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Public Private Cooperative Partnerships for Scaling Commercial Maize Production in Nepal: Linking Innovations With Policy

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Abstract

The Agriculture Development Strategy of the Government of Nepal (2015-2035) has identified maize as one of the key commodities for commercialization. Maize constitutes at least 50% of the total ingredients in poultry feed, with approximately 3,000 tons of poultry feed consumed daily in Nepal. However, while the demand for feed is increasing at about 10.0% per annum, maize production is only growing at 2.5% per annum. The low productivity with inferior grain quality and a lack of value chain coordination mechanisms starting from inputs (seeds) to output (grains) have hindered the commercialization of the domestic maize sector. Because of the inefficient market mechanism and competitive market structure, farmers are not able to pursue commercial maize production.

To address this issue, action research on the value chain was conducted by the International Maize and Wheat Improvement Centre (CIMMYT), focusing mainly on Sudurpaschim and Lumbini provinces, to implement the maize commercialization model (MCM) between 2020 and 2022. Results demonstrate that public-private partnership approach can increase maize production, improve farm gate prices and farmers' incomes, improve value chain coordination; improve access to services to farmers and enhance information flow among stakeholders.

The study recommends that policies aimed to streamline commercial maize production should adopt a value chain approach, with a focus on chain upgrading and governance and promote coordination among actors to scale up commercial maize production throughout the maize-growing areas of Nepal.

Keywords: Maize, Commercialization, Value Chain, Partnership, Policy

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1. Introduction

Maize is the leading cereal in terms of production, with 1,210 million tons produced on 205 million hectares (M ha) globally, with a productivity of 5.8t/ha (FAOSTAT, 2021). It is one of the three main types of cereal that feed the world (Shiferaw *et al.*, 2011). Beside its staple food use, maize makes a significant contribution to animal feed (especially poultry), as well as biofuel and industrial uses (Hellin & Erenstein, 2009). Population growth, changing diets and a rapidly growing poultry sector are contributing to a sharp increase in maize demand (Erenstein, 2010). In Nepal, maize is the second most important crop after rice in terms of area, production and yield (Subedi *et al.*, 2017; MOAD, 2020). Maize occupies 43% of cereal's area and contributes 53% of its production. The total area, production and yield of improved maize in Nepal have been reported at 0.98 M ha, 2.99 million tons, and 3t/ha, respectively (FAOSTAT, 2021). Mid-hill represent more than 70% of the area and production, whereas high hills occupy 20% of the area and 10% of the total production. The Terai occupies 10% area, contributing 20% to national maize production (Gurung *et al.*, 2011). In Nepal, maize is grown in three seasons: summer, spring and winter with 74% (mainly in mid-hills), 14% and 12% coverage respectively (Gurung *et al.*, 2011). In 2019/20, Nepal produced 2.99 million tons of maize, against a national requirement estimated to be 3.59 million tons (21% food, 60% household managed livestock, 19% industrial livestock), with the deficit being fulfilled by imports of about 0.6 million tons worth of US$ 138.97 million) (MoALD, 2020; TEPC, 2023). While about 86% of maize production in the hills is used for human consumption, about 80% of the production in terai is used for poultry and animal feed (Gurung *et al.*, 2011).

The Agriculture Development Strategy (ADS), which is the flagship policy of the GoN aims to commercialize the agriculture sector in Nepal to move from subsistence to commercial production. The GoN and the Prime Minister Agriculture Modernization Project (PMAMP) had launched various programs such as the maize mission program, mega maize program, and maize block program etc., to support production, mechanization, irrigation, subsidised loan, crop insurance, etc., in the country to promote maize production. Under PMAMP, zones (500ha) and super zones (1000ha) are administered by the federal government whereas blocks (50ha) and pockets (10ha) are managed by the provincial government and local level, respectively. The Provincial governments have set up Agriculture Knowledge Centres (AKCs) and Integrated Agriculture and Livestock Development Offices (IALDO) to provide agriculture extension and business development services in the agriculture sector, including maize, in their command area. However, these structural units face challenges in designing and implementing activities due to limited human resources, unclear communication strategies with the Local Levels and the federal government,

lack of institutional memory/data developed before federalism, and poor linkages with the private sector. Although various research and development organizations are working in the maize sub-sector, there is a huge yield gap between research stations and farmers' fields, and the value chain remains poorly organized. These challenges demand an approach to maize sector promotion and competitiveness that acknowledges the vital role of the private, public and cooperative sectors and better implementation of the policy priorities.

1.1 Rationale-Policy challenges in Maize Production

The commercialization of the domestic maize sector in Nepal faces several policy challenges, including low productivity with inferior grain quality and a lack of value chain coordination mechanisms starting from inputs (seeds) to output grains (grains). The generic maize VC map is depicted in Fig 1. However, there is a lack of estimation of the amount of maize used in household and unorganized feed industries.

According to CIMMYT (2018), only 14% of households in Nepal sold maize. This is primarily due to small size and fragmented farms, which make it difficult for farmers to realize economies of scale and forces them to sell produce in local markets where prices are low. Furthermore, the maize yield of 1.96 t/ha in Nepal is lower than the national average yield of maize in 2016, which was of 2.43 t/ha (CIMMYT, 2018). The total annual demand for maize seed in Nepal is 19,552t, but the seed replacement rate (SRR) is only 15.3% (SQCC, 2021).

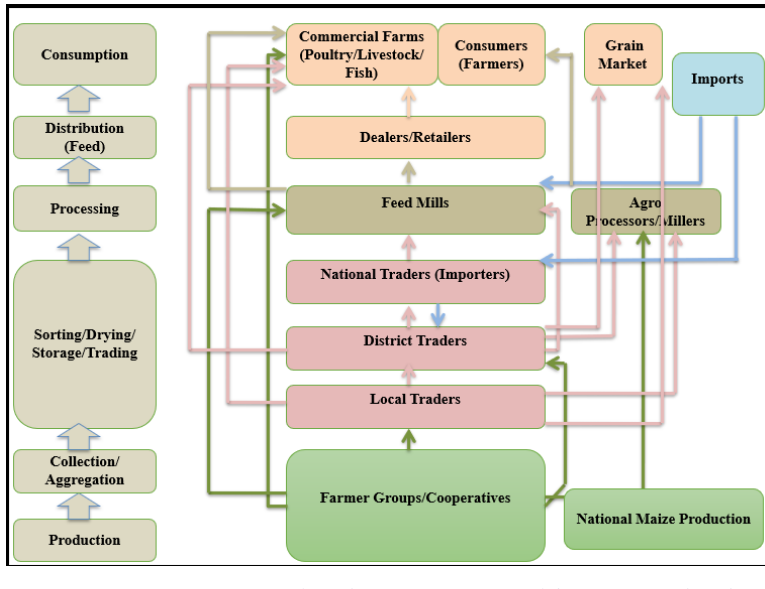

Fig 1: A generic maize value chain map in Nepal (Source: Authors)

The unavailability of competitive hybrid cultivars within the country and underdeveloped seed industries has resulted in a dependency on imported hybrid maize seeds every year (Gurung et al., 2011). Farmers and agro-dealers have limited access to information on new varieties and their traits. Only 24% of the farmers in Nepal are reached by formal extension services (ADS, 2014) and private-sector agricultural inputs and service providers are almost non-existent in remote rural areas (Gurung *et al.,* 2011). Producers also face major problems with postharvest handling for drying maize as maize must be dried to at least 14% in order to be stored safely for any period of time (Ransom, 2001). Additionally, the annual requirement of maize for formal sector poultry feed is 0.54 million tons and in 2021/22, the annual value of maize import for feed was estimated at US$ 126 million (TEPC, 2023). Due to the lack of an efficient market mechanism and competitive market structure, farmers are not in a position to benefit from increased production (Koirala, 2002). Small producers are unable to market their produce individually due to small volumes and long distances, resulting in selling produce in local markets where the prices are low.

1.2 Objectives of the paper

The feed sector is driving commercial maize markets in Nepal, and there is tremendous scope to link smallholder farmers to commercial feed markets. The objective of this paper is to share the results obtained from action research on public-private-cooperative partnerships for commercial spring maize production at three levels : value chain coordination, production and post-harvest, and market linkages.

2. Research Methodology

The assessment started with a literature review (Brown & Ashman,1996; Bouwen & Taillieu, 2004; Warner, 2006; Schut et al., 2017; Choudary et al., 2018) and key informant interviews with stakeholders within the United States Agency for International Development (USAID) delineated Zones of Influence (ZOI) covering the terai areas of Sudurpaschim, Karnali, Bagmati and Lumbini province. These included interviews with key personnel from seed companies, feed mills, provincial ministries of Agriculture, AKCs and IALDO, farmers cooperatives, and traders to assess the potential of spring maize in the ZoI in March 2021. It was found that the rice- wheat cropping pattern was the dominant cropping system in the study districts covering about 30% of the total rice production land. Maize was only cultivated at a small scale mainly for household consumption. In addition to wheat, farmers grew cash crops such as lentil, potato and rapeseed after rice. Thereafter, >80% the land remained fallow for about 70 days (after wheat) to 130 days (after potato & rapeseed). The commercial maize production program harnessed the potential of spring maize

in this fallow land estimated at 0.2 million ha in the western Terai region of Nepal (MoALD, 2021) and selected Banke, Bardiya, and Kailali for the action research. Thereafter using a framework for action research on value chains following Riisgard et al., (2010), the study assessed the structure, functioning and governance of maize value chains in Banke, Bardiya and Kailali and identified major challenges related to value chain coordination, production and post-harvest and marketing and key policy issues and risks in the maize value chain. To share these findings and to initiate action research to upgrade the maize value chains a multi stakeholder platform approach was adopted following the methodology suggested by Schut et al. (2017).

Three maize commercial networks (MCN) comprising the above-mentioned stakeholders were formed in the three identified districts between April – June 2021. All of these networks were coordinated by leaders from local farmers cooperatives and government agencies played the advisory roles and USAIDs Nepal Seed and Fertilizer (NSAF) project provided technical support. The VC assessment findings were compiled and shared with the stakeholders by organizing 4 MCN meetings in each district and actions and strategies to promote commercial maize production and improve domestic maize value chains in the three districts through the maize commercialization model (MCM) was co-created (Table A1, annex 1). A cropping calendar for maize was developed and activities were planned with roles of respective MCN members. These activities were focused on production, marketing and coordination of public sector programmes. A national level workshop was organized in March 2022 together with the Department of Agriculture (DoA) to share the learnings from the action research from 2021 and to review key policy and technical support required for scaling MCM to all potential spring and winter maize growing regions of Nepal.

Data on yield, prices, incomes, value chain coordination and learnings were collected through semi-structured interviews (30 farmers), crop cuts (56), focused group discussions with farmers groups, key informant interviews with traders (15) and feed mills (4) and GoN officials (5) between August 2021-2022. Data was analyzed using descriptive statistics and the process, functional and market upgrading of the maize value chains were assessed based on field observations and information received from stakeholders. Key policy issues were identified based on consultations with federal, provincial and local level departments and units.

3. Results and Discussion

This section provides the results obtained from the action research for improving the maize VC at three levels viz., value chain coordination, production and post-harvest and marketing.

3.1 Policies on value chain coordination:

The MCN meetings revealed several challenges for maize commercialization. These include a) limited knowledge about seed varieties, b) lack of seed market promotion, c) poor extension services to promote improved crop management practices; soil fertility management, irrigation and pest (fall armyworm) management, d) lack of efficient mechanism or framework to align central, provincial and local governments' efforts for maize commercialization, e) lack of suitable models to facilitate access to finance and insurance to small holder farmers, f) slow and inefficient service delivery and insufficient private sector engagement in extension. The MCN provided the platform for all the maize value chain actors and stakeholders to address these challenges and streamline their role and delivery of services to support commercial maize production. Realizing the potential, 15 Local Levels (Bardiya- Badhaiyatal, Bansgadhi, Guleriya, Madhuwan; Banke- Raptisonari, Dudhuwa; Kailali- Gauriganga, Lamkichuha, Kailari) including AKC Banke and Kailali and IALDO, Bardiya invested US$ 2.37 million for maize commercialization in 2022 (Authors own calculations from provincial and local governments funding to MCM).These streamlined GON investments in the MCM sites for improved seeds, mechanization, fall armyworm control, and irrigation boosted large scale maize production in spring season which became a new cropping window in the research sites. Moreover, Lumbini province government announced area-based incentive @ NPR 6,000/ha for farmers and NPR 300,000 per 50ha for cooperatives. The MCM mobilized government technicians and lead farmers through training of the trainer's program to provide extension services on crop and soil management. USAID's NSAF co-financing supported producers, traders and processors to acquire new tools, equipment and facilities for post-harvest management. Traders and feed mills shared market standards and prices and were able to procure locally produced maize in bulk thus reducing imports. Moreover, the Government agencies such as the Local Level (Palika)s, AKCs and IALDO) found the maize commercial network useful for implementing their programs in a fast-track, focused and coherent manner.

3.2 Production & Post Harvest

A total of 2,260 households (HH) associated with 65 cooperatives from 19 Local Level (Palika)s of Banke, Bardiya and Kailali districts received information on best management practices of maize crops and marketing. These HHs planted maize in 547.8ha and produced 3,232t maize grain. Due to improved connection with farmers seed companies were able to sell newly developed Nepali hybrid variety maize seed (Rampur Hybrid-10) in the MCM areas. Seed companies tested and demonstrated varietal performance of existing and pipeline varieties in farmers fields and increased

investment in hybrid maize seed production. Farmers also got information and purchased new varieties of hybrid maize such as Kanchan (early variety, single cross sold by Kanchenjunga Seed Company), Rajkumar (medium duration variety, single cross sold by Bioseed Company), and Subarna (medium duration variety, single cross sold by Bioseed company).

Due to training provided farmers practiced line sowing across the MCM sites. Farmers applied a full dose of DAP and MOP during planting as basal application. For urea, 37% of farmers did single top dressing and 63% did two top dressing in equal splits. Weeding, irrigation, and disease and pest management were performed by the farmers as per the recommendations. The average maize yield recorded in farmer's fields was 5.1 t/ha in 2021 and 5.7 t/ha in 2022. This is much higher than the national average of 2.5t/ha.

Table 1. Comparative assessment of MCM activities in 2021 and 2022.

Parameters	2021	2022
Districts	Banke and Bardiya	Banke, Bardiya and Kailali
Local Level (Palika)	5	19
Maize cooperatives	9	65
Maize growers	872	2260
Maize area	278	547.8
Crop yield	5.5	5.9
Total production (t)	1,390	3,232
Production value (US$)	290,039	890,708
Directly sales to feed mill (t)	30	521
Farm gate maize price (Rs/kg)	26.5 (20 to 29)	35 (33 to 37)
Household income (US$)	333	367

Note: 1 US $ = Rs. 127

Based on the potential of spring maize, a farmer's cooperative and a trader, built storage centers with the capacity of 3100t. The provincial Government provided 75% cost (NPR 2.6 million) for the first storage to the cooperative. A grain trader in Bardiya built a new storage facility with the capacity of 3,000t with a total cost of NPR 15 million that was fully funded by the proprietor.

Comparative assessment of MCM activities (maize grower farmers, yield, total production, maize grain price and household income etc.) is presented in Table 1. In 2022, the total commercial maize transaction in the MCM site was US$ 0.9 million, and average household income from maize farming was US$ 367 which is 10.2% higher than in 2021 (US$ 333).

3.3 Marketing and Access to Services

Maize farmers realized increased yield, higher output price, less price variation and higher income while participating in the MCM. In 2022 households received NPR 35/kg for maize which was Rs 3 to 4/kg more than previous season. Traders opined that they benefited from the gained knowledge about post-harvest management of maize grain, increased network with farmers cooperatives, and increased availability of grain with better quality. Feed mills remarked that locally produced maize grain was as per international standard (<14% moisture) and they were optimistic about potential to produce maize for feed in Nepal.

New forms of market coordination emerged as a result of the action research that also linked farmers with end markets. In 2021, a feed mill purchased 30t maize grain directly from two maize producing cooperatives which increased to 521t by three feed mills in 2022. By selling to feed mills, maize grower farmers received Rs. 2 to 3/kg higher price than from selling to the local traders while cooperatives were also able to earn Rs. 2 to 3/kg from maize trading. To encourage procurement from cooperatives, feed mills sent vehicles to collect maize grain if there was a guarantee of 5t maize availability in a location. Several bundled services such as reduced payment time of 15 days for cooperatives, setting up small scale weighing machines for smaller farmers (up to 50kg) and free of cost veterinary advisory services to maize cooperatives farmers for livestock and poultry care, were provided by feed mills. Local traders also launched new services such as collecting grains from farms, advance payments and provision of sacks for packaging. The results show that market coordination has the power to change often discriminatory market practices with a win-win situation for all actors. Previous studies (Brown & Ashman,1996; Bouwen & Taillieu, 2004; Warner, 2006) have also shown the benefits of multi-stakeholders' platform in trust building and technology dissemination.

4. Conclusions and Policy Recommendations

Based on the findings of this action research, it can be concluded that the Maize Commercial Model (MCM) has resulted in higher maize production, increased maize prices, improved maize quality, and enhanced networks and knowledge among

the actors and stakeholders, leading to better farmer-market linkages. New forms of market engagement by farmers' cooperatives and local traders have emerged, promoting transparency and mutual benefits from transactions. The MCM has the potential to increase the coverage of maize areas, indicating its potential for scaling to other maize production regions. Some of the main policy recommendations include:

- **Coordination**: The GON should utilize and expand the MCM platform to channel its maize development programs and funds to reach the target farmers. The ADS envisions commercial maize production in Nepal, and the MCM is a model that can be replicated to achieve this vision.
- **Seed Development**: Develop and launch new and competitive hybrids suitable for various agroecological regions of Nepal. Nepal needs early-maturity maize hybrids that can fit in the fallow period between wheat, rapeseed and potato and rice.
- **Extension and services**: Commercial maize production requires access to inputs and services. This entails mobilizing all service providers such as agro-dealers, machinery hiring centres, fertilizer distribution agencies, farm equipment and post-harvest technologies in the commercial zones, and facilitate the delivery of their services to farmers. There is a need to design suitable digital approaches to strengthen horizontal coordination and information exchange among maize farmers.
- **PHT and Drying**: Increase access to post-harvest processing equipment and technologies through custom hiring facilities, rural enterprises and cooperatives. Develop a maize storage directive which could facilitate to implementation of insurance while storing maize.
- **Markets**: Facilitate purchase agreements between farmer groups and feed mills. Develop maize market yards with large storage facilities to maintain grain quality. Develop maize quality grades and corresponding prices for transparency. Educate local traders on maize quality management and make available finance for access to capital for procuring maize.
- **Scaling Commercial Maize Production**: Follow a public-private partnership approach through multi-stakeholder platforms such as the Maize Commercial Networks to scale commercial maize production for meeting domestic demand.

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Authors Contribution

Dyutiman Choudhary: Conceiving ideas; formulation of overarching research goals and aims; Development or design of methodology; Application of statistical, mathematical, computational, or other formal; Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection; Report initial draft/review/ final draft polishing;

Narayan Khanal: Conceiving ideas; formulation of overarching research goals and aims; Development or design of methodology; Application of statistical, mathematical, computational, or other formal; Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection; Report initial draft/review/ final draft polishing

Naba Raj Pandit: Development or design of methodology; Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection; Report initial draft/review/ final draft polishing;

Dilli K.C: Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection; Provision of study materials, reagents, materials, instrumentation, computing resources; Report initial draft/review/ final draft polishing;

Krishna Prasad Timsina: Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection; Provision of study materials, reagents, materials, instrumentation, computing resources; Report initial draft/review/ final draft polishing;

Conflict of Interest

The authors declare no conflict of interest.

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Annex

Table A1. Issues, potential solution measures and stakeholders for strengthening maize value chain.

SN	Issues	Potential solution measures	Key stakeholders
1	Lack/limited seeds of farmers' preferred maize seed in the communities	Support local seed companies for developing suitable hybrids/ increased access to registered hybrid maize seed	Seed companies, importers, SEAN members, development partners
2	Land fragmentation-difficult in using machinery and irrigate crop fields	Land consolidation, implement land bank concept	Central, province and local government
3	Limited human resource (limited number of trained human resource at Local Level (Palika), poor service delivery from extension agencies	Use of ICT, development of district level maize commercial network	Local Level (Palika), AKC, PMAMP, development partners
4	Limited irrigation facility/dried water sources, no water release from irrigation project during the spring season	Mapping of irrigated area, strengthen linkage between maize grower cooperatives with linking with irrigation projects, establish additional irrigation facilities/ structures in PPP mode	AKC, Local Level (Palika), irrigation projects, development projects
5	Lack/Limited availability of chemical fertilizers	Promotion of community-based compost production and utilization schemes, use of digital soil map for rational distribution/ utilization of available chemical fertilizer, increase awareness on 4R principles to promote integrated soil fertility management	Cooperatives, Local Level (Palika), AKC, development projects

SN	Issues	Potential solution measures	Key stakeholders
6	Limited technical know-how on machinery calibration and use	Custom hiring center established by PMAMP, expertise of NARC and private actor (e.g. NAMEA, DKAM, agri-solution) could be utilised	PMAMP, NAMEA, AKC/ IALDO, development partners
7	Limited aggregation/ storage facility at farers level and lack of storage directive	Cooperative could utilize partial grants provisioned by national planning commission, PMAMP, AKC/IALDO, Local Level (Palika); feed mills could be motivated to build up/hire storage facility at maize production pockets	PMAMP, AKC/ IALDO, Local Level (Palika)
8	Limited knowledge and facilities of post-harvest and drying	Local innovations in drying (use of fan, plastic tunnel), testing and promotion of maize dryers	PMAMP, NARC, AKC, IALDO, Local Level (Palika)
9	Difficulty in accessing subsidized/ concessional loan to farmers due to collateral and complex and long documentation process	Possibility to access loan in 2 to 3% interest rate from province government; crop insurance available in free of cost to farmers; ICT could support on fast-track service delivery	MOLMAC/ MoALM, Bank, AKC/IALDO, Local Level (Palika), development partners
10	Crop damage by wild animals (wild boar, monkey)	Fencing of the maize production fields, siren, community mobilization	Local Level (Palika), National Park, development partners

Authors Bio

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Dr. Dilli KC, is working as Project Manager in the Sustainable Agrifood Systems program of CIMMYT. He holds a PhD degree in Agriculture Economics from the University of the Philippines. Over the last 44 years, he worked with various capacity in many organizations major including Ministry of Agriculture, Government of Nepal, international agri. research organizations (IRRI, CIMMYT) and international

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