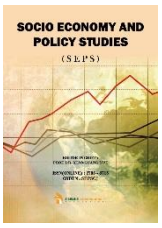
ZIBELINE INTERNATIONAL™ PUBLISHING

ISSN: 2785-8715 (Online)
CODEN: SEPSCJ

Socio Economy and Policy Studies (SEPS)

DOI: http://doi.org/10.26480/seps.02.2024.128.137




RESEARCH ARTICLE

# ROLE OF PRIME-MINISTER AGRICULTURE MODERNIZATION PROJECT ON MAIZE VALUE CHAIN DEVELOPMENT AND TECHNOLOGY ADOPTION (A CASE STUDY OF PARBAT DISTRICT)

**Saujan Acharya[a*], Shivnandan Kumar Mandal[a], Poojan Adhikari[a], Ashmita Upadhaya[b], Shubha Sigdel[a], Kabita Bhat[a], Prajwol Shrestha[a]**

*[a]Agriculture and Forestry University, Chitwan, Nepal*
*[b]Tribhuwan University, Pokhara, Nepal*
**Corresponding Author Email: Saujanacharya55@gmail.com*



**ARTICLE DETAILS**

***Article History:***

Received 23 May 2024
Revised 15 June 2024
Accepted 11 July 2024
Available online 08 October 2024

**ABSTRACT**

Maize is a major crop ranked as second highest staple crop after rice in Nepal and it shares 6.88% of AGDP in the country as of 2020. The crop is grown in most parts of the country and is focused on by Prime Minister Agriculture Modernization Project (PMAMP) to increase its production and productivity, in which, Parbat district is developed as a zone for maize crops. This research is proposed to assess the role of the PMAMP on the value chain development of maize in Parbat district. For this, study was conducted in Phalebas Municipality, Mahashila Rural Municipality and Bihadi Rural Municipality of Parbat district which was considered the maize zone of Parbat district by PMAMP, PIU, Baglung. To make this study effective, around 147 maize farmers were selected where sample size was obtained from the sampling frame using Yamane's formulae. Household survey, FGD and Key informants' interview were conducted in the maize zone areas. Primary data were collected by administering the pretested questionnaire. Descriptive and inferential statistics were computed using Ms-Excel and SPSS. The result showed that majority of the respondents were from Brahmin/Chhetri ethnicity (76.8%), literate (76.9%) and male (55.1%). Furthermore, most of them belonged to nuclear family type (64.6%) and were earning most of income from agriculture (63.26%). The B:C Ratio was observed to be 1.37 which indicates good value chain in maize production process. PMAMP has facilitated increased input availability as revealed by 89.12% respondents and increased improvement in marketing according to 80.3% respondents which leads to the good value chain development. Furthermore, majority of the farmers shifted from traditional farming to modern commercial farming. 72.8% respondents adopted the improved maize varieties, 44.9% respondents applied grain pest management, only few respondents (21.1%) owned mini tillers for land preparation but most of them used it for ploughing either through rent or by their own. The major value chain actors were local traders, farmers, wholesalers, government, co-operatives and consumers. However, challenges such as irrigation, pests and disease, persist, hindering comprehensive value chain development. By providing the farmers with easy access to the inputs, introducing modern farming technologies, improving access to markets and facilitating the distribution of maize products, conducting various extension training programs, PMAMP had helped the farmers to optimize their production. Thus, the Contribution of Prime-Minister Agricultural Modernization Project to the value chain of maize was significant. It is recommended that improving access to irrigation facilities, availability of inputs at right time and conduction of extension training programs must be prioritized to increase maize production.

**KEYWORDS**

Modernization, Maize, Prime Minister Agriculture Modernization Project (PMAMP).

## 1. INTRODUCTION

### 1.1 Background information

Agriculture is the dominant enterprise of Nepal having more than 23% contribution to the National GDP and providing the employment to more than 60% of the active population (MoAD, 2020). Maize (Zea mays) is the principal staple crop in the majority of the hilly region, animal feed/fodder in hill and livestock/poultry industry in Terai region of Nepal. Maize stands at 2nd position after rice in terms of area and production in Nepal and 3rd important crop after rice and wheat in world which shows its great importance in terms of food security and livelihood improvement. In 2020, the total area under maize was 9, 57,650 ha with the production of 28.35,674 MT and productivity of 2.96 MT/ha (MoAD, 2020). Maize crop alone contributes about 25.02% of total cereal production, 6.88% in Agriculture Gross Domestic Product (AGDP) and 3.15% in Gross Domestic Product (Pandey and Basnet, 2018). Being known as the 'Queen of cereal', it has wider adaptability and acceptance than any other cereal under varied climatic regimes.

Parbat district is one of the potential areas for maize cultivation. Geographically. It extends from 28°00′19′′N to 28°23′59′′N latitude and 83°33′40′′ E to 83°49′30′′ E longitude of Province No. 4. It occupies the area of 494 km$^2$ (191 sq mi) and has a population (2001) of 157,826. Climatic and geographical features of Parbat District immensely favor the cultivation and production of maize crops. It is a principal food crop of the

| Quick Response Code | Access this article online | |
|---|---|---|
| | Website: www.seps.com.my | DOI: 10.26480/seps.02.2024.128137 |

Cite The Article: Saujan Acharya, Shivnandan Kumar Mandal, Poojan Adhikari, Ashmita Upadhaya, Shubha Sigdel, Kabita Bhat, Prajwol Shrestha (2024). Role of Prime-Minister Agriculture Modernization Project on Maize Value Chain Development and Technology Adoption (a Case Study of Parbat District). *Socio Economy and Policy Studies, 4(2): 128-137.*

hilly region and important animal feed used for poultry and animal feed. Most of the maize grains were utilized to feed the livestock and poultry in mid hills of Nepal. Out of the total requirement 87% of the maize was imported from the India to meet the demand of feed industry. It is necessary to give more focus on the development and dissemination of maize varieties that can serve on the national food security (Timsina et al., 2016).

Maize is cultivated mostly in Bari land during the summer season (Paudyal et al., 2001). Maize production of Nepal increased from 833 thousand tons in 1970 to 2653 thousand tons in 2019 growing at an average annual rate of 2.73%. Maize is one of the highly favored crops as it can be grown in almost all seasons and in all localities. Maize is still a basic diet for a large portion of the population, and demand for it is rising quickly as Nepal's poultry and feed industries develop (Ghimire et al., 2018). Different actors, stakeholders and institutions (eg. PMAMP) are involved in production and supply of maize and their value adding activities. PMAMP (Prime Minister Agriculture Modernization Project), a ten-year project launched by Ministry of Agriculture and Livestock Development commenced from 2016 July and declared District Parbat as maize zone with the coverage area of 500ha.The function in this case includes input supply, production, collection, trading, wholesaling and retailing as major value chain activities.

Our agricultural economy is undergoing through structural changes. The recently implemented Agriculture Development Strategy (ADS) seeks to increase food self-sufficiency and eradicate poverty by promoting commercial agriculture. But still our Nepalese agricultural growth is constrained by poor infrastructures, weak institutions, and inadequate technical and technological support for commercialization and value chain development. The appropriate interventions should be made to examine the value chain of agricultural commodities together with the adoption and evaluation of various maize production technology in order to mitigate these agricultural constraints.

## 2. Research Methodology

### 2.1 Site of Social Research

Phalebas Municiplaity, Mahashila Rural Municipality and Bihadi Rural Municipality of Parbat district was purposively selected for the study. It is the district of Province no. 4 that extends from 28°00′19″N to 28°23′59″N latitude and 83°33′40″ E to 83°49′30″ E having an area of 494 km$^2$ (191 sq mi). Different wards of Phalebas municipality and Bihadi and Mahashila rural municipality were considered to take the survey.

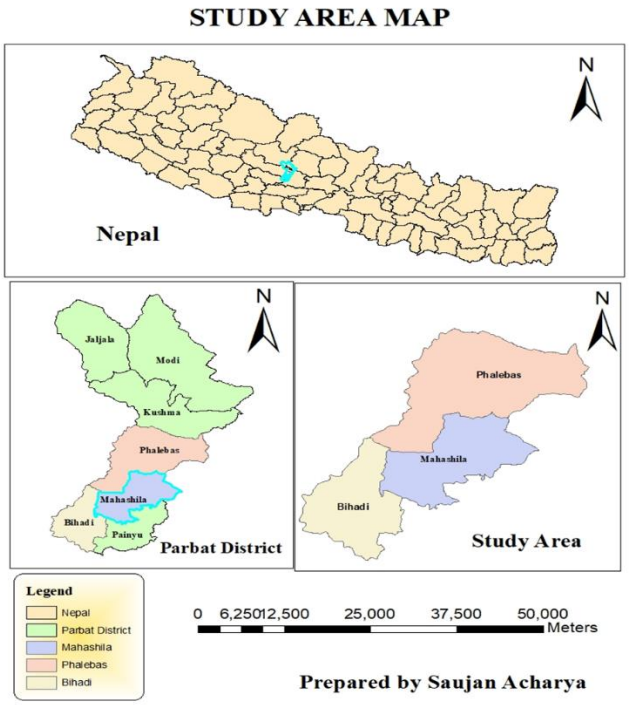



**Figure 1:** Study Area Map

The reasons behind this purpose were:

- Area was under command zone of the PMAMP project implementation unit.
- Majority of farmers on these areas were maize growers which was suitable for research according the objectives.
- It was easily accessible for the researchers and thus more affordable as far as travelling expenses were concerned.

### *2.2 Preliminary study*

A preliminary study was carried out to gather various data regarding the research's feasibility. Direct observation and casual interactions with farmers were used to assess the research site's features. It provided a summary of the maize zone from various aspects, which was helpful in building rapport with the farmers and other related personnel as well as for preparing the questionnaire.

### *2.3 Sample and sampling technique*

Purposive random sampling was done in empirical study to select the sample farmers. Leading maize farmers of Phalebas Municipality, Mahashila Rural Municipality and Bihadi Rural Municipality were included in sampling frame. The PIU had recorded 2520 maize growing farmers in maize zone of Parbat. Purposive Random sampling was done to select about 147 farmers for the survey. The sample size was obtained from the sampling frame using Yamane's formulae with 8% of margin of error.

Yamane's Formula for Sample Size Calculation,

$$n = \frac{N}{1+N(e^2)} \quad (1)$$

where, n= Sample Size, N= Population Size, e= Sampling error

### 2.4 Research instrument

#### *2.4.1 Pre-pilot field visit*

Pre-pilot field visits were conducted to gather preliminary information regarding the demographic, socio-cultural, topographical setting and marketing structures of the site. This information was used in preparing a schedule and designing a sampling framework.

#### *2.4.2 Household survey*

The target group, i.e. the maize farmers, agrovets, wholesalers, retailer, consumer was asked a series of open and close-ended questions that helped the research team to collect some useful data about the social dynamics, economic condition, production, marketing structure, technology advancement in production practices and price in the area. As not every individual of the target group can be included in the survey, a simple random method of sampling was used to draw out the sample population.

#### *2.4.3 Focus group discussion (FGD)*

One effective Focus Group Discussion was carried out in order to provide the information which may have been lost during the household survey. It generally involves the interview of small group od usually 8-10 farmers. Members of zone running committee, members of agriculture co-operatives, and members of farmers group were involved in FGD.

#### *2.4.4 Key informants' interview (KII)*

To develop further ideas of the study site, informal discussion and interview with key informant was carried out. Progressive farmers, Maize Zone-Parbat staffs, village leaders/ elders, representatives of farmers groups, as well as local leaders, DADO officers, NGO/INGOs officers, AKC Parbat officers were asked a series of questions about the present scenario of maize cultivation in the area, current yield statistics, number of people involved in agriculture and maize farming, marketing structure, value chain and the concerns on technology adoption associated with maize cultivation.

### 2.5 Data and its types

#### *2.5.1 Primary data*

Quantitative and qualitative data was collected from maize producer within the study area, maize zone Parbat district by using research instruments i.e., Questionnaire survey, Focus Group Discussion, Key Informant Interview and case studies.

#### *2.5.2 Secondary data*

To supplement the data from primary sources, various published and

unpublished secondary sources of data, articles, reports, books that are published by different institute and organization like Nepal Agriculture Research Council (NARC), NMRP, Central bureau of statistics (CBS), Krishi diary 2079, PMAMP publications, Agro-Enterprise Center (AEC), District Agriculture Development Office (DADO), proceeding of various NGOs and INGOs and technical documents relevant to maize production, trade and consumption were consulted. consulted. The data from secondary information sources such as production, productivity, price scenario, export and import figures, technology advancement in production was critically reviewed to establish the information gap.

### 2.6 Data analysis

#### *2.6.1 Analysis of socio-economic data from survey:*

After the obtained data are thoroughly checked, corrected and standardized they were entered in computer using MS- Excel. Thus, entered data was analyzed using Statistical Package for Social Sciences (SPSS). For the analysis of socioeconomic data such as land holding, gender ethnicity, family type, simple descriptive statistics such as average, standard deviation and percentage was used. Results from the questionnaire was represented by graphical means like bar diagrams, histograms and pie charts.

#### *2.6.2 Cost of production*

Cost of Production is summation of total fixed cost and total variable cost. It was calculated by summing all the variables inputs as given below:

Total cost= ∑ of cost of all variable inputs

= cost of seed + cost of land preparation + cost of labor + other input costs

#### *2.6.3 Analysis of benefit-cost ratio:*

The indication of an agricultural sector's economic viability is the benefit-cost ratio. It is the proportion of gross return to overall cost. It was calculated using the formula below:

B/C ratio= Gross Return/ Total cost

## 3. Result and Discussion

### 3.1 Socio-demographic characteristics

The socio-demographic information regarding gender distribution, family type, education, ethnicity, religion and total land cultivated for the maize cultivation were collected.

Among the sampled population, 55.1% of the respondents were male and 44.9% respondents were female. It clearly visualizes the dominance of male in maize production process compared to that of female.

Talking about the ethnicities of people involving in agriculture, analysis shows Brahmin/chhetri (76.8%) as the major involving group followed by Aadibasi/Janajati (15%) and then Dalit groups (8.2%).

In the survey area, the respondents were categorized into five groups based on the level of education obtained namely illiterate, primary level (1-5 class), secondary level (6-10 class), higher secondary level (11-12 class) and bachelor & above. The above table showed that majority of the respondents attended schools up to secondary level (42.2%) followed by the respondents with primary level education (28.6%). 23.1% of the respondents were illiterate. Very few people studied higher level of education viz. Higher secondary education (2%) and only 4.1% people were graduate. Therefore, the literacy rate was found to be 76.9%. This explains people with secondary and primary level education were the major maize growing farmers of Parbat district. People with higher education and Graduates were seem to be involved in different sectors leaving behind the agricultural field.

Occupation structure reflects nature of local economy and various commercial and employment opportunity of the people in the area. The study revealed that agriculture was the primary occupation in the study area (63.26%) which is lower than the national scenario of 65.6% (CBS, 2016).

With respect to religion, almost all respondents were Hindu, making up for huge 99.3% while Buddhist accounted for only 0.7%.

The family type was differentiated as nuclear and joint family. Study shows that more than half of the respondents were living in a nuclear family (64.6%) followed by the joint family (35.4%).

**Table 1:** Socio-demographic characteristics

| Variables | | Frequency |
|---|---|---|
| **Gender** | Male | 81(55.1) |
| | Female | 66(44.9) |
| **Ethnicity** | Brahmin/Chhetri | 113(76.8) |
| | Aadibasi/Janajati | 22(15) |
| | Dalits | 12(8.2) |
| **Level of education** | | |
| Illiterate | | 34(23.1) |
| Literate | Primary | 42(28.6) |
| | Secondary | 62(42.2) |
| | Higher secondary | 3(2) |
| | University | 6(4.1) |
| **Source of Income** | | |
| Agriculture | | 93(63.26) |
| Other than agriculture | | 54(36.74) |
| **Religion** | | |
| Hindu | | 146(99.3) |
| Buddhist | | 1(0.7) |
| **Family Type** | | |
| Joint | | 52(35.4) |
| Nuclear | | 95(64.6) |

Notes: Figures inside the parenthesis ( ) denote percentage.

#### *3.1.1 Average land holding, cultivation and average production*

Regarding land holding an average of 7.6 ropani, 7 ropani were under cultivation. Similarly, an average of around 5 ropani of land was under maize cultivation in Parbat district. Apart from the owned land holdings, few of the respondents were also found to have some of the land leased. Out of 147 sampled respondents, only 13 respondents had leased land for the purpose of maize production. The average area of leased land was 0.23 ropani. On analysis of the obtained data from the respondents, 5 ropani of cultivable land gave an average of 6.076 quintal (2.39 MT/ha) produces which is slightly lower than the national average 3.06 MT/ha (MoALD, 2021). Insect/pests, diseases and irrigation were the major constraints behind the lower production.

**Table 2:** Details of total area, area under cultivation and production.

| Details | Average |
|---|---|
| Total Area | 7.6 |
| Under cultivation (Ropani) | 7 |
| Under maize cultivation (Ropani) | 5 |
| Leased Land (Ropani) | 0.23 |
| Production (kg) | 607.5kg |

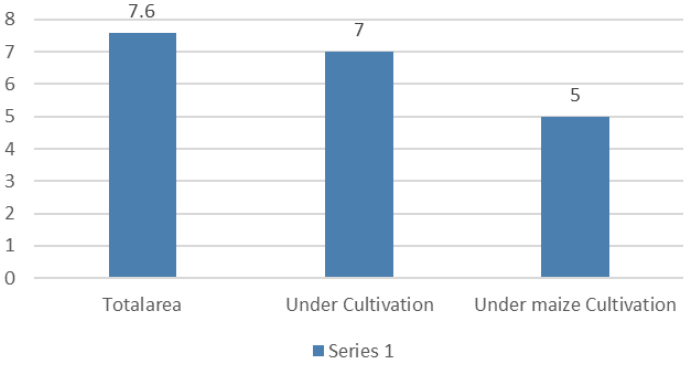



**Figure 2:** Total area under maize cultivation in Parbat district.

## 3.2 Maize value chain scenario

### *3.2.1 Major inputs used with their costs*

A total of 18 labors; 7 male and 11 females are required for cultivation in 5 ropani maize land. Tillage operations were performed using Minitiller which requires 6 hours of continuous plough for the given area of land. An average of 7.22 kg seeds and 256.6 doko FYM are used by the farmers. They used 24.12kg of Urea and 17.86 kg of DAP with no application of Potash as per the obtained data. The B:C Ratio was observed to be 1.37 which gives positive feedback for maize production in Parbat district.

**Table 3:** Total cost of inputs used in maize production under 5 ropani land

| S. N | Particulars | unit | Quantity | Rate | Total cost involved in 5 ropani |
|---|---|---|---|---|---|
| 1 | Human labor | Male | 7 | 1000 | 7000 |
| | | female | 11 | 600 | 6600 |
| 2 | Animal labor | day | 1 | 1500 | 0 |
| 3 | Minitiller | hr | 6 | 1200 | 7200 |
| 4 | Seeds | kg | 7.22 | 73 | 527.06 |
| 5 | FYM | doko | 256.6 | 61 | 15652.6 |
| 6 | Chemical fertilizers | | | | |
| 6.1 | Urea | kg | 24.12 | 25 | 603 |
| 6.2 | DAP | kg | 17.86 | 55 | 982.3 |
| 6.3 | Potash | 0 | 0 | 0 | 0 |

Source: Field Survey, 2023

### *3.2.2 Input Source and Availability*

#### *3.2.2.1 Seed Source*

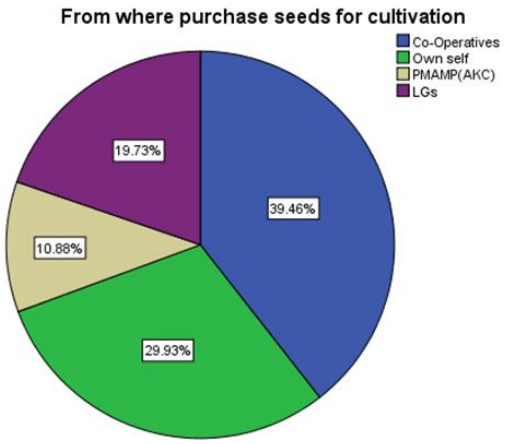



**Figure 3:** Source of seeds used for cultivation

Talking about the seed source, majority of the farmers obtained seeds for cultivation indirectly from PMAMP/AKC through co-operatives (39.46%) whereas 29.93% of the respondents used their own self seeds. 10.88% of the respondents purchased seeds directly from PMAMP(AKC) at certain % of subsidy while remaining 19.73% respondents purchased seeds from the local shops. PMAMP/AKC supplied the seeds to the different co-operatives at certain percentage subsidy which was then obtained by the farmers of that area at lower piece than normal.

How farmers obtained seed from above source.

**Table 4:** Methods of obtaining seeds from the sources

| Method | Frequency |
|---|---|
| Through Purchase | 25(17) |
| On credit bases | 1(0.7) |
| As grant | 120(81.6) |
| Through exchange | 1(0.7) |
| Total | 147(100) |

Notes: Figures inside the parenthesis ( ) denote percentage.

Majority of the farmers got the seeds as grant (81.6%) from the above-mentioned sources while some respondents purchased the seeds on their own (17%). Very few respondents obtained seeds on credit basis (0.7%) and through exchange (0.7%). This clearly signifies the availability of the seeds to most of the farmers from the various government organizations like PMAMP, AKC, LGs, etc. at certain % subsidy/grant.

#### *3.2.2.2 Fertilizer source*

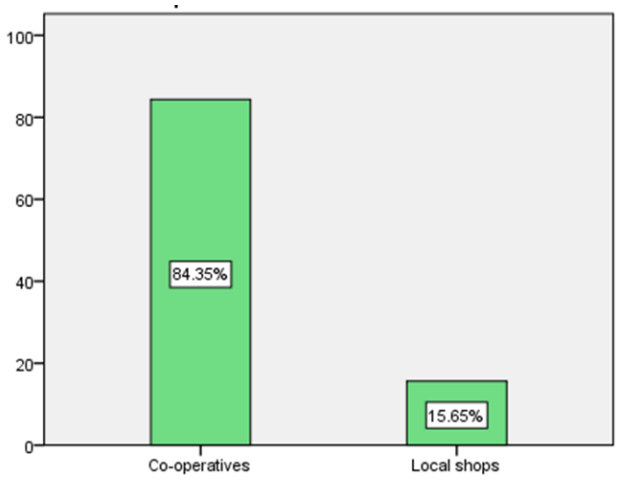



**Figure 4:** Source of fertilizers for cultivation

Majority of the respondents purchased fertilizer for their maize cultivation from the nearby co-operatives (84.35%) whereas the remaining farmers purchased from the local shops. Reason behind the supply of fertilizers by the co-operatives in huge mark is that Government provides NRs. 250 commission to the cooperatives per ton of all fertilizer products and thus, cooperatives sell the fertilizer to the farmers adding local transportation cost on their purchase price from AICL and STCL depots (Panta, 2018).

How farmers obtained fertilizers from above source.

**Table 5:** Method to obtain fertilizer from their source

| Method | Frequency |
|---|---|
| Through Purchase | 147(100) |

All the respondents used to buy the fertilizers from the above-mentioned source on their own.

#### *3.2.2.3 Input availability whenever required*

**Table 6:** Availability of inputs at desired period

| Input availability | Frequency |
|---|---|
| Yes | 135(91.8) |
| No | 12(8.2) |
| Total | 147(100) |

Notes: Figures inside the parenthesis ( ) denote percentage.

Out of the 147 respondents, 135 respondents i.e. 91.8% claimed to have no problems in input availability whereas 12 respondents i.e. 8.2% faced problems to obtain fertilizers at the right time during the maize cultivation process. In the last three years, the government has been able to supply only 63 percent of the chemical fertilizer requirement (Prasain, 2021) which is quite lower than the fertilizer supply (more than 80%) in the study area.

### *3.2.3 Crop Management Practices*

All the respondents used to carry out the weeding practices in their maize field.

Majority of the respondents i.e. 97.3% performed weeding practices 2 times, 2% performed only once and remaining 0.7% performed three weeding practices in their maize field. As a whole, above result claimed that 2 times weeding practice was common in almost all parts of Parbat district.

Maize growing farmers of Parbat district were totally dependent on rainfall to fulfill the water requirement of maize. This is one of the reason

for low productivity compared to national average as optimal irrigation application, throughout the growing season, is important for increasing maize productivity (Swelam and Atta, 2012). Lack of irrigation water during the dry seasons results low yield per unit area supported by (Kaini, 2004)

Only 13.55% respondents performed grading practices in maize before marketing whereas remaining 86.45% respondents were unaware of the grading practice done in maize before marketing. Though grading practices were not done by majority of the farmers of Parbat district, they claimed to have got the good price for maize as they sold the products to local consumers for livestock feed.

**Table 7:** Crop Management practices during cultivation

| Variables | Frequency |
|---|---|
| **Weeding Practices** | |
| Yes | 147(100) |
| **No. of Weeding** | |
| 1 | 3(2) |
| 2 | 143(97.3) |
| 3 | 1(0.7) |
| **Irrigation Practices** | |
| Rainfed | 147(100) |
| **Grading Practices** | |
| Yes | 16(13.55) |
| No | 102(86.45) |

Notes: Figures inside the parenthesis ( ) denote percentage.

### *3.2.4 Marketing scenario*

Majority of the respondents (49.7%) sold the products to local consumer for fresh consumption whereas 30.6% respondents sold the products to the wholesaler either for the seed purpose or for the processing to make sattu supported by (Magar, 2019). Similarly, 19.7% of the respondents consumed the products by themselves i.e. no marketing. Local consumers and the producers with no marketing used the maize products as livestock feed in most of the study area.

Out of 118 respondents (80.3%), 16.96% respondents claimed that the exporters have the requirement with certain variety, 23.72% respondents told that exporters have frequent supply requirement and remaining 59.32% respondents claimed the exporters with production volume requirement.

As per the data obtained from the respondents, minimum and maximum prices of maize were Rs. Rs.80 and Rs.100 which gives the average of Rs.88.18.

**Table 8:** Marketing status of maize in Parbat district.

| Variables | Frequency |
|---|---|
| **To whom the Product sold** | |
| No-one | 29(19.7) |
| Local consumer | 73(49.7) |
| Wholesaler | 45(30.6) |
| **Exporters Requirement** | |
| Certain Variety | 20(16.96) |
| Frequent supply | 28(23.72) |
| production volume | 70(59.32) |

Notes: Figures inside the parenthesis ( ) denote percentage.

| Price of Maize | | | | |
|---|---|---|---|---|
| N | Minimum | Maximum | Mean | S.D. |
| 118 | 80 | 100 | 88.18 | 8.002 |

## 3.3 PMAMP contribution to the improved technology adoption and value chain development of maize

### *3.3.1 PMAMP and Input Availability*

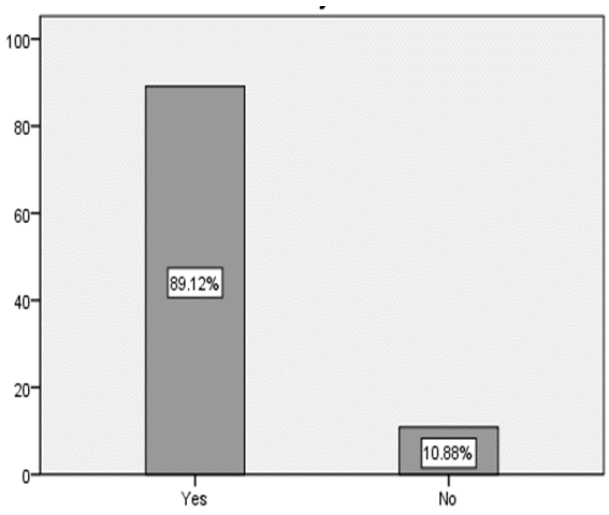



**Figure 5:** PMAMP and Input Availability

89.12% of our respondents revealed that PMAMP, Maize zone, Parbat facilitated them with easy access to input availability like mini tillers, seeds, etc. whereas remaining 10.88% respondents were negative about PMAMP with regards to input availability during the scarce time. This clearly explains that role of PMAMP, Maize zone, Parbat in facilitating the farmers with easy input availability was slowly extending in almost all areas of Maize zone, Parbat contributing to value chain and technology adoption.

### *3.3.2 Support from PMAMP in various activities to maize farmers*

27.2% respondents got the support from the government organizations like PMAMP, AKC, etc. to deal with the major pest and disease invading the maize field with the provision of pesticides, fungicides, etc. whereas remaining 72.8% respondents claimed to have no support in controlling these problems.

A huge mark of 94.91% respondents got the information regarding maize production and marketing like price, demand, etc. from the government organizations like AKC, PMAMP, palika, etc. 4.23% respondents obtained information through neighbors and 0.86% respondents got it through exporters. It showed the big role played by government organizations in helping farmers for their marketing.

Less than half of the total respondents (43.54%) got support from the organizations for marketing like direct contact with the wholesalers, whereas the remaining 56.46% respondents claimed to have no support from any organizations regarding marketing of maize. Among the 43.54% respondents, 60% got support from AKC and the remaining 40% from PMAMP and Palika. Farmers were able to fetch higher prices of maize at present against same quality in the past and the remaining stock was bought by the center i.e. PMAMP for seed production (Magar, 2019).

The 80.3% of the total respondents, there was vast improvement in the marketing of maize after the implementation of PMAMP, Maize zone, Parbat. Farmers were getting the good price for maize as PMAMP either by directly contacting the farmers or indirectly through various co-operatives with the wholesalers of the area, increasing the demand of the maize in that area at better price. Whereas remaining 19.7% respondents claimed to have no any improvement in marketing of maize even after the implementation of PMAMP, Maize zone, Parbat.

Farmers were asked about their involvement in any extension training program and it was known that less than half of the total respondents (42.9%) took part in various extension training programs on maize organized by PMAMP, Maize zone, Parbat. But 57.1% respondents were ignorant about the various training programs organized in their area by PMAMP. According to farmers, lack of advertisement, work load of farmers and farmers with no interest about the programs was the major problem.

Farmers participated in the training programs by PMAMP with a minimum of 0 times by 57.1% respondents to the maximum of 4 times by the other with an average of 0.67 times per person as a whole.

Cite The Article: Saujan Acharya, Shivnandan Kumar Mandal, Poojan Adhikari, Ashmita Upadhaya, Shubha Sigdel, Kabita Bhat, Prajwol Shrestha (2024). Role of Prime-Minister Agriculture Modernization Project on Maize Value Chain Development and Technology Adoption (a Case Study of Parbat District). *Socio Economy and Policy Studies, 4(2): 128-137.*

According to the data obtained from 91.2% of the total respondents, it was easy for farmers to find or contact with the technical assistant of PMAMP in order to solve the various problems incurred in the maize field whereas remaining 8.8% respondents didn't even know about PMAMP and thus found difficult to contact with PMAMP officers.

122 respondents seemed to be happy and positive about PMAMP office, Parbat as they were getting huge benefits in overall from maize production to marketing whereas remaining 25 respondents i.e.17% were still not getting the benefits from PMAMP. This might be either due to lack of communication among them or due to illiteracy of the farmers. To conclude, PMAMP, Maize zone, Parbat got a lot of positive response regarding the value chain development i.e. from production to marketing from the farmers of maize zone, Parbat.

**Table 9:** Support from the PMAMP to farmers for maize cultivation.

| Variables | | Frequency |
|---|---|---|
| **Support from organizations for disease and pest control** | | |
| Yes | | 40(27.2) |
| No | | 107(72.8) |
| **Information regarding Maize marketing** | | |
| Gov Organizations (AKC, PMAMP, Palika) | | 112(94.91) |
| Exporters contacted | | 1(0.86) |
| Through Neighbors | | 5(4.23) |
| **Support for marketing** | Yes | 64(43.5) |
| | No | 83(56.5) |
| **Improvement in Marketing after PMAMP Implementation** | | |
| Yes | | 118(80.3) |
| No | | 29(19.7) |
| **Participation in Extension Training Program Organized by PMAMP** | | |
| Yes | | 63(42.9) |
| No | | 84(57.1) |
| **Contact with technical assistant of PMAMP** | | |
| Easy | | 134(91.2) |
| More or less difficult | | 13(8.8) |
| **Benefits from PMAMP in overall Maize Production and Marketing** | | |
| Yes | | 122(83) |
| No | | 25(17) |

If yes, how many times?

| N | Minimum | Maximum | Mean | S.D. |
|---|---|---|---|---|
| 147 | 0 | 4 | .67 | .939 |

Notes: Figures inside the parenthesis ( ) denote percentage.

### *3.3.3 Listing of the benefits obtained by farmers from PMAMP*

Here is the overall view of the type of support or benefits taken by farmers from the PMAMP, Maize zone, Parbat. Majority of the farmers (36%) got the benefits in marketing at better price. 33.6% farmers were facilitated with easy input availability either directly or indirectly through co-operatives, 14.79% farmers got training on maize storage, 5.81% farmers got seed trainings, and 9.8% farmers were provided with metal bins, Tripal, etc. by the maize zone of Parbat district. The above benefits for the farmers clearly explained that PMAMP, Maize zone, Parbat had played a great role from input availability during production to marketing after harvest i.e. good value chain development.

**Table 10:** List of the benefits obtained by farmers from PMAMP.

| Benefits | frequency |
|---|---|
| Availability of Metal Bins, Tripal | 12(9.8) |
| Easy Marketing at better price | 44(36) |
| Improved maize storage program | 18(14.79) |
| Input availability (Mini tillers, seeds, pesticides, etc.) | 41(33.6) |
| Trainings on seed | 7(5.81) |
| Total | 122(100) |

Notes: Figures inside the parenthesis ( ) denote percentage.

## 3.4 Value chain actors and stakeholders

Majority of the respondents (61.86%) of 118 respondents claimed local trader as the major value chain actor in determining the price of maize. 23.74% respondents told wholesaler and 14.4% respondents claimed government as the major value chain actor in price determination of maize.

Half of the respondents (50.84%) told local traders as the major actor to play important role in marketing of maize. Similarly, 30.5% respondents claimed government organizations (mainly PMAMP and AKC) and 18.66% respondents told co-operatives as the major actor in maize marketing. This data explains local traders as the main actor in maize marketing in more than half of the area of Parbat district.

To the nutshell, this data explains local traders as the main actor in maize marketing in more than half of the area of Parbat district. Other actors were farmers, wholesalers, government, co-operatives and consumers.

**Table 11:** Major value chain actors involved in maize production and marketing.

| Variables | Frequency |
|---|---|
| **Value chain actor in price determination** | |
| Local trader | 73(61.86) |
| Wholesaler | 28(23.74) |
| Others (Government) | 17(14.4) |
| **Major actor in maize marketing** | |
| Government Organizations | 36(30.5) |
| Co-operatives | 22(18.66) |
| Local traders | 60(50.84) |
| Total respondents involved in marketing | 118 |

Notes: Figures inside the parenthesis ( ) denote percentage.

## 3.5 Maize value chain: constraints and opportunities

### *3.5.1 Ranking of problems during maize production*

Based on the direct field observation and informal talks with the farmers major problems associated with maize production in the maize zone area were identified and included in the interview schedule. The major problems related to the production of the maize were found to be Unavailability of quality seeds and fertilizer, Lack of irrigation, Disease/Insect/Pest, lack of training and extension services and high cost of production. The farmers were asked to rank these problems. Rank was given from 1-5 where 1 being the maximum/most severe and then decreasing as the severity decreases. Then the average score and rank subsequently was determined through analysis and ranking of different problems are presented in the table below.

**Table 12:** Ranking of the major problems incurred during maize production.

| Factors | Total score | Average score | Rank |
|---|---|---|---|
| Unavailability of quality seeds and fertilizer. | 669 | 4.65 | 5 |
| Lack of irrigation | 186 | 1.27 | 1 |
| Disease/Insect/Pest | 263 | 1.79 | 2 |
| Lack of training and extension services | 615 | 4.18 | 4 |
| High production cost | 456 | 3.10 | 3 |

Source: Field survey, 2023

Note;
1: most severe
2: highly severe
3: moderately severe
4: fair
5: less severe

According to the data, most severe problem faced by the farmers during

maize cultivation was irrigation as people are dependent on the rainfall for water requirement and erratic rainfall pattern was severely affecting their maize i.e. no rainfall during the critical periods and heavy rainfall during the period of less water requirement in maize. Disease/Insect/Pest was the highly severe problem after irrigation which is followed by high cost during production in the 3rd rank. Least severe problems faced by the farmers during production was related to quality seeds and fertilizer availability and training and extension services. Farmers were getting the seeds and fertilizers and other inputs whenever required from various government organizations like PMAMP, AKC, etc.

#### *3.5.2 Ranking of major insect/pests*

Based on the direct field observation and informal talks with the farmers, major insect/pests affecting the maize production in the maize zone area were identified and included in the interview schedule. Three major Insect/Pests were found to be Cutworm, fall Army Worm and White Grub. The farmers were asked to rank these Insects/Pests. Rank was given from 1-3 where 1 being the maximum/Highly severe and then decreasing as the severity decreases. Then the average score and rank subsequently was determined through analysis and ranking of different problems are presented in the table below.

**Table 13:** Ranking of the Insects/Pests incurred during maize production.

| Insects/Pests | Total score | Average score | Rank |
|---|---|---|---|
| Cutworm | 426 | 2.90 | 3 |
| Fall Army Worm | 160 | 1.09 | 1 |
| White Grub | 296 | 2.01 | 2 |

Source: Field survey, 2023

Note;
1: Highly severe
2: Moderately severe
3: Less severe

Fall Army Worm with rank 1 was the major pest causing huge damage to the whole maize plants according to the data obtained from the respondents which is followed by white grub causing the damage to the roots during the young stages. Cutworm was another Insect/Pest in 3rd/Last rank causing damage during the maize production.

#### *3.5.3 Ranking of major diseases*

Three major Diseases were found in maize field in Parbat district as Northern Leaf Blight, Stalk rot and Ear rot. The farmers were asked to rank these diseases. Rank was given from 1-3 where 1 being the maximum/Highly severe and then decreasing as the severity decreases. Then the average score and rank subsequently was determined through analysis and ranking of different problems are presented in the table below.

**Table 14:** Ranking of the Diseases incurred during maize production.

| Diseases | Total score | Average score | Rank |
|---|---|---|---|
| Northern Leaf Blight | 381 | 2.59 | 3 |
| Stalk rot | 353 | 2.40 | 2 |
| Ear rot | 148 | 1.01 | 1 |

Source: Field survey, 2023

Note;
1: Highly severe
2: Moderately severe
3: Less severe

Highly severe disease was found to be Ear rot in maize followed by stalk rot in 2nd and Northern Leaf Blight was found to be less severe.

#### *3.5.4 Problem in marketing*

**Table 15:** Problems faced during marketing

| Problem | Frequency | Valid Percent | Cumulative Percent |
|---|---|---|---|
| No | 147(100) | 100.0 | 100.0 |

Respondents were asked about the major problems they faced during marketing and obtained data revealed that farmers have no problems regarding the marketing of maize. The more their production, the more the products will be marketed either outside the area or by the local people of that area.

### 3.6 Adoption of improved maize technology: accessibility and feasibility

#### *3.6.1 Accessibility*

##### *3.6.1.1 Variety used*

**Table 16:** Types of seeds used

| Type | Frequency |
|---|---|
| Improved | 107(72.8) |
| Local | 40(27.2) |
| Total | 147(100) |

Notes: Figures inside the parenthesis ( ) denote percentage.

72.8% of the respondents started using the improved varieties of maize whereas 27.2% people were still using the local one. This shows that the percentage of people using latest and high yielding improved maize varieties were increasing gradually**.** The probability of adoption of recommended technology (improved seed) for maize farming was found to be higher for those with access to extensive service (Adhikari et al., 2019). The reason behind this was farmers were given high quality maize seeds and the fair amount for the produce after harvest supported by (Magar, 2019). High productivity and good resistance capacity were the other reasons according to farmers.

##### *3.6.1.2 Machineries own and their source*

###### *3.6.1.2.1 Machineries own*

**Table 17:** Availability of machineries

| Type | Frequency |
|---|---|
| Basic tools | 116(78.9) |
| Machineries only | 0(0) |
| Both | 31(21.1) |
| Total | 147(100) |

Notes: Figures inside the parenthesis ( ) denote percentage.

Very few respondents (21.1%) owe the latest technological equipment's for carrying out various agricultural activities like land preparation, sowing, etc. Whereas a huge of 78.9% people didn't have the technological equipment rather they use it in rent or doesn't use it at all. Fragmented land and small-scale farming are the main reasons for not having the machinery tools. Possibly it would be better to rent rather than invest on these machineries in this situation.

##### *3.6.1.2 Source from where machineries obtained*

**Table 18:** Source for obtaining machinery

| Subsidy % | Frequency |
|---|---|
| No Machine own | 120(81.6) |
| 50% | 20(13.6) |
| 75% | 7(4.8) |
| Total | 147(100) |

Notes: Figures inside the parenthesis ( ) denote percentage

Majority of the respondents 70.75% used the machine (Mini Tiller) for the land preparation through rent from the nearby neighbors whereas 18.37% of the respondents have their own machines obtained through subsidy from various government organizations. 13.6% of the respondents who have the machines obtained it at 50% subsidy level whereas 4.8% respondents obtained it at 75% subsidy level from the government organizations. It shows more the subsidy lesser the frequency of machine holders. The reasons behind it is majority of the farmers were unknown about the subsidy and poor farmers cannot reach out due to biased community environment.

34.67% respondents who have their own machine obtained it at subsidy from the PMAMP, 50% obtained from AKC, 3.8% obtained from LGs and 11.53% obtained from co-operatives. 2.72% respondents bought the machine on their own from the private company. The ratio of providing subsidy seemed highest by AKC followed by PMAMP. Remaining 10.2% respondents didn't use the machines at all for land preparation due to poverty in one hand and unsuitable topography of land on the other hand. To conclude, a huge of 89.8% respondents were adopting the technological equipment's for carrying out agricultural operations mainly land preparation whereas remaining 8.16% were still using the traditional tools i.e. ox for the land preparation purpose.

*3.6.1.3 Present Status of machinery*

| **Table 19:** Status of technologies used in maize production | |
|---|---|
| Status | Frequency |
| No machines | 12(8.2) |
| Functional | 103(70.1) |
| Functional and repaired times | 32(21.8) |
| Total | 147(100) |

Notes: Figures inside the parenthesis ( ) denote percentage.

70.1% respondents claimed the machine to be functional and is not needed to repair it yet (possibly recent holders) whereas 21.8% claimed it to be functional but repaired timely. Remaining 8.2% didn't use the machine at all due to the unsuitable land topography.

*3.6.1.4 Grain pest management*

| **Table 20:** Pest/grain management | |
|---|---|
| **Grain Pest Management** | **Frequency** |
| Yes | 66(44.9) |
| No | 81(55.1) |
| Total | 147(100) |

Notes: Figures inside the parenthesis ( ) denote percentage.

There was provision of preserving the stored grains using suitable management practices. A total of 66 respondents (44.9%) followed the grain pest management practices while the remaining (55.1%) respondents were unknown about the methods to control the grain pests.

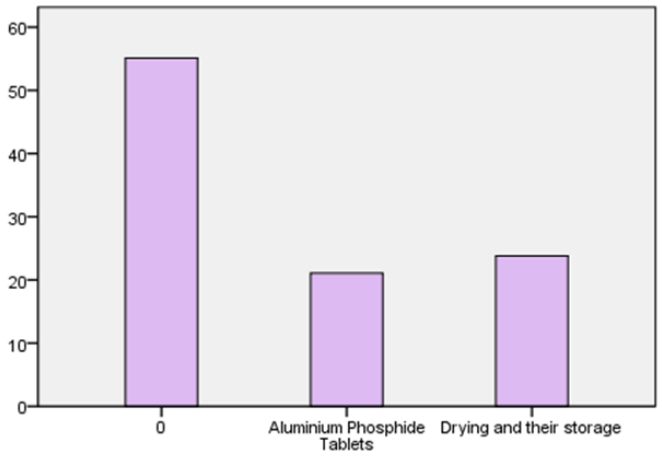



**Figure 6:** Prevent the damage in the grains by the pests

21.1% respondents used the Aluminum Phosphide Tablets, 23.8% respondents used the drying in sun and then storage method in order to prevent the damage in the grains by the pests. Surprisingly, a huge mark of 55.1% respondents didn't use these methods as they follow the traditional method of harvesting and then immediately storing. Respondents were asked about sun curing and they said there is no time as the date of transplanting of rice has come closer which means farmers were facing the huge loss from the post-harvest infestation.

Moreover, there was provision of pesticides, fungicides, etc. to control the infested pests and diseases in the maize field.

*3.6.2 Feasibility*

Farmers were adopting the advanced technologies obtained from governmental organizations like PMAMP. Apart from this, it's feasibility at those areas was known only after the effective Focus Group Discussion with these farmers. Some of them were negative about the improved seeds. These seeds are not adapted to the new environment and are susceptible to different disease and pests resulting lower yield than the local variety. Talking about the machineries like mini tiller, it's not feasible in almost all areas due to slope topography. Machines are heavier and transportation will be difficult that will add them extra cost. Some farmers of Jhaklak area of Phalebash Municipality are using the zap planter in line sowing giving the good yield response. To the nutshell, technologies are adopted by the farmers giving good response in some areas in one hand and on the other hand, they are adding extra costs to farmers with reduced yield.

### 3.7 Association of socio-economic and other factors with total production of maize

#### *3.7.1 Association between education level of respondents and total maize production*

The study revealed that farmers belonging to secondary education have higher production compared to others. Farmers with higher education were found to be involved in different sectors like government jobs, business, etc.

| **Table 21:** Total production of maize in kg with respect to education level of respondents | | | | | |
|---|---|---|---|---|---|
| **Education level** | **Production** | | | | **Total** |
| | **Below 200** | **200-400** | **400-600** | **Above 600** | |
| Illiterate | 6 | 16 | 4 | 8 | 34 |
| Primary education | 2 | 15 | 8 | 17 | 42 |
| Secondary education | 3 | 17 | 15 | 27 | 62 |
| Higher secondary | 0 | 1 | 1 | 1 | 3 |
| Bachelor's degree | 1 | 1 | 1 | 3 | 6 |
| Total | 12 | 50 | 29 | 56 | 147 |

Figures in parentheses indicates expected frequency

Chi square ($\chi 2$)= 13.738 P value 0.318 $^{ns}$ df=12 Non-significant at 0.05 level of significance

This result signifies that association between maize production and education level of respondents are statistically non-significant.

#### *3.7.2 Association between availability of inputs and total maize production*

The study revealed that farmers obtaining inputs at the right time have higher production compared to the case of non-availability.

| **Table 22:** Total production of maize in kg with respect to availability of inputs at right time | | | | | |
|---|---|---|---|---|---|
| **Input availability** | **Production** | | | | **Total** |
| | **Below 200** | **200-400** | **400-600** | **Above 600** | |
| Availability | 8 | 49 | 27 | 51 | 107 |
| Non-availability | 4 | 1 | 2 | 5 | 40 |
| Total | 12 | 50 | 29 | 56 | 147 |

Figures in parentheses indicates expected frequency

Chi square ($\chi 2$)= 12.780 P value 0.005 df=3 Significant at 0.10 level of significance

This result signifies that association between maize production and inputs availability at the right time are statistically significant. This result indicated that production is associated with the availability of required inputs at the right time.

#### *3.7.3 Association between adoption of improved varieties and total maize production*

The study revealed that farmers adopting the improved varieties have higher production with over 600 kg in huge number compared to farmers with local variety which is supported by (Pandey et al., 2019).

**Table 23:** Total production of maize in kg with respect to adoption level of improved varieties

| Adoption level | Production | | | | Total |
|---|---|---|---|---|---|
| | Below 200 | 200-400 | 400-600 | Above 600 | |
| High adopter | 5 | 31 | 23 | 48 | 107 |
| Low adopter | 7 | 19 | 6 | 8 | 40 |
| Total | 12 | 50 | 29 | 56 | 147 |

Figures in parentheses indicates expected frequency

Chi square ($\chi 2$)= 14.153 P value 0.003 $^{ns}$ df=3 Significant at 0.05 level of significance

This result signifies that association between maize production and adoption level of improved varieties used by them are statistically significant. This result indicated that production is associated with the adoption of improved varieties.

### *3.7.4 Association between participation in extension training programs and total maize production*

The study revealed that farmers who participated in extension training programs have very high production over 600 in good number.

**Table 24:** Total production of maize in kg with respect to participation in extension training programs

| Extension Training | Production | | | | Total |
|---|---|---|---|---|---|
| | Below 200 | 200-4004 | 400-600 | Above 600 | |
| Participated | 2 | 17 | 9 | 35 | 63 |
| Not participated | 10 | 33 | 20 | 21 | 84 |
| Total | 12 | 50 | 29 | 56 | 147 |

Figures in parentheses indicates expected frequency

Chi square ($\chi 2$)= 15.441 P value 0.001 df=3 Significant at 0.05 level of significance

This result signifies that association between maize production and participation in extension training programs are statistically significant. There was a significant relationship between farmer participation in extension and maize production supported by (Yuniarsih et al., 2021).

## 4. Summary

An assessment on the role of PMAMP on maize value chain development and technology adoption was done with the data taken from 147 respondents of different municipalities of Parbat district. The objective was to analyze the value chain scenario, technology adoption status, value chain actors, major constraints and opportunities of maize production in Parbat district. The study revealed the majority of the respondents were male (55.1%) with Brahmin/Chhetri as the dominant caste (76.8%). Literacy rate was found to be 76.9%. The study revealed that majority of the respondents (63.26%) had agriculture as the major source of income with the nuclear family type (64.6%) and Hindu as the dominant religion (99.3%). An average of around 5 ropani of land was under maize cultivation with the production of 607.5kg.

Talking about value chain scenario, the B:C Ratio was observed to be 1.37 for an average of 5 ropani land. Farmers obtained the seeds from the PMAMP either directly (10.88%) or indirectly through co-operatives (39.46%). Fertilizers were obtained through the co-operatives (84.35%). According to 91.8% respondents, there was no problem in input availability whenever required. Regarding the management practices, all the respondents performed weeding but only 13.55% respondents performed grading before marketing. With respect to irrigation, all the respondents were dependent on rainfall. Majority of the respondents (49.7%) sold the products to local consumer for fresh consumption. As per the respondents, minimum and maximum prices of maize were Rs. Rs.80 and Rs.100. Majority of the farmers gave positive response in various value chain activities from inputs to marketing which directs good value chain.

Regarding PMAMP contribution, 89.12% of our respondents revealed that PMAMP, Maize zone, Parbat facilitated them with easy access to input availability like mini tillers, seeds, etc. A huge mark of 94.91% respondents got the information regarding maize production and marketing like price, demand, etc. from the government organizations like AKC, PMAMP, palika, etc Majority of the respondents (80.3%) revealed that there was vast improvement in the marketing of maize after the implementation of PMAMP, Maize zone, Parbat. 42.9% took part in various extension training programs on maize organized by PMAMP, Maize zone, Parbat. 122 respondents seemed to be happy and positive about PMAMP office, Parbat as they were getting huge benefits in overall from maize production to marketing. Some of the benefits farmers got from PMAMP are Availability of Metal Bins, Tripal, Improved maize storage program, Trainings on seed, Input availability (Mini tillers, seeds, pesticides, etc.), etc.

The major value chain actors were local traders, farmers, wholesalers, government, co-operatives and consumers.

Regarding the constraints in maize production, ranking of the major problems was done by the farmers and it revealed irrigation in the top followed by disease and insect pests on the 2nd rank and high production cost in the 3rd. Also ranking of the major diseases on the maize field was done by the respondents and found ear rot as the devastating disease followed by stalk rot and northern leaf blight. On ranking major insects/pests, fall army worm was found to be the major problem. However, farmers revealed no problems regarding the marketing of the maize.

Regarding the accessibility of technologies, 72.8% of the respondents started using the improved varieties of maize. Very few respondents (21.1%) owe the latest technological equipment's for carrying out various agricultural activities like land preparation, sowing, etc. whereas remaining either use it in rent or don't use it at all. A total of 66 respondents (44.9%) followed the grain pest management practices like Aluminum Phosphide Tablets (21.1%), drying in sun and then storage method (23.8%), etc.

## 5. Conclusion

Based on the study conducted in Parbat district of Nepal, some conclusions can be drawn. Local traders, wholesalers, government, co-operatives were the major market channel actors. Higher benefit cost ratio shows that the business was profitable so investment on maize production enterprise was found to be financially viable in the study area. Provision of various inputs like mini tillers, seeds, pesticides, fertilizers etc. as well as easy marketing facilities from PMAMP and other government organizations encourages farmers to invest on this enterprise. Irrigation, disease and pests were the major problems associated with the production of maize, respectively. Availability of inputs in right time, adoption of improved maize varieties and farmers participation in extension programs were found to be highly associated with total maize production in Parbat district.

## References

Adhikari, S., Dahal, B. R., and Bist, V., 2019. Technology adoption in maize farming: a comparative analysis between improved seed users and local seed users of Argakachi district of Nepal. Agricultural Science and Technology (1313-8820), 11*(4)*.

CBS. 2016. Annual Household Survey 2014/2015. Singh Durbar, Kathmandu: Central Bureau of Statistics, National planning Secretariat, Government of Nepal.

Expert Consultation on Maize for Food, Feed, Nutrition and Environmental Security. 2018. Ludhaina, India. October 8-10. CIMMYT, Mexico D.F. Pp. 184-190.

Ghimire Y.N., Timsina K.P., Devkota, D., Gautam, S., Choudhary, D., Poudel, H. and Pant, J., 2018. Dynamics of Maize consumption and its implication in maize technology demand in Nepal. In B.M. Prasanna, Aparna Das and Kelah K. Kaimenyi (eds.) 2018. Book of Extended summaries, 13th Asian Maize Conference.

Kaini B.R., 2004. Increasing crop production in Nepal. In: Proceeding of the 24th National Summer Crops Research Workshop. Nepal Agricultural Research Council (NARC), Kathmandu, Nepal, Pp. 15–19.

Magar, Arpana, 2019, May 15. PMAMP delights maize farmers in Parbat district. The Himalayan Times,

https://thehimalayantimes.com/business/prime-minister-agriculture-modernisation-project-delights-maize-farmers-in-parbat-district

Ministry of Agriculture Development (MoAD), 2020. Statistical information on Nepalese agriculture. Government of Nepal, Ministry of Agriculture and Livestock Development, Statistics and Analysis Section.

MoALD, 2021. Statistical Information On Nepalese Agriculture (2077/78 ) Publicatons of the Nepal in Data Portal, 73, Pp. 274. https://nepalindata.com/resource/statistical-information-nepalese-agriculture-207374-201617/

Pandey, G., and Basnet, S., 2018. Objective agriculture book at a glance. Kapil Group and Company Pvt. Ltd. Budhanilkantha, Kathmandu.

Pandey, K. P., Shrestha, B., Naharki, K., and Kunwar, C. B., 2019. Assessment of maize production and adoption of improved maize seeds in Tanahun district of Nepal. International Journal of Applied Sciences and Biotechnology, 7(2), Pp. 279-288.

Panta, H. K., 2018. Supply chain of subsidized chemical fertilizers in Nepal. Journal of the Institute of Agriculture and Animal Science, 35(1), Pp. 9-20.

Paudyal, K. R., Ransom, J. K., Rajbhandari, N. P., Adhikari, K., Gerpacio, R. V., and Pingali, P. L., 2001. Maize in Nepal: production systems, constraints, and priorities for research. In Cimmyt,Narc.

Prasain, Sangam, 2021, August 27. Chemical Fertilizer Shortage is a perennial problem. The Kathmandu Post, https://kathmandupost.com/national/2021/08/27/chemical-fertiliser-shortage-is-a-perennial-problem-it-stems-from-multiple-factors

Shrestha, J., Gurung, D.B., Koirala, K.B. and Rijal, T.R. (2019). Performance evaluation of maize in Jumla district of Nepal from yield perspective. International Journal of Applied Biology, 3(2), Pp. 35-45.

Swelam, A., and Atta, Y., 2011. New approach of farm management under surface irrigation to improve water saving and productivity. New Horizons in Sci. Technol, 1, Pp. 76-83.

Timsina, K. P., Ghimire, Y. N., and Lamichanne, J., 2016. Maize production in mid hills of Nepal: from food to feed security. Journal of Maize Research and Development, II.

Yuniarsih, E. T., Andriyani, I., Halil, W., & Anas, S. (2021, November). Relationship analysis of farmers participation in agricultural extension with corn production levels in South Sulawesi. In *IOP* Conference Series: Earth and Environmental Science. 911 (1), Pp. 012070. IOP Publishing.