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Empirical Analysis of Paddy Value Chains in Nepal: Evidence from Logistic Regression Modeling

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Abstract

Background: In the South Asian region, rice is one of the most significant staple food crops. The value chain provides a lot of support for a seamless operation from growth to reaching clients' hands. It not only aids farmers, but it also creates opportunities at every stage. As a result, the goal of this research is to determine the value chain analysis of paddy products in Nepal.

Objective: The objectives of the study were to analyse value chain analysis of paddy product, and to identify the constraints and opportunities of rice value chain in Parsa, Siraha and Saptari districts of Nepal.

Method: The thesis followed the design of explanatory research and collected data using structured questionnaires. Binary logistic Model was used for inferential analysis. Siraha, Saptari and Birgunj (Parsa) districts are chosen purposely. 260 respondents were conveniently sampled from farmers and traders.

Result: The study shows the cooperatives play role in accessing credit, accessing inputs, and training with the help of government and non-government organization. The study tells us the fact that paddy value chain functions in a traditional way, there is no innovative way of integrating the chain actors. The cooperatives are involved in both input supply and credit service. Ages, off-farm income, access to information, access to input are the factors that add value in paddy value chain.

Conclusion: This research is based on value chain analysis of paddy product in Parsa, Siraha and Saptari districts. Generally, the price of rice/paddy goes down in the post-harvest period due to heavy arrivals in the market and later shoots up, which results in unstable price. Providing better access to credit to farmers to reduce dependence on money lenders can solve the existing problem.

Paper Types: Research Paper

Keywords: Value Chain Analysis, Framers, Traders, Value addition, Logistic Model, Kobo toolbox.

JEL Classification: N55, C8, Q18, Q24, Q25

Introduction

A value chain in agriculture describes the range of activities and set of actors that bring agriculture product from production in the field to final consumption, wherein at each stage value is added to the product. In the rice value chain, a large number of market actors play various roles in input supply, output, selection, processing/milling, wholesaling, and retailing. In both the fine and coarse rice value chains, the same actors were discovered (Akpeko, 2018). A total of 76,000 farm households were rice growers in the district out of which 52,000 farm households used to sell some amount of rice in the market. Rice is obviously exchanged in large quantities, but no precise data on demand and supply in domestic and international markets is available. Fine and coarse rice demand is nearly equal, while aromatic rice demand accounts for around 5% of the overall market demand (Yi et al., 2020) .

The most important cereal crop in Nepal is rice, which contributes significantly to food security and the rural economy. Rice is the most important crop in the district, which covers 72,500 hectares areas (Devkota, 2019). Large-scale collectors hold rice/paddy for six to nine months in order to take advantage of the high market price during the scarce season. Millers process rice by dehiscing, polishing, grading, and packaging it. Rice grains from big millers are of good quality. Because of the better grading facility, it performs better than small millers (Yi et al., 2020). When opposed to other high-value agricultural commodities, the rice sector has a poor profit margin for market participants. Rice industry is attractive to market players because it offers low risk and a large market. The profit margin in the rice industry varies from Rs. 0.5 to Rs. 3.0 per kg of rice depending on the purpose. The rice millers have a higher margin per kg of rice compared to other market actors. Farmers do not calculate profit margin but they say that the cost of production is high cost and straw is the profit from rice business (Minas et al., 2020).

The value chain's function is to reduce inventories, waste, and costs while increasing productivity within the company and market channel (Devkota et al., 2017). The knowledge flow in the supply chain will be streamlined by collaborative planning and information sharing activities. A good value chain will provide superior value to the ultimate customers. There are many value added products that is produced from paddy (Kamilaris et al., 2017). The major products are rice, rice bran oil, rice paper, rice straw, rice glue, rice cakes, rice vinegar, rice soy milk, red yeast rice, and other rice-based food products. This study will provide a clear picture on value addition, marketing efficiency etc., in the present rice marketing system. Value addition process and possibilities in each and every stage of marketing of rice from the farmers to consumer will be revealed. The result would help the farmers to cultivate consumer preferred rice varieties using modern technologies. Farmers have good access to agro-vets and fertilizer dealers, but improved seeds and fertilizers are always scarce. In agriculture, barriers to adaptation refer to factors, circumstances, and challenges that are thought to diminish the efficacy of farmers' adaptation approaches (Phuyal et al., 2017). The poor quality of improved seeds and fertilizers on the input market is another major issue and a harsh reality. Rice productivity and profitability are low, according to farmers, due to insufficient use of technology and high input and labor costs. There are a number of other constraints in the rice value chain that must be overcome in order to promote the sub-sector as a viable business venture (Zitong, 1986) .

Rice is one of the world's most important staple food crops (Adhikari, 2015). Over half of the world's population relies on rice to meet their 80 percent of food needs. Rice accounts for 43% of total food grain production and provides 20% of global human per capita energy and 15% of per capita protein requirements (Ampadu-ameyaw et al., 2017). The result would help the farmers to enhance their income and rice processing industries to manage their value chain effectively by minimizing the cost and increasing the efficiency and thereby enhance their profit (Devkota, 2019). The rationality of value addition on rice, which satisfies the consumer needs, can be identified and the consumers would benefit through the quality product as they prefer. This study will be useful to the farmers and other stakeholders, researchers and policy makers (Arouna et al.,, 2020).

Since rice is the staple diet and its cultivation is the main occupation of millions of small scale producers the prices of both paddy and rice significantly affects the welfare of the people in the country (Mishra et al., 2016). By pushing up a package of improved technologies in the farming community, effective and efficient extension services from government and non-government organizations are needed to increase rice productivity and profitability. To ensure the availability of high-quality improved seeds, fertilizers e.g., although these prices are fixed by the government, their effectiveness is limited. It is contended that both the producers and consumers are exploited by the players, particularly by rice millers and wholesalers, involved in the value chain due to the oligopolistic/oligopsonic structure in the market. These people are blamed for manipulating both paddy and rice prices particularly by private rice millers and who are allegedly concerning the markets of both paddy and prices. Thus, the main objectives of this paper is to find out the level of competition prevailing in the paddy/rice market in Nepal and evaluate its efficiency by undertaking a value chain analysis (Senanayake & Premaratne, 2016).

Review of Literature

Opportunities of Rice Production in Value Chain Analysis

A value chain can include processing, packaging, storage, transformation, and distribution. Rice is notorious for its inferior post-harvest quality standards in term of cleanliness and head rice recovery. Urban dwellers have increasingly high opportunity costs of time for cleaning and grading rice (Demont et al., 2017). The model starts with a population of generic, heterogeneous agribusiness that seek and exploit new value-creating opportunities while interacting with their environment (via resources identification and extraction) and with other agri-food value chain players. Table 1 shows that in agriculture, the value chain includes all businesses and their activities, such as farming, procurement, and processing. Rice is notorious for its inferior post-harvest quality standards in terms of cleanliness and head rice recovery. Urban dwellers have increasingly high opportunity costs of time for cleaning and grading rice. Our result shows that the more this is the case, the more they discount and reduce their demand for domestic rice relative to imported rice. Poor post-harvest practices by farmers (harvesting, threshing, drying, and storage) in combination with outdated and substandard processing infrastructure in the milling sector result in inferior quality of domestic rice (Demont et al., 2017).

Table 1: Opportunities of Rice Production in Value Chain Analysis

S.N.	Author's and Study Area	Methods	Variables used	Result	Conclusion / Recommendation
1.	Demont & M (Demont et al., 2017) West Africa	Descriptive Statistics	Independent variable: Income per capita, dependent variable: Female, Household size	the more they discount and reduce their demand for domestic rice relative to imported rice	increasingly high opportunity costs of time for cleaning and grading rice.
2	(Kato, 2007)	Qualitative method	Independent variables: their practices of growing rice, potential solutions and dependent variable: with rice farmers regarding	opportunities and innovation	traders established new commercial net-works between urban and rural communities against a background of increasing food demand from a growing urban population

Barriers in Rice Production Value Chain

In-agriculture has received attention of the environmental problems that have been resulted from the over use of chemicals in agriculture, but despite many benefits, the adoption rate of organic farming is still low (See Table 2). This study used an expert consensus Delphi technique in three rounds to identify drivers and barriers for organic rice production. Due to the lack of attention to role of branding in the promotion of organic rice, consumption were the main barriers for organic rice farming. The absence of state policies has led to many areas in Nepal having barren lands, while development projects and urbanization have significantly impacted agricultural lands (Rai et al., 2020). It is recommended that the government should consider providing direct incentives to organic rice farmers and extension services should support organic farmers to maintain or enhance grain yields.

Table 2: Barriers in Rice Production Value Chain

S.N.	Author's and Study areas	Methods	Variables used	Result	Conclusion/ Recommendation
1	Elsevier B.V (Totin et al., 2012) Inland	Secondary (Longitudinal method) and Primary	Independent variables: their practices of growing rice, potential solutions and dependent variable: with rice farmers regarding	problems and barriers to innovation	although options exist for significant innovation in the current situation, there is a risk that local production will remain low
2	H. Mahdav and M. S. (Mahdavi et al., 2020) Iran	Qualitative	Dependent variables: drivers and independent variable: barriers	Providing representatives from the important reference groups of rice production	The main barriers for organic rice farming were the 'high cost of inspection and supervision of organic fields by
3	Yoshiaki Harushima and Masahiro Nakagahra (Harushima et al., 2002) Japan	Quantitative and Qualitative analysis	dependent variable: plants, map position and independent variables: intensity, and type	The expected frequencies at each reproductive barriers act on locus were calculated assuming that no other barriers act.	One possible force responsible for such rapid evolution of the barriers may have been the domestication of rice

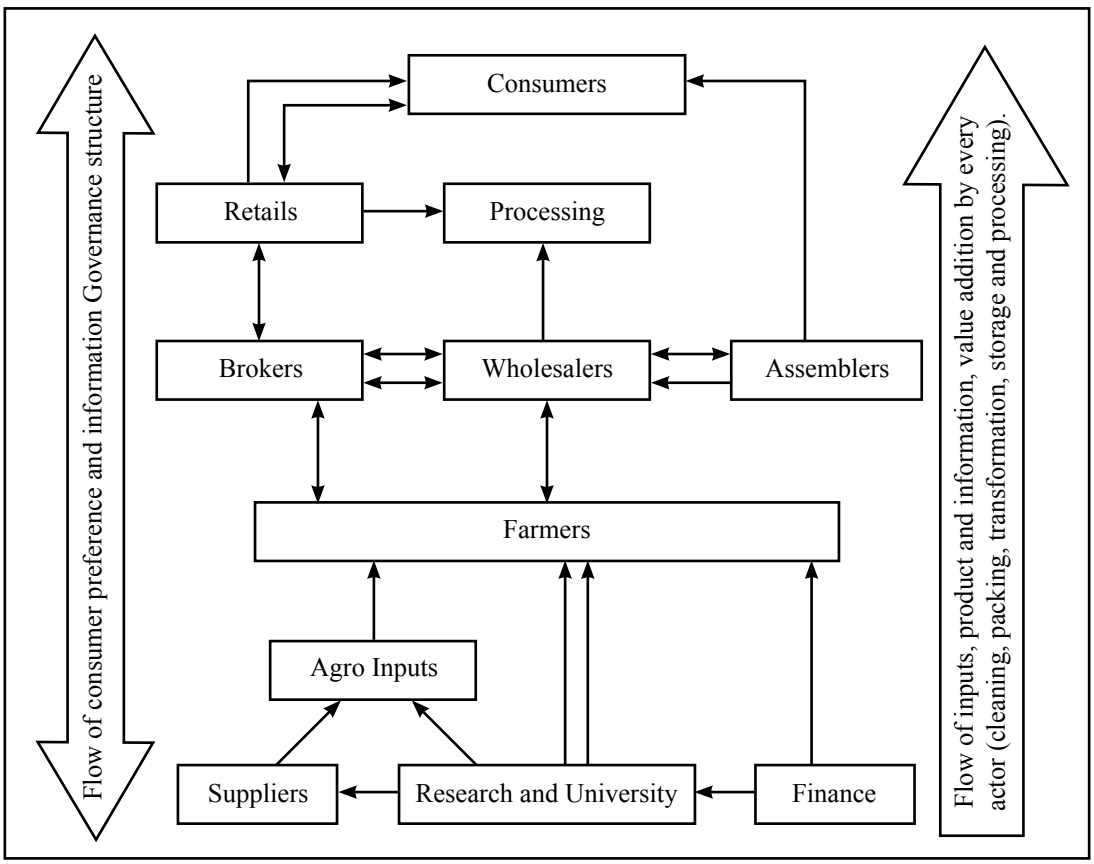
Research Method

Various theories have been explained for this study, including value chain analysis, competitive advantage theory, and locational theory, theory of reason action and theory of choice uncertainty theory. The first theory is value chain theory, which is the entire set of activities that an organization undertakes to bring a product or service from conception to delivery (including design, manufacturing, marketing, and distribution). The second theory is competitive advantage theory, the sustainable competitive advantage, which is usually used to infer the existence of any competitive advantage (SCA). RBV theory

has been used to describe the impact of different tools on SCA on several occasions. The third theory is locational theory, which is mentioned this research. This theory explains that an industry chooses where to position itself based on three key factors: agglomeration, labor costs, and transportation costs (Ajzen, 2015). Theory of reason action also determined that person's attitude toward an action is formed by his assumptions about the behavior's consequences, multiplied by his assessment of those consequences(Ajzen, 2015). And the last one is theory of choice under uncertainty defined as where a producer decides how much production to generate based on which inputs to use.

The conceptual framework of rice production value chain views paddy as conceptualized according to the core processes involved. The first step towards realizing the potential for agriculture systems models is to recognize that most work has been carried out by scientists in research or academic institution and thus motivated by research and academic consideration more than users (Kementerian Kesehatan Republik Indonesia, 2016). There are many actors in rice value chain which play different roles in product marketing and ultimate to consumers. The same actors are involved in both the fine and coarse rice value chain. The value chain includes direct actors who are commercially involved in the chain (input suppliers, producers, traders, retailers, consumers) and indirect actors who provide services or support the functioning of value chain. A strong vertical and horizontal linkage among the key actors was not found mainly due to lack of mutual understanding and poor functional relationship. Figure 1 depicts the conceptual framework of the study which reflects possible order of analysis of rice production value chain (Barua et al., 2021).

Figure 1: Conceptual Framework



Sources: Modified from (Barua et al., 2021)

Variables and its Definition

Based on the framework, mentioned above, the variables used and its definition is presented in table 3.

Table 3: Dependent and Independent Variables

Variables	Description	Value	Expected Sign
Dependent variables			
Quantity supplied to market	the amount of rice actually supplied to the market by household in the year 2015	Continuous (qt)	+
Market outlets	Represents rice/ paddy market outlets in the study areas	1 for wholesalers, 3 for processors	+
Independent variables			
Productivity	assumed to affect the volume supply positively, because a farmer that obtains high yield can supply more to the market than a producer	Continuous (qt/ha)	+ve
Sex of households head	expected to have either a positive or negative relation with volume of rice and paddy marketed	1 if Male, 0 if Female	+/- ve
Family size	family size is expected to have positive impact on volume of sales of rice/paddy, but larger family size requires larger amounts for consumption	Continuous (number)	+/ _ ve
Education level of households	educational status of the farmer determines the speed with which he/she is likely to adopt agricultural technologies	1 if follow formal education, 0 if illiterate	+ve
Distance to nearest market	those households who are close to market are assumed to have more probability of choosing better market outlets	Continuous (walking minutes)	_ve
Farm experience	farming experiences are more likely to change and/or aware rice and paddy marketing	Continuous (years)	+ve
Access to off/on farm income	farmers who gain more income from non/ off farm income want to supply their rice/ farmer to any nearest market outlet	1 yes, 0 otherwise	_ve
Extension contact	extension is assumed to have positive contribution to farm level volume supply of rice/ paddy	Continuous (number)	+ve
Land allocated for rice/ paddy	land allocated to sesame production influenced marketable supply of sesame positively	Continuous (hectares)	+ ve

The study examines several variables that influence the market supply of rice/paddy by individual households. The primary dependent variable is a dummy variable that indicates farmer participation

in value addition and the independent variables hypothesized to affect this dependent variable include several key factors. Here, productivity, measured in quintals per hectare, is expected to have a positive impact on the quantity supplied, as higher yields generally lead to more significant market sales. The Family Size of the household, representing the total number of members, is another factor, with the assumption that a larger family provides more labor for production, thereby increasing supply volume.

The Education Level of the Household Head also plays a crucial role, where higher education levels may lead to quicker adoption of agricultural technologies and better engagement with modern marketing systems, potentially increasing supply. Distance from the Nearest Market, measured in walking minutes, is considered crucial since shorter distances reduce transportation and marketing costs, making it easier for farmers to access market information and services, thus influencing their choice of market outlets. Furthermore, a farmer's Experience in rice/paddy farming, measured in years, is expected to correlate positively with supply volume, as more experienced farmers are likely to produce and sell more. The presence of Non/Off-Farm Income is another factor, where households with significant income from non-farming activities may prefer to sell at lower prices to the nearest market outlet to minimize travel.

Additionally, the Average Current Farm Gate Price of rice per quintal is an important determinant, as more attractive prices are likely to motivate farmers to sell their produce through specific market outlets. The frequency of Extension Contact, representing the number of days a farmer interacts with an agricultural extension agent, is expected to positively influence production and marketing practices. Finally, the Land Size Allocated for rice/paddy cultivation, measured in hectares, is assumed to have a positive relationship with the quantity supplied, as larger land areas typically yield higher production volumes, leading to more significant market supplies.

These variables collectively contribute to the understanding of household decisions in rice/paddy production and marketing, highlighting the importance of productivity, labor availability, education, market access, farming experience, and external income sources in shaping market outcomes.

Study Area, Population and Sample Size

This study employs an explanatory research design as it focuses on describing the cause-and-effect relationship (Amatya et al., 2023), as well as how and why it occurs (Shmueli, 2010). The area chosen for the study is Kathmandu valley and Birgunj, and Parsa districts. The Kathmandu valley comprised of three districts namely Kathmandu, Lalitpur and Bhaktapur which is located in province 3 of Nepal (Koirala et al., 2021). Kathmandu valley lies between the latitudes 27º32"13" and 27º49"10" north and longitudes 85º11"38" and 85º31"38" east (Maharjan et al., 2022) having population of around 1 million people. It is located at a mean elevation of about 1300 meters (4265 feet) above sea level in the bowl- shaped. Kathmandu valley covers an area of 395 km2 (Basnet et al., 2024 & Shrestha et al., 2020).

Parsa district is one of Nepal's seventy-seven districts and is located in Province No. 2 in the Terai plain. The district, which has Birgunj as its headquarters, spans 1,353 km2 (522 sq mi) and has a population of 497,219 people (as of 2001). Locals say that Parsa is named after the Parsagadhimai temple in the district (Yadav, S. 2020). Birgunj is a metropolitan city in Nepal's Province No. 2's Parsa District. It is located 135 kilometers (84 miles) south of Kathmandu, and is bordered to the north by Raxaul in the Indian state of Bihar. Birgunj is known as the "Gateway to Nepal" since it acts as an entry point to Nepal from Patna and Kolkata. It is also regarded as Nepal's "Commercial Capital." Birgunj is a major Nepalese business center, especially for trade with India. Bansh (2013), this route is used for almost all trade with India. Birgunj Custom makes a huge contribution to the country's revenue earnings. Birgunj

Inland Dry Port was opened on July 16, 2004, to boost trade operations and resolve concerns about handling large volumes of goods. Basmati rice is in high demand in the United States, Europe, and the Gulf countries. Rice worth Rs998.1 million was imported via the border point in the first six months of this fiscal year, according to statistics from the Birgunj customs office. Imports totaled Rs888.3 million in the same period of the previous fiscal year (Mahajan et al., 2018).

Convenience sampling (also known as Haphazard Sampling or Accidental Sampling) is a type of non-probability or non-random sampling in which members of the target population who meet certain practical criteria, such as easy accessibility (Bhatta et al., 2023), geographic proximity, and availability at a specific time, are selected. The Parsa district was chosen with care, bearing in mind the study's aims, greater production potential, and researcher convenience in mind. Higher secondary students from Nepal's Parsa district were taught survey interviewing skills and given information about the survey questions. A total of 260 respondents were selected from Parsa, Siraha and Saptakoshi districts using purposive sampling technique (based on researchers' experience and knowledge) (Paudel et al., 2018). The following formula for the sample size n:

$$n = N*X / (X + N - 1), \text{ (Devekota \& Phuyal, 2018)}$$

Where,

$$X = Z_{\alpha/2}^2 * p * (1-p) / MOE^2,$$

Instruments and procedure of data collection and Anlysis

The Primary data were collected from Key informant interview (KII) survey and Questionnaire survey. Until beginning the Study Methodology, the use of KII in the research was crucial in deciding whether the current research was on the right track and covered all available tools and studies. Three experts were interviewed by KII. For the data collection for the questionnaire study, a questionnaire was developed and implemented. The information will be gathered through a standardized questionnaire and interviews. Interview was conducted among the manager's cooperatives, farmers, traders of Siraha, Saptakoshi and Parsa district and quantitative data was extracted through interviews. The KII collaborated with three experts in the fields of paddy/rice production and agriculture to conduct the study. Their input has helped in the production of research questions and procedures. And the data collection problems have been planned and enforced.

Descriptive, value chain analysis, and inferential approaches were all used in the data analysis. STATA software is used to code, add, and measure variables, while Excel is used for data entry and tabulation (Kamilaris et al., 2017). Inferential analysis includes binary logit model and regression (Adhikari et al., 2023). The first section below uses descriptive statistics to show and discuss data on respondents' socio-demographic profiles, cooperative obstacles in promoting the paddy value chain, and managerial initiatives.

Data Analysis and Results

Socio-demographic Characteristics of the Respondent

The characteristics of the research respondents are summarized in this section. The respondents' age, gender, employment experience, and education are among the characteristics of their responses, presented in table 4.

Table 4: Socio-demographic Characteristics

Farrmer		Frequency	Percentage
Sex	Male	196	75
	Female	64	25
Education Level	Master and above	6	2.31
	Bachelor	60	23.08
	Higher Secondary	76	29.33
	SLC/ SEE	41	16.15
	Lower Secondary	25	9.62
	Primary	30	11.54
	None	22	8.46
Age of Household Respondents	Below 27	22	8.46
	27-30	35	13.46
	31-37	37	14.23
	38-44	54	20.76
	45-48	48	18.46
	49-54	43	16.53
	Above 55	21	8.07
Study Area	Birgunj	100	42.69
	Golbazar	83	31.92
	Saptakoshi	34	13.08
	Rajbiraj	43	16.54
Marital Status	Married	217	83.46
	Single	31	11.92
	Widowed	10	3.75
	Divorced	2	0.87
Types of Family	Nuclear	118	45.38
	Joint	110	42.3
	Extended	32	12.49
Source of Income	Sales of Crops	173	66.54
	Off farm Income	88	33.85
	Sale of livestock	107	41.15
	Other	26	10

Farrmer		Frequency	Percentage
Occupation besides Paddy Production	Agriculture (Beside Paddy Production)	161	61.92
	Remittance	30	11.62
	Service	25	9.54
	Business	20	7.77
	Government Employment	13	5.32
	Others	11	4.15
Decision on Paddy Production	Household Head	111	42.69
	Father	108	41.54
	Husband	18	6.92
	Mother	13	5
	Elder Brother	6	2.31
	Sister	4	1.54
Size of Family	Below 5	25	1.92
	5 to 7	98	37.69
	7 to 9	48	18.46
	9 to 11	44	16.92
	11 and above	45	17.31
Farming Experience	Below 10	31	11.92
	10-15	94	36.15
	15-20	60	23.07
	20-25	47	18.07
	25 and above	28	10.76

Current Status of Farming

In the study area, land is possibly the single most important factor of production and a measure of wealth. It is the primary source of revenue and elevates people's social standing. Table 5 shows the land use pattern for various production system.

Table 5: Land Use for Production

Land	Maximum	Minimum	Mean	STD.Dev
Total land	50 Katha	5 Katha	37.13 Katha	43.84 Katha
Rented land	50 Katha	0 Katha	6.66 Katha	23.95 Katha
Total area allocation of paddy	60 Katha	5 Katha	16.63 Katha	22.48 Katha

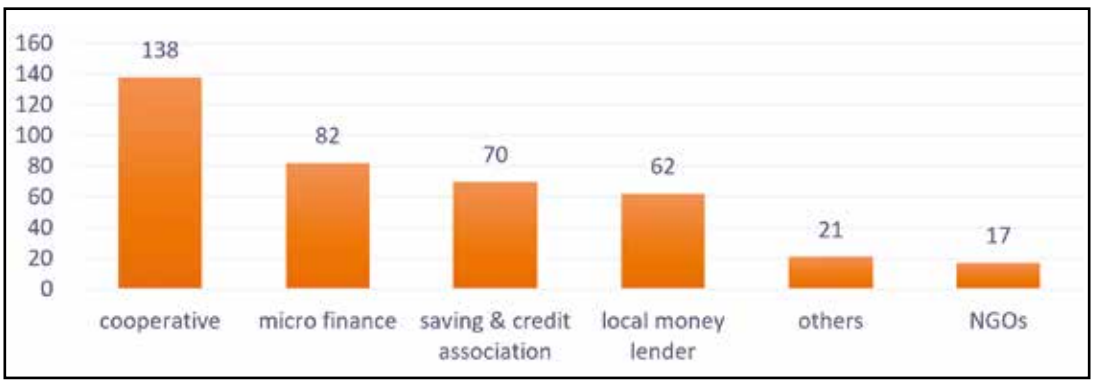
Respondents' average land size is 37.69 Katha. A household's average rental land was 6.66 Katha, with a maximum of 50 Katha. The respondent farmers' minimum and maximum landholdings were 50 Katha and 5 Katha, respectively. Out of total land, an average of 16.63 Katha was allocated for paddy production. The respondent farmers' minimum and maximum land sizes for paddy production are 60

Katha and 5 Katha, respectively. The majority of the people in the sample said they were involved in paddy production.

In addition, it's crucial to apply fertilizer correctly in accordance with the suggested rate in order to attain the necessary productivity and marketable supply. Farmers in the study region utilize a range of fertilizer rates for the production of paddy. Depending on their financial resources and the state of the market, private shops' typical annual purchases varied. Along with supplying pesticides, chemical suppliers also give farmers advice on chemical use, paddy seeds, and farm implements. It is also believed that using improved seed types in conjunction with sensible advice will increase paddy crop output and productivity in the study region. The main seed providers for the study are Agro vet and themselves. Additionally, non-governmental organizations (NGOs) support by providing farmers and primary cooperatives with seed. 65% of the respondents reported having trouble obtaining the input, compared to 35% of the respondents who had no such issues. The survey found that the top four problems that farmers had with receiving these inputs were a lack of supply, late delivery, high cost, and excessive distance from the input site. These problems accounted for 34.23, 30.77, 35.93 percent, 27.69 percent, and 2.31 percent of the study's total.

Loans are necessity for farmers in order to produce. According to the study, the majority of respondents, or 85.63%, have credit, while 34.33 percent do not have. For 41.54 percent of all respondent's, using credit was mostly done to pay for agricultural inputs. Additionally, for the purchase of livestock, land rent, other expenses, and HH consumption, respectively, 11.75 percent, 11.15 percent, 8.85 percent, and 2.69 percent of respondents claimed credit. The primary sources of credit in the research area are cooperatives, microfinance, saving and credit associations, neighborhood money lenders, NGOs, and others. Figure 2 depicts from where the respondents had accepted credit from micro finance, savings and credit associations, local lenders, NGOs, and others. Cooperatives play a critical role in providing financing in rural areas, allowing farmers to obtain input supplies and improve finance.

Figure 2: Sources of Credit Services



Sources: Field visit

When harvest time comes around, the majority of farmers sell the majority of their paddy/rice, keeping only a tiny portion for personal use and seed. Rice and paddy are grown by farmers for the market, and they sell to wholesalers at farm gates and local market places. Additionally, they sell to a range of local market participants, such as rural collectors, consumers, and retailers (with various volumes of sales).

The main consumers of paddy from farmers are wholesalers and retailers, who accounted for 61.15 percent and 43.08 percent, respectively, of all farmer sales. Compared to other traders, wholesalers have greater access to storage, shipping, and communication. Additionally, consumers, collectors, and brokers are other actors who split 19.23%, 18.85%, and 16.54% of the paddy sold by farmers in the research area. In the study area, small farmers who owned less than 5 Katha of land for paddy production and sold paddy directly to customers both inside and outside of the community made up

29.02 percent of the total respondents. Actors (distributors, retailers, assemblers, cooperatives, and processors) give the farmers advantages in terms of: pricing differences from others, proximity in distance, transportation availability, and others. Additionally, table 6 depicts 66.15% of respondents prefer to sell their product to these actors because they provide a lower price than the competition whereas 36.92 % and 35.38% of respondents want to sell because of proximity and transportation respectively.

Table 6: Reasons for Selling

Reason for Reselling	Frequency	Percentage
Price different from other	172	66.15
Closeness in distance	96	36.92
Transport availability	92	35.38
Others	18	6.92

Challenges of Actors along Paddy Value Chain

A variety of factors stifle the growth of the paddy value chain in general. As a result, the key restrictions mentioned by the actors which impeding the growth of the paddy value chain can be classified into three basic stages based on the findings: farm level, marketing/traders' stage, and cooperative stage. Hurdles in the term of farm level area are: infestation of insect and disease, lack of credit facility, irrigation facility and quality inputs and high cost of inputs, lack of technology in field of agriculture. Most of the marketing problems faced by respondents are: low farm gate price, insufficient processing facilities, insufficient market information, and rejection of crops by traders reasoning low quality and low production.

Value Chain Analysis

The respondents' value chain activities are qualitatively investigated in order to understand which factors influence the organization's value chain activities. The value chain is made up of three groups: primary activities, support activities, and factors that influence value chain activities. A significant amount of paddy is carried from the farm to the market and consumed by the intended receivers. To overcome roadblocks, it's critical to first understand the existing situation and the plan that must be implemented. The necessity of working together with each artist and stage is discussed.

Paddy Consumers

Consumers are final purchasers of paddy products mostly from retailers for consumption purpose. Paddy consumers are individual households (rural and urban dwellers) hotels and institutions. The majority of sampled consumers preferred smooth white, medium size and undamaged paddy/rice and followed by large size and clean paddy/rice. Further, the survey results revealed that dry, large size and red color paddy/rice are preferred by majority of consumers. In general, when it comes to purchasing veggies, people have their own set of quality standards.

Processing

Processing of paddy in the sense of preserving and value addition is not as such practiced in the study areas. Processing function is undertaken by millers and then paddy/rice are sold to consumers. Rice is commonly consumed in the form of cooked meals in different traditional dishes. Nowadays, consuming different rice's such as basmati, mansuli rice, jera masino, black rice, red rice and so on are becoming common in major towns of the study areas.

Retailers

Retailers play an important role in the value chain of paddy both inside and beyond the research area.

These are recognized for their limited purchasing and handling capacity, as well as their financial and information capacities. They are the final link in the chain between producers and consumers. Consumers in the research area typically purchase products from shops because they cater to their needs and spending power. In the research area, retailers are important players in the paddy value chain. They are the final link in the chain connecting manufacturers and consumers. They primarily purchase from wholesalers and resell to end users. They could also buy straight from the producers on occasion.

Brokers/ Middlemen

Brokers often go beyond transaction facilitation and attempt to control and fix pricing, create price symmetry, and reap additional benefits from the process, in addition to persuading farmers to sell their paddy at miller-set prices. Brokers that work for certain traders are known as commission agents. Almost 10% of farmers in the study area sell their produce through brokers. However, cooperatives were not found to have a strong enough involvement in purchasing paddy products in the research area or acting as assemblers. Brokers play a crucial role in connecting farmers to markets and other stakeholders in the commodity chain, especially when farmers' capacity to reach markets is limited, and market demand necessitates an increase in quantity and variety of product types.

Wholesalers

According to the findings of the survey, wholesale marketplaces are the primary assembly centers for paddy in their respective districts. They have easier access to storage, transportation, and communication than other traders. Almost every wholesaler owns or leases a warehouse in a market. Wholesalers are primarily responsible for purchasing paddy in big quantities from collectors and producers and distributing them to exporters, retailers, and consumers.

Collector/Assembler

They serve a crucial function and are well-versed in many areas. Collectors are important players in the paddy value chain, as they are in charge of transporting paddy from production areas to wholesale and retail markets in the research areas. Buying and assembling, repacking, sorting, transporting, and selling to wholesale marketplaces are all tasks that collectors engage.

Farmers

Growing paddy crops in a variety of agro-climatic conditions can be very cost-effective and competitive, and it opens up a lot of possibilities for research. Unfortunately, farmers have not taken advantage of these opportunities because of the reduced prices they obtain for their produce in the markets, as well as the cost of post-harvest losses. Siraha, Saptari and Parsa practice all these three solitary cropping and intercropping paddy production. Farmers, traders, and brokers handle post-harvest handling, which includes tasks such as sorting, grading, packing, storage, transporting, loading, and unloading. Aside from that, NGOs have a role in providing inputs, either directly or through cooperatives. If paddies are sold at the farm gate, as they are in three districts, the buyer is responsible for all of the aforementioned tasks traders or broker. For farmers, the availability of financial resources for credit is critical. Some farmers use it as a critical ingredient in their farming operations.

Inputs suppliers

Many actors are involved in agricultural input supply in the research area, either directly or indirectly, along the value chain. Currently, the main sources of input supply are the Agro vet, primary cooperatives/ unions, and GO/NGOs. Farmers that grow paddy took part in this stage as well, primarily for seed supply. Agricultural inputs such as better seed varieties, fertilizers, herbicides, insecticides, and farm implements are crucial inputs during the production stage, and all of these actors are accountable for supplying them. The bulk of the sample producers used their own seed for primary paddy grown in Siraha, Saptari and Parsa.

Primary Actors

Seed and other input suppliers, farmers, traders, and consumers were the main players in the paddy value chain in Siraha, Saptari and Parsa. In the process of changing a product's title, each of these actors adds value. Some duties or parts are shared by multiple actors, while some actors play multiple roles.

Supporting Actors

Supportive factors include those who provide training and extension, information, financial, and research services. According to Martin et al. (2007), the level of success of value chain actors is determined by access to information or expertise, technology, and finance. Agriculture Information and Council Centers, primary cooperatives, microfinance institutions, and non-governmental organizations (NGOs) are key supporting actors in the provision of such services.

Value Chain Governance

The findings of the study show that wholesalers, with the help of brokers, are the major value chain regulators. The governance structure reveals the smallholders' position in the supply chain as well as relationships between smallholders and purchasers. Wholesalers, with the help of brokers, are the major value chain regulators. The paddy value chain's governance is buyer-driven, with little trust between the many parties. Producers rely largely on traders due to a lack of relevant market information and organization.

Inferential Analysis

Summary statistics, binary logistic regression and the final regression result has been analyzed in this part of the study.

Summary Statistics

Mean, minimum and maximum value, and standard deviation were observed through 260 respondents. Under this, the variables expect age, family member, total land, land allocated paddy, level of education, family types, near market, storage have been assigned values zero and one where zero holds minimum value and one maximum value where one represents yes and zero otherwise. Zero and one can also be interpreted as dummy variable and other remaining values can be stated as numeric variables.

Dataset of the study revealed maximum years of farming experience is 34 years, with a minimum of 0 years. In addition, age has the highest mean and standard deviation of 41.02 and 9.78 respectively. Among socio demographic variables (age, farming experience, family types, level of education, off farm income), a minimum and maximum value are 24 and 72 respectively.

Under the sources of information variable (information from radio, information from newspaper, information from TV, information from cooperatives, information from traders, information from the internet, and information from GOs/NGOs), information about paddy had the highest mean and standard deviation of 0.61 and 0.48, respectively. The biggest mean and standard deviation, 1.41 and 0.49, respectively, were found in inputs from personal sources, followed by those from agro vet, cooperatives, locally available, and GOs/NGOs. similarly, inputs the right amounts at the right moments. Similar to total land, which has a maximum land of 140 katha and a minimum land of 5 katha, the mean and standard deviation are 35.66 and 23.07, respectively. Land allotment for paddy has a mean of 14.94 and 11.02 with a maximum land of 60 katha and a minimum land of 0 katha.

Similarly, the mean and standard deviation for transit by vehicle are 0.81 and 0.38, respectively. Similar to this, the paddy market's transportation has a mean and standard deviation of 1.35 and 0.48. The mean and standard deviation for credit availability is 1.32 and 0.46, whereas the mean and standard deviation for credit securing difficulties are 1.52 and 0.50. Similarly, the mean and standard deviation of the paddy minimum price are 1.72 and 0.86, respectively. The paddy future plan has mean and standard deviation values of 1.21 and 0.41. Similar to this, the mean and standard deviation of nearest

to market are 4.10 and 0.85 respectively with a maximum distance of 5 and a minimum distance of 3.

Logistic Regression

Wald chi2 (28) of the data is 76.40 which explains that our model is fit and we can go ahead. Likewise, pseudo R2 is 0.3872 indicating that the independent variables, undertaken for the study explained dependent variable by 38.72% indicating good in terms of logistic regression. According to Cohen (1992) r-square value .12 or below indicate low, between .13 to .25 values indicate medium, .26 or above, and above indicate high effect size. Similarly, log pseudolikelihood value is -94.58 and the coefficient value of constant is -1.90.

There are fifteen significant variables in the coefficient in order model. This demonstrates that these factors do have an impact on the value addition in paddy. Value addition is influenced by factors such as age, off-farm income, cooperative membership, total land, paddy-allocated land, input from own source, input from cooperatives, quantity of input at the right time, access to credit, credit difficulty, information from radio, newspaper, traders, internet, and days of storage.

Table 7 contains fifteen significant factors with p-values of less than 1%, 5%, or 10% which state that a farmer adds more value to the paddy value chain the older he or she is. It increases value addition by 1.08 times at a relevant level of 1%. The value contributed rises by 1.01 times when the total amount of land provided is increased. The chances of expanding value addition by 0.31 times at a significant level of 1% have improved once again with a decrease in the difficulty of obtaining credit. Additionally, if access to knowledge, such as that found in newspapers and from merchants, helps to increase output, the chances of value addition increase by 2.86 and 3.45 times, respectively, at the same level of output.

In order logistic regression and other nonlinear models, marginal effects are useful technique to represent the average influence of changes in explanatory variables on the change in likelihood of outcomes. Age, off-farm income, cooperative membership, family member, family type, total land, land set aside for paddy, input from own source, input from cooperatives, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input from other sources, input quantity from NGOs at the right time, Credit availability, credit issues, information from radio, newspaper, traders, internet, NGOs/GOs/NGOs, and days of storage are all significant variables in marginal effect. There are marginal impacts of 0.0090, -0.025, -0.032, 0.002, -0.133, 0.04, 0.120, 0.142, and 0.159 for age, off-farm income, family type, paddy acreage allotted, input from own source, credit problem, and days of storage, respectively. Table 7 indicates that the value addition rises by 0.0207 with a marginal change in age, 0.0090 with a change in family type, -0.032 with off-farm income, 0.002 with land set aside for vegetables, 0.318 with input from own source, -0.133 with credit problems, 0.120 with information from newspapers, 0.142 with information from traders, and 0.159 with information from the internet. In addition, the marginal effects of total land, GOs/NGOs input, input quantity at the proper time, credit access, and radio information are 0.00199, -0.101, 0.0130, -0.0507, and 0.043, respectively.

Table 7: Logistic Regression

	(1)	(2)	(3)
VARIABLES	**Logit Model**	**Odds Ratio**	**Marginal Effects**
fac_aff_valadd			
gender	0.546	1.727	0.0624
	(0.528)	(0.912)	(0.0603)

	(1)	(2)	(3)
VARIABLES	**Logit Model**	**Odds Ratio**	**Marginal Effects**
_ag_	0.0791**	1.082**	0.00904**
	(0.0337)	(0.0365)	(0.00377)
_fam_mem_	0.108	1.114	0.0123
	(0.0907)	(0.101)	(0.0102)
_edufammem	0.0836	1.087	0.00955
	(0.134)	(0.146)	(0.0153)
typefamily	-0.224	0.799	-0.0257
	(0.382)	(0.306)	(0.0436)
_farm_exp_	-0.0722	0.930	-0.00825
	(0.0450)	(0.0419)	(0.00505)
_off_farm_incm_	-0.288	0.750	-0.0329
	(0.443)	(0.332)	(0.0505)
_total_land_	0.0174*	1.018*	0.00199*
	(0.0105)	(0.0107)	(0.00114)
_alloc_pdy_land_	0.0247	1.025	0.00283
	(0.0188)	(0.0193)	(0.00217)
_inp_all_	0.751	2.120	0.0859
	(0.518)	(1.098)	(0.0582)
_inp_pdy_loc_avi_	0.480	1.617	0.0549
	(0.523)	(0.845)	(0.0594)
_inf_pdy_coop_	0.963	2.619	0.110
	(0.633)	(1.658)	(0.0692)
_inp_pdy_gos_	-0.883	0.414	-0.101
	(0.563)	(0.233)	(0.0646)
_inppdy_qty_time_	0.113	1.120	0.0130
	(0.467)	(0.523)	(0.0536)
_acc_crdt_	-0.443	0.642	-0.0507
	(0.425)	(0.273)	(0.0476)
_prb_crdt_	-1.164**	0.312**	-0.133**
	(0.479)	(0.149)	(0.0552)
_trans_vech_	-0.568	0.567	-0.0649
	(0.506)	(0.287)	(0.0564)

	(1)	(2)	(3)
VARIABLES	**Logit Model**	**Odds Ratio**	**Marginal Effects**
_transpdy_mktplace_	-0.682	0.506	-0.0779
	(0.478)	(0.242)	(0.0537)
_inf_fmradio_	0.383	1.467	0.0438
	(0.463)	(0.679)	(0.0533)
_infpdy_newspapr_	1.052*	2.865*	0.120**
	(0.538)	(1.541)	(0.0597)
_inf_pdy_tv_	0.828	2.289	0.0946
	(0.760)	(1.740)	(0.0850)
_infpdy_coo_	-0.184	0.832	-0.0211
	(0.652)	(0.542)	(0.0746)
_infpdy_trad_	1.239**	3.452**	0.142**
	(0.556)	(1.920)	(0.0629)
_inf_pdyint_	1.387	4.005	0.159
	(0.913)	(3.655)	(0.103)
_inf_pdy_sms_	-0.276	0.759	-0.0316
	(0.998)	(0.757)	(0.114)
_mini_price_pdy_	-0.499	0.607	-0.0570*
	(0.305)	(0.185)	(0.0334)
_plan_pdy_futur_	-0.420	0.657	-0.0480
	(0.473)	(0.311)	(0.0536)
_narest_mkt_	0.510	1.665	0.0582
	(0.511)	(0.851)	(0.0571)
Constant	-1.905	0.149	
	(3.013)	(0.449)	
Observations	260	260	260

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Discussion

The study used ordered logistic regression to analyze the dataset. Age, off-farm income, cooperative membership, total land, land allocated for paddy, input from cooperatives, input quantity at right time, access to credit, credit difficulty, information from; radio, newspaper, traders, information from the internet, and days of storage affect the value addition. In contrast to the study, Biggeri (2018) claims

that access to credit, age, and information affect involvement in value addition. This could be due to the fact that younger farmers have a better awareness of value chain and can contribute value to it.

As the distance between the farm and the nearest market has a significant impact on market outlet selection, the government should ensure that developing markets for paddy is within reach. Infrastructure and transportation systems should be developed to keep paddy and rice price lower. But if price becomes lower then famers would have loss. In so inputs for paddy production should be reduced or subsidized (Asaleye et al., 2020). The study revealed that there is lack of resources, technological products and market for the paddy production. Due to a lack of resources, bad leadership, lack of transparency, a lack of administrative experience, an unsuitable cooperative structure, and a failure to seize market possibilities, cooperatives do not perform as intended (Jaroensathapornkul & Tongpan, 2007). Providing the needed inputs like: fertilizers and training does provide the advantage to the cooperatives. So, to get the advantageous responses cooperative have to perform well. The concerned parties like: government, cooperatives should concentrate on increasing the productivity of paddy/ rice crops per unit area of land by promoting and providing improved seeds, production skill training, technical support to farmers in agronomy practices, and technical support in post-harvest handling, all of which will boost smallholder productivity and enable them to connect with the crop output market (Kato, 2007) .

Furthermore, government should provide sufficient credit and subsidy to the famers and other value adding actors. It shows that price issues must be solved by the government and for that, government should make policies on prices for the farmers (Kato, 2007). Additionally, to decrease the unjust price caused by brokers, it is critical to organize (voluntarily) traders and producers and construct trustful and robust trade agreements between the two institutions. Searching for market information and disseminating it will be critical if traders and producers have a solid relationship (Voldness et al., 2020).

Conclusion

The majority of the respondents were from the age group 49-55 which is a total of 130 respondents out of 260. Among 260 respondents, 110 of them had working experience of 11-25years in farming or agricultural sector. In addition, the land size of the respondents for the production was different according to their ownership. In which, out of total land, an average of 16.63 katha was allocated for paddy production. The analysis reveals that there are numerous intermediaries between producers and consumers, with a significant disparity between the amount farmers earn and the price consumers pay. The paddy value chain is hampered by a lack of technical, business, and financial support for producers and dealers, as well as poor infrastructure (storage and transportation) and lack of integration among chain actors, according to the report. Moreover, some of the recommendations collected from the farmers for value chain analysis of paddy product are: Government should finance the farmers at the time of paddy cultivation period and also after harvesting; Policy makers should focus on enhancing producers marketed surplus of paddy; strengthening farmers' technical knowledge of paddy farming and enabling adult education are advised for improving paddy production. Unnecessary prolongation of value chain should be eliminated.

References

Adhikari, S., Paudel, U. R., Devkota, N., Dhakal, K., Basyal, D. K., Koirala, R., ... & Parajuli, S. (2023). Assessment of gender diversity on banking performance in Nepal: Evidence from binary logit estimation. In *Perspectives on Women in Management and the Global Labor Market* (pp. 163-193). IGI Global.

Adhikari, V. R. (2015). *Impact of climate variation in paddy production of Nepal* (Master's thesis, Norwegian University of Life Sciences, Ås)

Ajzen, Icek. "Consumer attitudes and behavior: the theory of planned behavior applied to food consumption decisions." *Italian Review of Agricultural Economics 70,* no. 2 (2015): 121-138.

Akpeko, A. (2018). Value chain and local economic development in the shai-Osudoku district assembly of Ghana: The experience of the Asutuare rice farming project. *Journal of Public Administration and Policy Research,* 10(2), 7-19.

Amatya, S., Basyal, D. K., Lawaju, P., Paudel, U. R., & Bhandari, A. (2023). Key Factors Influencing Adoption of Online Dispute Resolution in Banking Sector: An Empirical Analysis. *Journal of Business and Management,* 7(02), 104-124.

Arouna, A., Soullier, G., Del Villar, P. M., & Demont, M. (2020). Policy options for mitigating impacts of COVID-19 on domestic rice value chains and food security in West Africa. *Global Food Security,* 26, 100405.

Asaleye, A. J., Alege, P. O., Lawal, A. I., Popoola, O., & Ogundipe, A. A. (2020). Cash crops financing, agricultural performance and sustainability: evidence from Nigeria. *African Journal of Economic and Management Studies*, 11(3), 481–503.

Bansh Jha, H. (2013). Nepal's border relations with India and China. *Eurasia Border Review*, 4(1), 63-75.

Barua, P., Rahman, S. H., & Barua, M. (2021). Sustainable value chain approach for livestock-based livelihood strategies for communities of the southeastern coast of Bangladesh. *Modern Supply Chain Research and Applications,* (ahead-of-print).

Basnet, A., Basyal, D. K., Thakur, A., Lawaju, P., Devkota, N., Devkota, J., & Paudel, U. R. (2024). Green Marketing and its Impact on Consumer Buying Behavior in Kathmandu Valley. *Quest Journal of Management and Social Sciences*, 6(1), 100-117.

Bhatta, S., Devkota, N., Paudel, U. R., & Danuwar, R. K. (2023). Prospect of tourism development in Khaptad National Park: A Local Perspective. *Journal of Tourism & Adventure*, 6(1), 53-71.

Biggeri, Mario, Francesco Burchi, Federico Ciani, and Raoul Herrmann. "Linking small-scale farmers to the durum wheat value chain in Ethiopia: Assessing the effects on production and wellbeing." *Food Policy* 79 (2018): 77-91.

Devkota, N., Phuyal, R. K., & Shrestha, D. L. (2017). Cost and benefit analysis of adoption of climate change adaptation options among rural rice farmers in Nepal. *Asian Journal of Agriculture and Rural Development*, 7(7), 136.

Demont, M., Fiamohe, R., & Kinkpé, A. T. (2017). Comparative advantage in demand and the development of rice value chains in west Africa. *World Development*, 96, 578–590. https://doi.org/10.1016/j.worlddev.2017.04.004

Devkota, N. (2019). *Economics of Climate Change Adaptation on Rice Production in Nepal a (Dissertation Submitted to the Faculty of Humanities and Social Sciences of Tribhuvan University)*. *January*

Devkota, N., & Phuyal, R. K. (2018). Adoption practice of climate change adaptation options among Nepalese rice farmers: Role of information and communication technologies (ICTs). *American Journal of Climate Change,* 7(2), 135-152.

Harushima, Y., Nakagahra, M., Yano, M., Sasaki, T., & Kurata, N. (2002). Diverse variation of reproductive barriers in three intraspecific rice crosses. *Genetics*, 160(1), 313-322.

Jaroensathapornkul, J., & Tongpan, S. (2007). Impacts of government spending on Thailand's agricultural sector. *Kasetsart Journal of Social Sciences*, 28(3), 385-395.

Kamilaris, A., Kartakoullis, A., & Prenafeta-Boldú, F. X. (2017). A review on the practice of big data analysis in agriculture. *Computers and Electronics in Agriculture*, 143(January), 23–37.

Kato, F. (2007). Development of a major rice cultivation area in the Kilombero Valley, Tanzania. *African Study Monographs*, 36(March), 3–18.

Koirala, A., Bhandari, P., Shewade, H. D., Tao, W., Thapa, B., Terry, R., ... & Karki, S. (2021). Antibiotic use in broiler poultry farms in Kathmandu valley of Nepal: Which antibiotics and why?. *Tropical medicine and infectious disease,* 6(2), 47.

Mahajan, G., Matloob, A., Singh, R., Singh, V. P., & Chauhan, B. S. (2018). Basmati rice in the Indian subcontinent: Strategies to boost production and quality traits. *Advances in Agronomy*, 151, 159-213.

Maharjan, P., Devkota, N., Mahapatra, S., Haq Padda, I. U., Dhakal, K., Mahato, S., ... & Bhattarai, U. (2022). FinTech adoption among online grocery buyers during covid-19 lockdowns in Nepal. *Journal of Private Enterprise*, 37(2).

Mahdavi, H., Allahyari, M. S., Damalas, C. A., & Dunn, E. S. (2020). Drivers and barriers for organic rice (Oryza sativa L.) production in northern Iran: experts' consensus using the Delphi method. *Biological Agriculture and Horticulture*, 36(2), 96–106.

Minas, A. M., Mander, S., & McLachlan, C. (2020). How can we engage farmers in bioenergy development? Building a social innovation strategy for rice straw bioenergy in the Philippines and Vietnam. *Energy Research & Social Science*, 70, 101717.

Mishra, A. K., Kumar, A., Joshi, P. K., & D'souza, A. (2016). Impact of contracts in high yielding varieties seed production on profits and yield: The case of Nepal. *Food Policy*, 62, 110–121.

Paudel, U. R., Devkota, N., & Bhandari, U. (2018). Socio-cultural and economic factors in cross-border purchase: A study of customers' perspective in Sunauli-Nepal/India Border. *Modern Economy*, 9(6), 1089-1102.

Phuyal, R. K., Devkota, N., & Shrestha, D. L. (2017). Climate change adaptation related hindrances among rice farmers in Nepal: Farm level analysis. *Journal of Development and Administrative Studies*, 25(1–2), 1–10. https://doi.org/10.3126/jodas.v25i1-2.23434

Rai, A., Devkota, N., Bhandari, U., & Paudel, U. R. (2020). Land management for agricultural entrepreneurship development: Farmers' perspective from Udayapur, Nepal. *Asian Journal of Agriculture and Rural Development*, 10(2), 612–627. https://doi.org/10.18488/journal.ajard.2020.102.612.627

Senanayake, S. M. P., & Premaratne, S. P. (2016). An analysis of the paddy/rice value chains in Sri Lanka. *Asia-Pacific Journal of Rural Development,* 26(1), 105-126.

Shmueli, G. (2010). To explain or to predict?. *Statistical science*, 25(3), 289-310.

Shrestha, M., Manandhar, S., & Shrestha, S. (2020). Forecasting water demand under climate change using artificial neural network: a case study of Kathmandu Valley, Nepal. *Water Supply*, 20(5), 1823-1833.

Totin, E., Van Mierlo, B., Saïdou, A., Mongbo, R., Agbossou, E., Stroosnijder, L., & Leeuwis, C. (2012). Barriers and opportunities for innovation in rice production in the inland valleys of Benin. *NJAS-Wageningen Journal of Life Sciences*, 60, 57-66.

Voldnes, G., Kvalvik, I., & Nøstvold, B. (2020). Taking care of a highly valuable resource throughout the value chain-Lack of market orientation in red king crab export?. *Marine Policy*, 117, 103965.

Yadav, S., & Singh, S. P. (2020). Blockchain critical success factors for sustainable supply chain. *Resources, Conservation and Recycling*, 152, 104505.

Yi, Q., Liang, B., Nan, Q., Wang, H., Zhang, W., & Wu, W. (2020). Temporal physicochemical changes and transformation of biochar in a rice paddy: Insights from a 9-year field experiment. *Science of the Total Environment,* 721, 137670.

Zitong, G. (1986). Origin, evolution, and classification of paddy soils in China. In *Advances in soil science* (pp. 179-200). Springer, New York, NY.