's possession in retailer's price by neutralizing involvement of middleman's. Despite agriculture as a main source of occupation, most of the fine rice were imported from India.

Active participation of different market stakeholder can increase competitiveness in rice sub-sector. Development of physical infrastructure can improve efficiency of marketing system due to feasibility of spatial market integration. Similarly, vertical integration of supply chain actors can stabilize price fluctuation and assurance of supply. Development of appropriate business enabling environment and intervention from government bodies is vital for involvement of public sector to achieve food security through self-sufficiency.

Suggestions for Further Research

- Study on value chain development of rice sub-sector.
- Feasibility study on farm mechanization for commercialization in rice sub-sector.
- Assessment on import of fine rice.
- Demand and supply situation of rice seeds.
- Study on impact of low producers share and measures to control it.
- Study on post-harvest loss of grains at different stage of marketing functions.

Acknowledgement

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