

Integrating structure conduct and performance framework for maize seed value chain analysis in western Nepal

RAJENDRA PRASAD MISHRA

Ministry of Agricultural Development, Singh Durbar
Kathmandu Nepal

G. R. JOSHI

Commission for the Investigation of Abuse of Authority, Nepal

J. P. DUTTA

Dean Faculty of Agriculture, Agriculture and Forestry University
Rampur, Chitwan, Nepal

Abstract:

Structure, conduct and performance (SCP) framework is a market analysis tool used for analysis of maize seed value chain in western Nepal. The data were collected from two hundred farm households involved in maize seed production, hundred for maize grain production were randomly selected from purposively selected sites, seed collectors, seed processors, seed retailers, and end users through structured questionnaires and focus group discussion. The SCP indicators that best fit to the operating environment of maize seed value chain were selected through review of available literatures. The findings have shown that structurally maize seed value chain is operating in competitive environment (Lerner index 0.37), low level of market concentration for overall chain (Herfindahl index 0.44) but high level of market concentration for source seed production stream, cooperative and captive structure, independent ownership among value streams, seed processing firms and cooperatives led chain, and there are no entry and exit barriers except some legal and technical requirements. The demand of hybrid maize seed is increasing by 12% while improved variety is about 6% in the region. Analysis of conduct indicators showed price is largely determined by market forces, low

level of product diversification, low investment in promotion, primary focus of actors is individual gain, and no embedded services and risk sharing mechanism in place. There is poor horizontal linkage among seed production stream, however there is better vertical linkage. The level of trust is important glue for smooth functioning of value chain which is found low among chain actors. In spite of deficiencies in structure and conduct, the maize seed value chain found performing well against set objectives of food security, poverty reduction, social inclusion, local value addition, and distribution of income among actors (GI 0.75). The income from seed production largely concentrated toward small producers, similarly large proportion of value addition concentrated towards farmers and net margin more or less equitably distributed among value streams (GI 0.74).

The major implication of this study is towards implementation of programs focusing improvement in structure and conduct deficiencies to achieve better performance of the maize seed value chain. The increasing competition with external more competent, coordinated and highly efficient integrated value chains demand upgrading programs for current maize seed value chain to make it competent and resilient in the territory to reduce external dependency in maize seed and improve domestic seed production. Similarly high concentration of source seed market needs higher participation of other agencies in source seed production and distribution.

Key words: maize seed value chain, structure conduct, performance

1. INTRODUCTION

The structure, conduct and performance (SCP) of a market are different interrelated terms that focus on analysis of competitive conditions of the market. SCP paradigm measures the behavior of all market players which has direct bearing on conduct and performance of the market. The structure of the market refers to monopolistic, oligopolistic and perfect competition, conduct denotes behavioral patterns of market players to adjust the market conditions and performance is

understood as the share of different actors in ultimate outcome of market function and achievement of its goals. This framework was first published by economists Edward Chamberlin and Joan Robinson in 1933, and developed by Joe S. Bain in 1959. SCP framework was initially used to analyze the markets as an analytical framework, to make relations among market structure, conduct and performance. In this framework holistic approach is used and prevailing market is considered as unit of analysis.

In the market a product moves from the producer to the consumer with many transformations making a chain of interrelated value adding successive activities in a given environment. Such chains characterize the set of interconnected and coordinated activities that takes place as a product moves from primary production point to the final consumer. The enabling environment surrounding a chain is the set of global, national and local government regulations and practices creating incentives for private sector growth (Kula et al., 2006). A value chain is the full range of activities which are required to bring a product or service from conception through the different phases of production, delivery to final customers, and final disposal after use (Kaplinsky and Morris, 2000:4). Value chain analysis is a systematic approach to examine the development of competitive advantage that enables the producer to create superior value for its customers and superior profits for itself.

Now markets and industry analysis extended to value chain approach and SCP framework is integrated to analyze value chains. In extended framework of SCP, value chain stream is the unit of analysis rather than a firm or market in the territory. Value chain stream is the segment of the chain in a territory and can be viewed as a local net chain (Lazzarini et al., 2001). In this framework firms in a value chain operating in a territory with shared objective try to maximize their value by

working together, making strategic decisions, enhancing competitive capacity and reducing short term mutual exploitation. Klint and Sjoberg (2003) characterized SCP categories for firm networks and Figueiredo Junior and Sostowski (2010) expressed the need of extended SCP to devise the strategy for networks of firms and supporting actors (cited in H.S.J. de Figueirêdo, 2014). Application of SCP framework in value chain analysis identifies the relations among value streams, and participants are evaluated based on their influence on structure conduct and performance. Thus integration of SCP framework in value chain analysis provide deeper insight to provide better ways for value chain upgrading, improved competitiveness and enhanced performance.

In Nepal the import of maize grew 16% annually during 2010 to 2014 and same period domestic production grew 3 % (TEPC, 2015; MoAD, 2015). This shows increasing domestic demand of maize and exponentially growing import is compelling to devise the policies, programs, and activities to increase production and productivity of maize. The fundamental and initial step to overcome this challenge is upgrading of existing maize seed value chain through improved competitive structure, transparent conduct and high level inclusive performance. The availability of preferred improved variety quality seed in reasonable price among maize growers largely depend on resilient competitive maize seed value chain. The analysis of maize seed value chain using SCP framework identifies current status and find upgrading ways to get best performance. Considering these facts, the present study aims to examine (i) how are the different streams of the maize seed value chain are structured, (ii) the behavior of main actors in maize seed value chain with respect to their production, collection, processing and retailing decisions; and (iii) the

performance of the maize value chain as a whole and its streams.

2. METHODOLOGY

This study was based on primary and secondary data collected from seed producer farmers, seed collectors, seed processors, seed retailers and seed users operating in western Nepal. Farmer's level data were collected from four purposively selected sites and randomly selected households for seed producers and end users for structured questionnaire survey. Seed collectors, processors and retailers were interviewed purposively in the region. In addition to these, different government offices having direct and indirect linkage with maize seed production and marketing were interviewed. Semi-structured questionnaires and personal interviews were used to collect the data. Four focused group discussions (FGDs) that involved key informants were held Dadeldhura, Dhangadi, Doti, Surkhet and Dailekh. These were complimented with direct observation.

Value chain actors were respondents from input suppliers, agro vets, cooperatives, seed producer farmers, quality control agencies, regional seed testing laboratories, seed quality control center, and seed processing enterprises from Dadeldhura, Dhangadi, Sukhet, and maize grower farmers. The information was collected on different functions of each actor in the seed value chain at various levels. The involvement of actors in the complete seed value chain was assessed through primary data from sample value chain actors such as input supplier, seed producer, seed traders, and seed buyer/user. Input sales, maize seed purchase and sales record, market information flow, transaction costs on seed marketing, infrastructure available, training on input handling were also collected and analyzed.

Similarly, information from seed producer farmers and end user farmers was obtained on household information, land holding, maize grain and seed production, seed sale record, infrastructure available, training and technical services, seed storage and postharvest operations, seed quality and certification process, problems in seed production and marketing and suggestions to improve, seed licensing, technical services being obtained from input/seed suppliers, market transaction costs, cost of production of maize seed etc.

Table 1: Sample size in different streams of value chain

Districts	Surkhet, Dadeldhura, Kalilali, Doti
Focus group discussion	6
Maize grower farmers survey	100
Collectors survey	6
Quality control agency survey	2
Seed processors	6
Agro vet survey	6
Seed producers survey	200
Source seed producers survey	2

3. STRUCTURE CONDUCT AND PERFORMANCE FRAMEWORK FOR VALUE CHAIN ANALYSIS

3.1. Structure

The structural aspects in value chain are exogenous and include relatively stable features linked with buyers, sellers and rivalry (Figueiredo J., 2015). The most commonly used structural aspects in SCP framework for value chain analysis by different scholars are supply, demand, local infrastructures, enabling environment, institutions, regulations, policies, entry and exit barriers and geographic location (Nadvi 2004, Giuliani et al 2005, Coe et al 2008, Trienekens 2011, Van Dijk and Trienekens, 2012, Ruben and Zuniga 2011, Fias 2007, Figueiredo Junior and Sostowski 2010 and Weber and Labaste, 2010). Hugo Santana de Figueirêdo Junior 2015 used demand behavior, concentration of clients, rivalry intensity, entry

barriers, substitute products, local natural and institutional environment and local infrastructure related indicators as structural aspects for evaluating strategies for honey value chains in Brazil. Characterizing the determinants of successful value chains Canadian Agri Food Policy Institute, 2012 mentioned four structure of value chain fragmented, cooperative, coordinated and collaborative with different characteristics. These characteristics are defined under five categories: strategic factors, governance arrangements, financial, communication and operations. Value chain structures reflect a continuum that spans from traditional open market approaches to businesses that are closely aligned to the point that they may jointly invest in infrastructure and resources (Dunne, 2003; Spekman et al., 1998). This continuum inhabits fragmented, cooperative, coordinated and collaborative structure of value chains. Regarding governance structure of value chain Gereffi, 2005 identified five structures market, modular, relational, captive and hierarchy.

Structure of value chain stream is main component of structure conduct performance (SCP) paradigm and relates to how value chain participants are organized in terms of strategy, governance, finance, communication and operation in the territory. In open and fragmented value chain stream, market demand and supply determine outcomes like pricing, product, quality, variety and there is free entry and exit characteristics. In such case all value chain actors grow in free and fair environment. On the other hand, value chain stream may exhibit purely monopolistic structure having conditional framework where the majority command to production and supply of products in the market (Onyango, 2013). The deviation of value stream structure from the competitive framework may result to a decline in value stream efficiency as entire stream remain under control of single or few actors and value created does not flow to all the beneficiaries logically.

Failure to create competitive framework may distort market operations and eventually lead to collapse of the value stream.

3.2. Conduct

In SCP framework of market analysis conduct is the operational behavior of market actors like collusion, price discrimination, warranty, transparency, governance, measurement and standards of the products. The conduct is measured in terms of price set by individual actors for their role or value addition in the product. In case of SCP framework of value chain analysis conduct aspects: choices of products, market segments, technologies, and horizontal/vertical linkages, business process, agglomeration, decisions, and distribution activities, use of resources, supporting services, diversification, promotion, and organizational decisions are commonly cited (Humphrey and Schmitz 2000, Gereffi et al 2005, Lastres and Cassiolato 2005, Morrison et al 2008, Coe et al 2008, Bolwig et al 2010, Trienkekens 2011, Ruben and Zuniga 2011, Fias 2007 and Weber and Labaste 2010). In the value stream conduct variable includes behaviors patterns adopted by value stream actors as a way of adjusting market conditions, deter competitors and to achieve strategic goals and thus it is considered endogenous.

3.3. Performance

Market performance is measured on the basis of socially preferred outcomes of overall market processes. In SCP framework of value chain analysis this is extended to performance aspects like poverty reduction, operational chain efficiency, competitiveness, revenue, local employment and value addition, farm yield, quality, price and sustainability (Figueiredo et al 2015, Bolwig et al 2010, Fias 2007, Trienkekens 2011, Ruben and Zuniga 2011 and Weber and Labaste 2010). Production costs, margins, price markups,

productive capacity and productivity are among the possible measures of chain performance (UNIDO, 2009). In the value chain analysis it is most important to establish meaningful linkage between conduct and performance for which measures are selected before conduct measures such links can be established well.

4. SCP FRAMEWORK FOR MAIZE SEED VALUE CHAIN ANALYSIS

This study used integrated assessment of value chain SCP framework derived from Figueiredo Junior, Meuwissen, and Oude Lansink 2014 and other studies. Maize seed value chain is considered as unit of analysis and overall seed value chain is decomposed in different five value streams and each stream is analyzed separately and together to get the conclusion. In each value stream SCP framework employed with selected indicators for structure, conduct and performance measurement. The source seed supply stream is mostly under government agency control and not analyzed fully.

- a. Source seed supply stream
- b. Seed production stream
- c. Seed collection stream
- d. Seed processing stream
- e. Seed distribution stream

The maize seed value chain in western Nepal has not long history and is still government supported to some extent. The basic objective behind promotion of maize seed value chain is enhance maize seed self sufficiency to promote food security and reduce poverty among farming population.

The structure of value chain is most important aspect that determines effectiveness against these strategic goals. The available literatures have shown that there are number of

different indicators used to analyze the structure of value chains. Only the selected indicators suitable to this were used in this study. The selected ones are: demand, supply, infrastructure, entry barriers, and substitute products. Similarly strategic, governance, financial, communication and operational structures in the value chain are also taken in consideration. Based on the strategic, governance, financial, communication and operation indicators, value chain structure are categorized in fragmented, cooperative, coordinated and collaborative. Lerner index and Herfindahl index are calculated to examine the structure of the value stream and overall value chain.

- **Lerner Index:** Lerner index is calculated for each value stream and for overall value chain and interpreted as higher the value of Lerner index higher the market power of the value chain or value stream in the chain. In the market structure higher Lerner index indicates toward monopolistic structure lesser indicates toward competition market and between is oligopoly. The Lerner index requires information on marginal cost of production which is not readily observable by outsiders. Investigators then use the weighted average of profit rates (Profit of firm i /Revenue of firm i) as a proxy for Lerner index (Hanekm et al 2010). The calculation of the marginal cost of production for each value stream is not possible from survey so weighted profit rates (profit margin of value stream/ revenue of value stream) of value stream is used as proxy of Lerner Index in this study.

$$L = \frac{P - MC}{P}$$

Where,

L = Learner index used as proxy value chain power in the market

P = Market Price per kg of seed

MC = marginal cost of production of maize seed per kg

- Herfindahl Index:** Generally market concentration is measured $1/n$ when share of the operating firm or value chains is identical where n is the number of value chains or firms but it is difficult when the market share among firm or value chains is different. The Herfindahl index is used to determine and compare concentration within maize seed value chain in western Nepal. If there are n firms with total output of q in the particular value stream and the market share of value chain i is denoted by $S_i = q_i / q$.

$$\text{Herfindahl index: } H = S_1^2 + S_2^2 + \dots + S_n^2$$

Interpretation: Higher value of Herfindahl index indicates that the value stream is concentrated irrespective of number of firms involved in the chain stream. This indicate that concentration cannot be calculated or predicted solely based on number of firms operating in the value stream, but the distribution of market shares between them also have to be taken into account.

Table 2: Selected measures for SCP framework

Value stream	SCP framework selected measures		
	Structure indicators	Conduct	Performance
Source seed supply	Demand, Supply, Governance, Finance, Communication, Regulations, Entry barriers, Substitute products, Lerner index, Herfindal index	pricing, promotion, internal quality control, financial focus of actors, primary focus of actors, method of mitigating risk, presence of trust and commitment, evaluation and reporting	Supply, quality, predictability, available options, profit margin
Seed production	Number of organized growers, Governance, Finance, Communication, Operation,	pricing, promotion, vertical, horizontal and network, internal quality control, primary focus of seed	quality, predictability, profit margin, social inclusion, contribution poverty

Rajendra Prasad Mishra, G. R. Joshi, J. P. Dutta- **Integrating structure conduct and performance framework for maize seed value chain analysis in western Nepal**

	Regulations, Entry and exit barriers, Alternative enterprise	producers, method of mitigating risk, presence of trust and commitment	reduction and food security
Seed collection	Number of seed collectors, Governance, Finance, Communication, Operation Regulations, Entry barriers	pricing, promotion, vertical, horizontal and network primary focus, method of mitigating risk, presence of trust and commitment	quality, predictability, profit margin, local value addition
Seed processing	Number of seed processing industries in the area, processing capacity, demand and supply, Governance, Finance, Communication, Regulations, Entry barriers	pricing, promotion, vertical, horizontal and network internal quality control, financial focus, primary focus, method of mitigating risk, presence of trust and commitment	quality, predictability, profit margin, employment, local value addition
Seed distribution	Number of seed distributor in the area, demand and supply, Governance, Finance, Communication, Operation, Regulations, Entry barriers, Substitute products	pricing, promotion, vertical, horizontal and network, primary focus, method of mitigating risk, presence of trust and commitment	quality, predictability, profit margin, social inclusion, end user satisfaction, market share, contribution poverty reduction and food security

The analysis of conduct of maize seed value chain was made in the socio economic environment of western Nepal. The basic indicators selected for measurement of the conduct are: product, market, pricing, promotion, vertical, horizontal and network linkages, internal quality control, support mechanism, nature of business communication, primary focus of actors, method of mitigating risk, mechanism to prevent free loading, decision making, presence of trust and commitment, evaluation and reporting in this analysis.

Market performance is ultimate outcome of value chain activities and measured generally by proportion of profit margins and nonprofit benefits gained by different value chain streams and players within the stream. In case of maize seed value chain, performance in the territory refers to the extent to which value chain result in outcomes like regular and predictable availability of quality maize seed in affordable price, equitable proportion of profits, and reasonable cost of marketing, processing, transaction and reasonable proportion of the prices received by farmers and paid by end users. The most important measure of value chain performance is achievements against strategic goals. In case of maize seed value chain, the performance includes reduced food insecurity and poverty, enhanced social inclusion and promoted local value addition and employment. Following measures are used for value chain performance.

- **Added value:** The added value that results from industrial processes, is generally defined as the difference in exchange value between the physical inputs and outputs of a production process. This added exchange value is used as a proxy for added societal value, insomuch as it contributes to employment, government revenue and entrepreneurial incentive (European Union, 2006). The valuation of input should be in terms of current purchaser price, which is the full amount paid by the industry to obtain possession of the input goods, including the basic price, cost of transport, insurance and packaging, and all taxes and duties on the goods (United Nations, 1983). The value of a product increases as it proceeds along the value chain from raw material extraction to use by the customer. At the production level, the focus is on value added through physical or chemical modification of material inputs. Later in the chain, as the product approaches retail sale

to the end-user, value is added through e.g. logistical or administrative operations that increase the convenience and availability offered to the final consumer. Thus a given product, while perhaps physically unchanged, may have different values at different points in the value chain (Sphere 2014). Local value addition is measured as the difference between the value of the output and the value of primary and other inputs which have been used in value stream production process. The value added at different value streams is calculated by using following equation adapted from Sathre et al 2009.

$$V_{AT} = (V_{PP} + V_{BP}) - (V_{PI} + V_{OI})$$

Where,

V_{AT} = Total added value

V_{PP} = Value of primary product

V_{BP} = Value of by product

V_{PI} = Value of primary Inputs

V_{OI} = Value of other Inputs

- **Price spread:** Price spread is percentage share of seed producers over end buyer price and used as performance measure of value chain is calculated by using following equation. It is interpreted as higher the value of price spread higher efficiency of the value chain.

$$PS(\%) = \frac{Prp}{Ppb} * 100$$

where,

PS = Price spread (%)

Prp = Price received by the seed producer (Rs)

Ppb = Price paid by seed buyer (Rs)

- **Marketing efficiency:** Marketing efficiency is estimated by using SEPHARD equation and is an important measure of market efficiency. It is interpreted as higher the marketing efficiency index, the value chain said to be performing well and efficiently.

$$ME = \frac{V}{I} - 1$$

Where,

ME = Marketing efficiency (Index)

V = Value of the seed sold or buyer's price (NRs)

I = Total marketing cost (including margins) (NRs)

- **Gross Margin:** Gross margin derived by deducting total variable costs from total revenue for each value stream and interpreted during net margin distribution per kg of maize seed among the value streams in the maize seed value chain. The following equation was used to derive gross margin.

$$GM = TR - TVC$$

- **Return on investment:** Return on investment on per kg of seed is calculated to understand the strength of the value chain to attract investment in different value streams.

$$ROI(\%) = \frac{\text{Total Revenue} - \text{Total cost}}{\text{Total Cost}} * 100$$

Where,

ROI = Return on investment in percentage

Total revenue and cost is calculated per kg of seed during the given period of time, for farmers it is about ten month, for collectors it is about two month, for processors two month and for retailer it is about two month.

5. RESULT AND DISCUSSION

5.1. Maize sub sector in Nepal

Maize contributes 7% in national agriculture gross domestic product, covers 0.88 million ha of area and with 2.15 million mt production in Nepal. The average yield is 2.503 metric ton per hectare (MoAD, 2015). The average per year growth of area, production and productivity of maize during 1992 to 2015 is 0.7 %, 3% and 2% respectively (MoAD, 2015). The import of maize

increased with annual average of 16% during 2010 to 2015 which indicates domestic demand of maize is increasing sharply. The western Nepal (in this study mid and far western region) occupies 21 % of maize area and contributes 17% in national maize basket. The average yield in western Nepal is 2.02 metric ton per ha which 19% less than national average of 2.503 during 2015. This shows larger yield gap in attainable and existing one which is already large at national level (MoAD, 2015). Unavailability of improved variety quality seed among farming population is main constraint associated with others attributable to such yield gap.

There is huge gap between existing and attainable yield (estimated 5.7 mt/ha for improved varieties) which is largely contributed by unavailability of improved quality seed to the farming population. The annual domestic seed production of maize by private and public sector is 2330 mt which is 13% of total national maize seed requirement (MoAD, 2015).

The current Seed Replacement Rate (SRR) for maize is about 14.48% which is far below than recommended rate of 33 % for cross pollinated crops (SQCC, 2017). In Nepal more than 88% farmers use farm saved seeds (Gurung, 2011). This is basically due to lack of strong maize seed value chain with wide distribution network in the country. Private sector, public sector and community sector is involved in improved variety maize seed production processing and distribution in Nepal.

5.2. Maize seed value chains in western Nepal

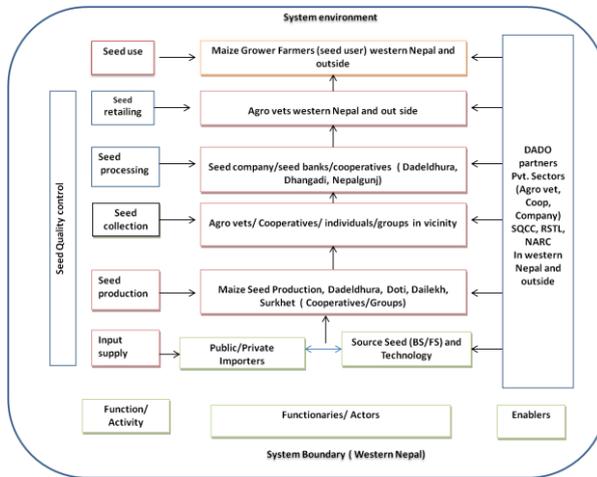


Figure 1: Maize seed value chain in western Nepal

Historically the maize seed value chain was led by government owned Agriculture Input Corporation (AIC) and later the responsibility was shifted to National Seed Company (NSC). During the early period, improved variety maize seed was distributed by district agriculture development offices as minikits to disseminate improved varieties and farmers use farm saved seed of such varieties. With the development of transportation and market facilities private and community sector led maize seed value chain evolved and integration of agro vets in seed retail market expanded the business in the country. The maize seed value chain in the study area is still weak and not developed well and is a kind of partnership among public community and private sector to increase food security and reduce poverty among farming population being promoted by different governmental and non governmental agencies. There are five types of maize seed value chain functioning in western Nepal.

1. Source seed suppliers - district agriculture development offices - seed producers cooperative/groups - seed

- producer farmers - seed producer cooperatives/groups - seed processing industries - retailers - maize grower farmers
2. Source seed suppliers - seed processors/cooperatives/groups - seed producer farmers - seed producer cooperatives/groups (process their own) - retailers - maize grower farmers
 3. Source seed suppliers - district agriculture development offices - seed producers cooperative/groups- seed producer farmers - seed collectors - seed processing industries – retailers - maize grower farmers
 4. Source seed suppliers (seed processors) - seed producer farmers - seed processing industries – retailers - maize grower farmers
 5. Maize seed importers - retailers - maize growers farmers

5.3. Characteristics of study area

Table 3: Characteristics of study area

Characteristics	status
Agro ecology	Tropical to temperate
Cropping pattern	Single maize and mixed cropping
Total area under maize ha	187714
Yield mt/ha	2.02
Seed producer farmers (seed production for selling)	1000
SRR	14
Seed processors	10
Number of agro vets	150
Seed processing facility	15 mt/ha

Source: Field survey 2015

6. STRUCTURE OF MAIZE SEED VALUE CHAIN

The fundamental structure of the maize seed value chain is constructed within the framework of source seed supplier - seed producer farmers - seed collectors - seed processors - seed retailers and end user farmers in which different soft systems

and functions are inbuilt in the given physical and policy environment. The structural indicators of maize seed value chain are grouped under three categories.

- a. **Demand, supply and concentration:** There are 1050 farmers involved in maize seed production, 20 seed collectors, 8 seed processors and 150 seed retailers are operating in western Nepal during 2015. The total maize seed demand estimated in 2015 in western Nepal is about 1020 mt and found increasing by 8% during last five years. The market share of domestic improved varieties is about 80% and hybrid is about 20%. The demand of hybrid is increasing at 12% per year between 2010 - 2014 which is about 6% for domestic improved varieties. This shows demand of hybrid maize varieties is increasing at higher rate in comparison to domestic improved varieties. The market demand of maize seed is largely distorted by irregular government and nongovernmental organization programs to support maize production through improved variety seed distribution among target population. Similarly the demand of source seed for improved maize seed production is increasing 20% which is also largely determined by agency supported seed production programs. Among 200 surveyed seed growers 30% of farmers sell their produce directly to processor, 40% sell to cooperative, and 30% sell to local seed collectors.

The market concentration measured by Herfindahl index is 0.44 for maize seed market in the area and indicates maize seed value chain is not concentrated. Similarly this index is calculated for source seed producer and seed processor which is 0.85 and 0.20 respectively. This shows source seed market is concentrated due to domination of government agency basically

Nepal Agriculture Research Council (NARC) in source seed production while seed processor market is not concentrated.

Table 4: Market concentration

Value chain category based on chain leader	Market share %	Si ²
Private seed processing company led	60	0.36
Cooperative or farmer group led	20	0.04
Maize seed importer led	20	0.04
Herfindahl index		0.44

b. Competition and substitute products: There is increasing number of seed processors and seed retailers but seed producer farmers are not increasing at the same rate. There is competition among processors for seed collection and find prominent retailers to promote their business. There are only six varieties available for improved seed production and processors can only compete in terms of price and quality. There are five imported hybrid varieties competing with domestic maize varieties, and the price of hybrid varieties is 300 % higher than locally produced improved varieties. New domestic as well as joint venture companies are incoming which can increase competition among seed value chains.

Lerner index is derived to understand market power of three maize seed value chains namely private Seed Company led, cooperative / group led and importer led and found none have monopolistic market power and are operated in a competitive market. Similarly Lerner Index is calculated for seed producer, collector, processor and retailer and for overall value chain in private seed company led value chain. The index value has also shown that no value stream carry monopolistic characteristic and overall value is operating in a competitive structure.

Table 5: Lerner Index

Value stream	Lerner index	Value chain leader	Lerner index
Seed producer	0.31	Private seed company	0.37
Collector	0.07	Cooperative /Farmer groups	0.42
Processor	0.08	Importer	0.28
Retailer	0.09		
Overall chain	0.37		

c. Local infrastructure: The eight seed processing firms and cooperatives have modern seed processing facility of their own. The total processing capacity per hour is 10 mt and storage capacity of 3000 mt. There is good network of roads, technology service centers and three seed testing laboratories are hosted by western Nepal. The processing firms lack their own farm to carry source seed production activities and varietal testing however some firms have limited field trail facilities.

d. Chain leader, decision making and communication: All the actors working for maize seed value chain abide the seed act, seed regulation of government and directives issued by seed quality control center at different times. The seed processing firms, cooperatives create forward and backward linkages and play role of chain leader. The source seed production decision is made by public sector agencies and processing firms also can make decisions on source seed production after getting license from government. The value chain leaders are processing firms/cooperatives that decide on variety, quality, requirement and production of maize seed in different clusters and arrange supply of source seed. Seed producer farmers cannot produce improved maize seed until they get source seed and are linked with processors. The communication among actors is mostly informal, weak and unscheduled. The information flow index

constructed through five point Likert scale among value chain actors is 0.37 which shows weak communication structure of maize seed value chain. Similarly the coordination index constructed is 0.42 which is also also indicates weak linkages. With these coordination, relationship and linkage characteristics, the structure of maize seed value chain is captive and directed in nature to some extent.

- e. **Barriers to entry:** There are legal and operational barriers for different actors to enter in the seed value chain. Seed producers need training on seed production and required amount of source seed supply to be involved in seed production business. Seed processors, foundation/source seed producers, seed retailers, seed inspectors, seed testing laboratories need license from the government authority to be involved in mentioned functions. The license fee is nominal but need to fulfill certain technical requirements specified for particular function (Table 6). These all can be considered minimal barriers to entry in seed value chain and no other informal, associational barriers are in place to limit entry. The government is facilitating to processors and other actors to be involved in seed business to overcome technology and investment barrier. Credit facility is available to seed producers, collectors, processors and retailers based on existing rules of financial institutions.

Table 6: Entry barriers in maize seed value chain

Actors	Legal barriers to entry
Seed inspectors, seed sampler, seed analyst	40% marks in written examination by SQCC
Seed retailer and processor	Compensation to seed user if any loss incurred due to poor quality seed and wrong information
Seed sampler	Follow seed sampling directives by SQCC
Seed entrepreneur	Seed production and management training to get license and basic infrastructures
Source seed producer	Own land or leased land, man power educational

	qualification of B.ScAg trained in seed production, seed storage facility
Hybrid seed producer	Own land or leased land, man power M.ScAg (Breeder) trained in seed production, seed storage facility
Seed testing lab	License after fulfilled basic requirement
Seed production and distribution	Only registered varieties with truthful label

f. Financial ownership and focus: All the actors linked in maize seed value chain have independent ownership and no cross investment or joint ownership in any stream of value addition was found during study. None of seed collectors or processing enterprises invested in seed production activities with farmers and vice versa. This shows the cooperative structure of value chain and some time it is fragmented when there is only spot market relationship between value streams. Thus no value addition stream found with joint ownership making all actors concerned and strategically oriented about protection, competition and growth of seed value chain. All individual actors and streams are found concerned about their own operations, profitability and gain.

Risk aversion and sharing mechanisms are most important in value chain functioning and its resilience. In maize seed value chain no clear mechanism of risk mitigation and aversion was found among actors. There is government mechanism for insurance in seed production but in other stream of value addition there is no insurance facility in operation. The primary focus of risk mitigation is short term and seeks to pass on to third parties.

7. VALUE CHAIN CONDUCT

The conduct of maize seed value chain stream is measured by using selected three categories of indicators and most of them are measured in five point Likert scale and index is formed for relative comparison.

- a. Product, pricing, promotion, market and technology:** All the value streams led by respective processing firms produce similar products as there are only six registered varieties popularly available for seed production in the region. There is no product diversification found between value streams except brand name, the varieties are the same. All the actors involved in maize seed value stream are free to set their price but there is some influence of seed processing companies located at Dadeldhura, Dhangadi and Nepalgunj. The price of source seed basically determined by NARC centers but in case of private seed companies, and cooperatives this is determined by their own. None of the seed processing firms and seed retailers found investing in seed market promotional activities. The maize seed value chain stream is using modern processing technology but production technology at farmer field is the same for all areas, low use of chemical fertilizers, low level of mechanization and traditional postharvest handling practices. Only 40% of seed producer farmers use chemical fertilizer and of which 80% is urea. This shows seed producer farmers not using balance dose of fertilizer to get higher yield. Similarly none of the seed producer farmers use machines in seed production process and most of the work is done by human labor. Around 65% of the produced seed is marketed within the region and

remaining is sold outside. However, this ratio fluctuates based on demand.

- b. Coordination linkage and trust:** Linkages are the business relationship among the value chain actors and trust is social capital embedded in such relationship. The coordination, relationship and linkage among actors is evolved in maize seed value chain to implement the decisions made, and proper implementation of rules, regulations, and directives to make consistent flow of improved variety quality maize seed in the market. The seed producer farmers are vertically coordinated, 80% of them sell their produce to the cooperative, collectors or processing firm with whom they have established relation and formed linkage. Only 20% farmers go outside the relational linkage to sell their produce. Similarly 60% of the seed retailers are loyal to the processor with whom they have relational linkage. Embedded trust refers level of confidence that value chain actors have that all actors will act as they say or are expected to act and their reliability. This also includes trust on fairness of rules, guidelines, official procedures, and dispute resolution. The level of embedded trust measured by Likert scale shows less than 0.45 which is low as business relations in value chain demand high level of trust among actors.

Horizontal Linkage: Ninety percent of improved variety maize seed producer farmers are organized in groups and cooperatives in all four study sites however there are farmers producing seed outside the groups. These farmers share information, labor and other materials during maize seed production in their respective locality. Similarly there is seed entrepreneurs association (SEAN) for the firms involved in seed

processing and retailing. There no similar association for seed producer farmers making linkage outside their territory.

Vertical Linkage: In all four study sites there is vertical linkage established from seed producers to seed collector, processors, retailers and government agencies.

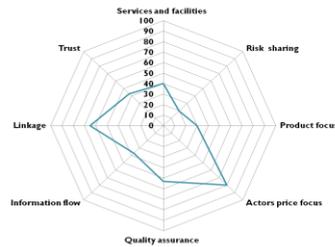


Figure 2: Maize seed value chain conduct

c. Embedded services

and facilities: These are the forward and backward services and facilities provided by value chain actors to each other being a member in value chain system. About 20% of collectors and 50% of seed processors provide source seed to the seed producer farmers, government agencies provide training on different aspect of seed production and support to processing enterprises. Generally in market conduct consumers or end users are entitled with certain facilities and services like warranty, repair and maintenance etc but in case of maize seed value chain no services are traced. There is no risk mitigation measures in practice associated with seed germination, poorer production and disease outbreak due to use of sold seed in the value chain system though is provision compensation in government directives.

8. VALUE CHAIN PERFORMANCE

The performance of maize seed value stream is measured in economic, local employment, poverty reduction, social inclusion and contribution to food security. Social inclusion, food security and poverty reduction are the important strategic goals for

government while promoting maize seed value chain. Food security is measured in terms of increased edible maize grain production through use of improved variety seed supplied by the value stream and income increased per head through involvement in maize seed production. Both dimensions contribute in poverty reduction through reduced expenditure and increased income.

- a. **Value added:** The value addition from farm gate to end user farmers level for selected value chain in survey region was 100.5%. The largest value addition of 45% is at farmer level which is due to maize seed grain production and associated activities. The second largest value addition of 24% is at retailer level followed by 19% at processor level. The lowest value addition is at collector level which is about 12%. The 100.05% of value addition at local level and its rational distribution among actors shows the better performance of maize seed value chain against normal maize grain production. In addition to value addition there is employment generation and use of local materials at local level. The ROI is 45% for farmer, 8% collectors, 9% processors and 10% for retailers for six months and it will be nearly double on annual basis. The total ROI for overall maize seed value chain is 58%. The per hectare value addition for maize seed production is calculated NRs 70571 which implies increased area under maize seed production increase value addition at regional level.

Net margin and its distribution: The average net margin is derived for each actor in the value stream by deducting total cost involved from final retail price. The total net margin NRs 20.9/kg in which farmers share is 53%, collectors share is 8%, processors share is 14% and retailers share is 26%. The net margin was analyzed for Dadeldhura and Doti maize seed value stream for 2010 to 2015 time series data were available through

cooperatives and these are linked with unique and Panchsakti seed processing firm in Dhangadi. In this average farmers share is 56.20%, collector's share 8.35, processers share is 16.87% and retailers share is 18.80%. There is decreasing trend of farmers share due to increasing number of seed producer farmers in the region, similarly increasing share of collectors is due to increased linkage outside the territory and retailers share is somewhat constant. When Gini coefficient is calculated for income distribution among seed producer farmer, collector, seed processor and retailer it is 0.75 which shows the higher level of income equality among farmers, collectors, processers and retailers.

Table 7: Value addition and net margin for actors

Actors	Costs			Revenues	Profits		Margins		ROI%
	Total cost NRs/kg	Added cost NRs/kg	% added cost	Price NRs/kg	Profit NRs/kg	% total profit	Gross margin NRs/kg	% Retail price	
Farmers	22		58.0	32	10	45.2	32	53.3	45
Collector	32	2.4	6.3	37	2.6	11.8	5	8.3	8
Processors	45.9	8.9	23.5	50	4.1	18.6	13	21.7	9
Retailers	54.6	4.6	12.1	60	5.4	24.4	10	16.7	10
Total cost	37.9		100.0			100.0		100	58
Gini coefficient									
Per ha value addition per year NRs (net value addition * seed yield)						70571			

Table 8: Value chain actors share in added value

Year	Value Chain Actor Share %				% Value addition
	Farmer	Collector	Processers	Retailer	
2010	70.79	4.42	8.84	15.92	119
2011	58.33	10	16.66	15	118
2012	58.48	11.7	23.39	6.43	178
2013	45.45	8.55	22.07	24.32	200
2014	51.16	7.44	16.28	25.12	186
2015	53.00	8.00	14.00	26.00	186
Average	56.20	8.35	16.87	18.80	164

Source: Field survey 2015, CSB Dadeldhura and Doti

- b. Price spread:** The difference between the net amount received by the seed producer and paid by the end user worked out as the percentage of seed buyer' price for the maize value stream. All marketing costs and margins of

the intermediaries were calculated as the percentage of buyer's price of the seed. The average price spread for 2015 was calculated 53.3% for overall maize seed value chain. How do the price spread was changing overtime is analyzed for community seed bank Amargadi Dadeldhura for which six years time series data were available and showed that price spread is declined over time 2011 to 2015 which indicates increasing number of seed growers in the same territory and market demand did not grow as per the seed production.

- c. Marketing cost and efficiency:** The marketing efficiency index for overall maize seed value chain was 0.58 which is low indicating poor marketing efficiency which was used proxy of value chain efficiency. While deriving marketing efficiency for each value stream it was 2.2, 6.4, 2.8, 5 for farmers, collectors, processors and retailers respectively. This shows collectors and retailers value stream is more efficient in comparison to farmers and processors.

Five years data were analyzed for community seed bank (CSB) Amargadi Dadeldhura to understand the trend over time which showed increased marketing cost and decreased efficiency of maize seed value chain over time this was due to unpredictable market demand due to different seed distributing programs by governmental and non governmental agencies.

Table 9: marketing cost and margin

Year	Producers Rate/kg	Buyers Rate/kg	MC	ME	PS %
2010	24	35	11	2.2	69
2011	24	35	11	2.2	69
2012	28	45	17	1.6	62
2013	30	50	20	1.5	60
2014	32	55	23	1.4	58
2015	32	60	28	1.1	53

Source survey 2015 (CSB, Dadeldhura)

d. Poverty reduction: The recent Nepal Living Standard Survey (NLSS) 2010/11 shows that 25 percent of Nepali people are below the absolute poverty line. The official monetary poverty line in local prices is NRs 19,261 (CBS, 2011) per person per year. The most of the seed producers are small holders and residing in poverty prone areas. The increased income per head due to involvement in maize seed production has contributed in poverty reduction to some extent. The total 200 household with a population of 1183 received NRs 4600/ household per year. This is the production part there is employment generation along the value chain largely contributed in poverty reduction. Farmers involved in seed production produced 85 mt of improved seed which is about NRs 51 million at end user price. This value addition is spread among the chain actors and has largely contributed in poverty reduction. The Gini coefficient for income distribution from maize seed production shows there is inequality that is more concentrated toward small and marginal farmers which carries larger implication in poverty reduction. Based on annual household income category Gini coefficient also shows inequality favoring toward low income groups that also supports pro poor performance of maize seed value chain.

Table 10: Gini index for seed producer farmers

Category Ropni	Number	Proportion X	Income NRs	Proportion Y	Cumulative proportion	X*Y
>20	5	0.03	61200	0.02	0.02	0.0005
>14 to <= 20	10	0.05	120000	0.04	0.06	0.0021
>10 to <=14	59	0.30	875800	0.31	0.37	0.0908
>5 to <=10	80	0.40	1174700	0.41	0.78	0.1651
<=5	46	0.23	613500	0.22	1.00	0.26
Total	200		2845200		GI	0.74
GI	0.74					

Source: Field survey 2015

- e. Food security:** Maize seed value chain has contributed in local and regional food security through two ways; first one is food security through income security among seed producers, collectors, processors, retailers and others able to get employment along the value chain, secondly increased maize productivity among maize growers through use of improved variety quality seed. The survey result has shown that there is average 17% yield increase among maize producers. This has increased 17 % yield increase over 2.2 mt/ha in 3835 ha of maize area. The maize seed supply chain increased 1434 mt additional maize in regional granary. Furthermore maize is staple crop among mid hill small farmers operating in rainfed condition where food security is of prime focus maize seed value chain has increased income and production for improved food security.
- f. Seed quality and end user satisfaction :** The survey results has shown that only 60 percent of the seed users are fully satisfied with quality and performance of seed and the remaining are waiting for suitable varietal options for their locality. Their dissatisfaction is basically associated with heavy nutrient uptake, difficulty in stalk removal, taste and long duration of the crop in comparison to their local varieties.

9. CONCLUSION AND RECOMMENDATIONS

The SCP framework can be a useful tool for the analysis of value chains. The indicators used for analysis of structure of maize seed value chain showed seed value chain and its value streams are operating in an open competitive market, without any concentration, non monopolistic power of actors, without any informal entry barriers except some technical and legal

barriers set by the government. The source seed supply stream is found concentrated due to domination of NARC in source seed production and supply. There is weak communication, coordination and linkage structure, and chain leaders are mostly cooperatives and processing industries. There is no joint ownership and investment in the value streams to create more coordinated structure of the chain. The demand and supply of maize seed is inconsistent and unpredictable due to different erratic interventions by different agencies. With these attributes maize seed value chain in western Nepal is cooperative and captive in structure and weak in competition with internationally integrated hybrid seed value chains. In the conduct aspect maize seed value chain is operating in traditional technology except in processing, low level of promotional activities by value streams, poor horizontal coordination in seed production stream but with better vertical integration, low level of trust among value chain actors and product diversification. The pricing is largely influenced by different agency programs focusing on maize production through improved variety quality seed distribution. There are no embedded services or facilities provided to different actors in the value chain. The maize seed value chain is performing well with respect to its objective of food security, local employment, poverty reduction, and local value addition. There is better marketing efficiency, return on investment and equitable distribution of net margins among actors. In spite of these positive attributes SCP analysis has shown that the maize seed value chain needs to promote more coordinated structure, better communication, wider participation of private sector in source seed production and promotion, more investment on product diversification, coordination, embedded services and improved technology for seed production to make it competitive and resilient in future. Similarly maize seed production and

grain production intervention need to be designed carefully so that there is least distortion in seed market.

ACKNOWLEDGMENT

CIMMYT International South Asia Regional Office Kathmandu Nepal for provided financial support for this study and we are thankful to them. Similarly we are thankful to seed producer farmers, seed collectors, traders, seed processors, retailers and District Agriculture Development Offices and staffs of the study area who supported one or other way during field study.

REFERENCES

1. Bolwig, S., Ponte, S., Toit, A., Riisgaard, L., and Halberg, N. (2010). Integrating poverty and environmental concerns into value-chain analysis: a conceptual framework. *Development Policy Review*, 28(2): 173-194.
2. Value Chain Management Center of George Morris Center (2012). Characterizing the determinants of successful value chains. A paper prepared for the Canadian Agri-Food Policy Institute. [available www.capi-icpa.ca]
3. Central Bureau of Statistics (2011). Nepal Living Standards Survey 2010/11. Kathmandu: Central Bureau of Statistics.
4. Coe, N., Dicken, P., and Hess, M. (2008). Global production networks: realizing the potential. *Journal of Economic Geography* 8(3): 271-295.
5. De Figueirêdo, J.H.S., Meuwissen, M.P.M., and Oude Lansink, A.G.J.M. (2014). Integrating structure, conduct and performance into value chain analysis. *Journal on Chain and Network Science* 14(1): 21-30.

6. Foreign Investment Advisory Service (FIAS), 2007. Moving towards competitiveness: a value chain approach. The World Bank Group, Washington, DC, USA.
7. Government of Nepal, Import Directory 2010-2014 [retrieved 25 July 2016. www.tepc.gov.np]
8. Gereffi, G., Humphrey, J. and Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy* 12 (1): 78–104.
9. Gulati, R., Nohria, N., and Zaheer, A. (2000). Strategic networks. *Strategic Management Journal*, 21: 203-215.
10. Humphrey, J., and Schmitz, H. (2000). Governance and upgrading: linking industrial cluster and global value chain research. IDS Working Paper No. 120. Institute of Development Studies/University of Sussex, Brighton, UK.
11. Krishnan, M., and Narayanakumar, R. (2010). Structure, Conduct and Performance of Value Chain in Seaweed Farming in India. *The Journal of Agricultural Economics Research Review*, 23: 505-514.
12. Kaplinsky, R., and Morris, M. (2001). A handbook for value chain research. Prepared for the International Development Research Centre (IDRC). [Available at: <http://www.globalvaluechains.org/docs/VchNov01.pdf>. on 10 October, 2007].
13. Kula, O., Downing, J., and Field, M. (2006). Value chain program to integrate competitiveness, economic growth and poverty reduction. *Small Enterprise Development*, 17(2): 23-35.
14. Lastres, H.M., and Cassiolato, J.E. (2005). Innovation systems and local productive arrangements: new strategies to promote the generation, acquisition and diffusion of knowledge. *Journal of Innovation: Management, Policy & Practice*, 7(2/3): 172-187.
15. Lazzarini, S.G., Chaddad F.R., and Cook, M.L. (2001). Integrating supply chain and network analyses: the study

- of net chains. *Journal on Chain and Network Science*, 1(1): 7-22.
16. Morrison, A., Pietrobelli, C., and Rabellotti, R. (2008). Global value chains and technological capabilities: a framework to study learning and innovation in developing countries. *Oxford Development Studies*, 36(1): 39-58.
 17. Nadvi, K., (2004). Globalization and poverty: how can global value chain research inform the policy debate? *IDS Bulletin*, 35(1): 1-13.
 18. Patrick, N. M., Henrietta, U.U., Fani, D.R., and Donald, D., (2016). Structure, Conduct and Performance of Sesame Farmers in Benue State, Nigeria. *International Journal of Humanities Social Sciences and Education* 3 (6): 31-35.
 19. Ruben, R., & Zuniga, G. (2011). How standards compete: comparative impact of coffee certification schemes in Northern Nicaragua. *Supply Chain Management International Journal*, 16(2), 98–109.
 20. Sathre, R., and Gustavsson L. (2009). Process-based analysis of added value in forest product industries. *Journal of Forest Policy and Economics* 11(1): 65-75.
 21. Trienekens J. H. (2011). Agricultural Value Chains in Developing Countries A Framework for Analysis *International Food and Agribusiness Management Review*, 14(2): 51-83.
 22. UNIDO, 2009. Agro-value chain analysis and development the UNIDO approach. A staff working paper united nations industrial development organization Vienna
 23. Van Dijk, M.P., and Trienekens, J.H. (2012). Global value chains: an overview of the issues and concepts. In: Van Dijk, M.P. and J.H. Trienekens (eds.) *Global value chains: linking local producers from developing countries*

to international markets. Amsterdam University Press, Amsterdam, the Netherlands, 9-30.

24. Webber, C.M., and Labaste, P. (2010). Building competitiveness in Africa's agriculture: a guide to value chain concepts and applications. The World Bank, Washington, DC, USA. [Available at: <http://siteresources.worldbank.org/INTARD/Resources/>]

AUTHORS' PROFILE

RAJENDRA PRASAD MISHRA is PhD fellow at Agriculture and Forestry University, Department of Agriculture Economics Rampur Chitwan Nepal. He has more than 22 years of work experience in the field of agriculture extension, project planning, implementation and evaluation. He is Joint Secretary at Ministry of Agriculture Development Singh Durbar Kathmandu Nepal and currently working as Project Director Irrigation and Water Resource Management Project DOA component (IWRMP). Email: [/rajendra_mishra2004@yahoo.com](mailto:rajendra_mishra2004@yahoo.com)

GANESH RAJ JOSHI holds a PhD in Agricultural Economics with specialization in Resource Economics and Policy. He served as a Secretary in Environment, Forestry, Tourism and Agriculture Ministries of the Government of Nepal. He has published research and review papers on environment and climate change, agriculture, forestry and natural resources management and governance. Currently, he is working as a Commissioner in the Commission for the Investigation of Abuse of Authority, Nepal. He is also an Adjunct Professor in the Agriculture and Forestry University of Nepal. Email: grjoshi20@yahoo.com

Prof. JAY PRAKASH DUTTA is an agriculture economist with a specialization in farm management. He is currently dean at faculty of agriculture, University of Agriculture and Forestry. He has published a number of articles in national and international journals and supervised more than 50 MSc students.