Research article

MAIZE CULTIVATION: PRESENT STATUS, MAJOR CONSTRAINTS AND FARMER'S PERCEPTION AT MADICHAUR, ROLPA

S. Dhakal*[1], S.K. Sah[1], L.P. Amgain[2], and K.H. Dhakal[1]
[1] Agriculture and Forestry University, Rampur, Chitwan, Nepal
[2] Far Western University, Tikapur, Kailali, Nepal

*Corresponding author: sdhakal@afu.edu.np
Received date: 29 December 2021, Accepted date: 24 February 2022

ABSTRACT

Maize (*Zea mays*) has been one of the most popularly grown crops in the mid hills of Nepal. With a view of assessing the present agronomic management and constraints of maize cultivation, a field survey was carried out in the summer of 2020 at Madichaur, Rolpa, Nepal. Simple random sampling procedure was used to collect data from 100 respondents using a semi structured interview schedule. Information regarding the productivity and adoption of improved technologies by maize growing farmers were also collected. The data were processed and analyzed using MS-Excel and SPSS. Results revealed maize-based cropping system as the major cropping system (65%) with rainy season maize being the dominant one (76%). Varietal selection was primarily based on the local prevalence whereas own preserved seeds were used by majority of the respondents. Local plough was the major tool for land preparation whereas majority of the respondent used FYM as nutrient source and followed sowing behind the plough. Gap filling, thinning, weeding, earthing up was quite common among the respondents, however their intensity varied. External cob storage was the common method of storage. Biotic stress was identified as the major bottleneck for increasing maize productivity followed by lack of irrigation and technical know how.

Keywords: Survey, productivity, rainfed maize

INTRODUCTION

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 second most widely cultivated crop after rice in Nepal. 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 & Basnet, 2018). 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 season and in all locality. Large population still consume maize as their staple food and its demand is increasing rapidly due to the expansion of poultry and feed industries in Nepal (Ghimire et al., 2018). Despite the tremendous potentiality for its marketing, increase in maize production is not being able to meet the higher pace of demand growth. There is huge gap between the demand and production level of maize (Shrestha et al., 2019). The farm level yield of maize (2.45 ton/ha) is not satisfactory as compared to attainable yield (5.7 ton/ha) in Nepal (K.C et al., 2015). Even if maize is not used for animal feed, production is not enough to meet human demand for maize in the country (Guragain, 2019). On the other hand, the feed demand is also increasing at the rate of 11% annually (CDD, 2011).

The mid-hill region occupies almost 43% of the total land area. Large variations in maize productivity exist in mid-hills of Nepal. Poor soil fertility, quantity and pattern of rainfall, time of crop establishment, quality of seed, level of input use, availability of irrigation and disease and pest infestations are the commonly identified problems for lower productivity of maize in the mid hills of Nepal. Moreover, the productivity of maize in Nepal is very low as compared to global yield, the wide yield gap can be attributed to various biotic and abiotic factors (Subedi, 2015). Dominance of OPV's and lower seed replacement rate are also among the major reasons behind lower productivity (Gaire et al., 2018). Higher densities (92000 plants/ha) at vegetative stage and about 30,000 plants per hectare at harvesting period prevail in maize (K.C et al., 2015). The mean grain yield of maize under current farmer practice was found to be 2 ton/ha whereas good

agronomic management practices increased maize yields up to 6.5 tons/ha (i.e. exploitable yield gap of 4.5 ton/ha) (Devkota et al., 2015).

Rolpa district lies in the mid hill region of Nepal and relies on maize as the source of food, feed and fodder. It has cultivable land area of 31,496 ha. Maize is widely cultivated crop in Rolpa with more than 12,660 ha coverage in summer of 2020 with the average productivity of 2.30 ton/ha (AKC, 2020). Rolpa district resembles the perfect mid-hill ecology of Nepal. This study was carried out in Madichaur, Rolpa to assess the present scenario and existing problems in maize cultivation.

MATERIALS AND METHODS

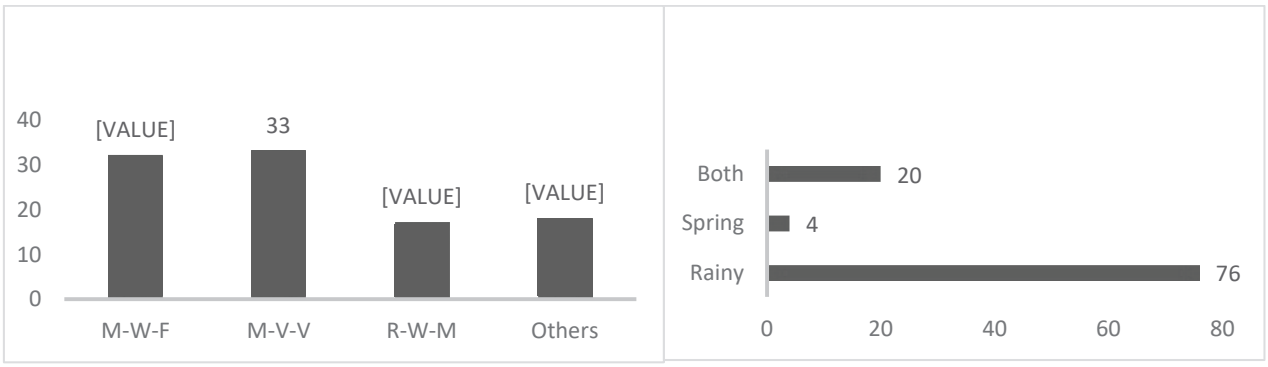
Rolpa District was purposively selected for the study taking into consideration the proximity and that the Prime Minister Agriculture Modernization Project (PMAMP) has selected Rolpa Municipality as 'Block' for maize cultivation. Rolpa municipality was selected under stratified sampling and the samples were selected via simple random sampling in proportionate of their sampling frame. A total of 100 households were surveyed. Primary data were collected via a pre-tested interview schedule. Secondary data were collected through the relevant publications from Government and Non-Government offices. The data were entered and processed in MS-Excel and the results were analyzed via SPSS.

RESULTS AND DISCUSSION

Cropping system and season of maize planting

Variable cropping system was found to be prevalent in the study area. Almost equal number of respondents adopted Maize-Vegetable-Vegetable and Maize-Wheat-Fallow cropping system. However, the former was dominant in the area with irrigation facility whereas the later was popular in the rainfed areas. Rice-Wheat-Maize was also popular especially in the KHET lands of the study area. Apart from these cropping system, other cropping system like Maize-Rapeseed-Fallow, Maize-Vegetable-Fallow were also prevalent in the study area.

Maize was the most widely cultivated crop in the study area. Majority of the respondent (76%) cultivated the maize during rainy season as the maize crop was predominantly grown in BARI land. Very few (4%) of the respondents grew maize during spring season whereas 20% of the respondent grew maize during both rainy season and spring season. Very few of the respondent opted spring planting because of the lack of irrigation facility. Maize is cultivated as food, feed and fodder on slopping Bari land (rainfed upland) in the hills during the summer (April-August) as a single crop or relayed with millet later in the season (Sapkota & Pokhrel, 2010) **(Figure 1).**



(a) **(b)**

Figure 1. Distribution of respondent based on cropping system adopted (a) and season of maize planting (b) in the study area, 2020.

Pre-sowing cultivation practices

Variation in pre-sowing practices was observed during the field survey (Table 1). Varietal selection for sowing was predominantly based on the local prevalence (52%) followed by trait preference (24%),

recommendation from government and technical organizations (13%) and random (11%). Own stored seeds were used by majority of the respondents for sowing purpose (48%) whereas procurement of seeds from Agro-vets (26%), Co-operatives (17%) and Community (9%) was also common. Local plough was the widely used tool for land preparation (69%) whereas the use of mini tiller (14%), tractor (17%) was also observed. Majority of the respondent did not use fertilizers in their field (71%) whereas the use of urea only was adopted by 25% of the respondent but just 4% of the respondent only used the all three macronutrient via Urea, DAP and MOP in their field. Local FYM was widely used as the source of nutrients in the field by 95% of the respondent whereas 3% used compost and just 2% used the poultry litter as the nutrient source. Regarding the irrigation, majority of the respondent did not use irrigation in their field (59%) whereas 41% of the respondent used irrigation in the field.

Variety is selected based on fertility status of the soil as different varieties are adapted to different niches and thus is likely to replace the other varieties (Subedi & Shrestha, 2016). Paudyal et. al. (2001) reported that several socioeconomic, environmental and cultural factors also affect to the selection of maize varieties. Productivity level, maturity days, foliage quality and quantity, harvesting time and farmer's perception regarding the performance of certain variety also affect the adoption of the variety (Timsina et al., 2016).

The reasons for low use of chemical fertilizer included high cost, non-availability at key times and a lack of knowledge of their use (K.C et al., 2015). Mostly maize is sown after preparing soil with good tilth either with local plough or mould board plough (Bhantana, 2019) (Table 1).

Table 1. Description of pre-sowing operations followed by respondents on maize farming in the study area, 2020.

Pre Sowing Operations	**Distribution of Respondent Based on Options Available (Percentage)**			
Variety Selection	Local Prevalence	Trait Preference	Recommendation	Random
	52	24	13	11
Seed Source	Own Stored	Agro-vets	Co-operatives	Community
	48	26	17	9
Land Preparation	Local Plough	Mini Tiller	Tractor	Others
	69	14	17	-
Fertilizer Application	No	Urea only	Urea, DAP and Potash	
	71	25	4	
Local Nutrient Source	Local FYM	Compost	Chemical	Poultry
	95	3	-	2
Irrigation	Yes		No	
	41		59	

Sowing Cultivation Practices

Variable practices were also observed during sowing in the study area (Table 2). For spring maize, majority of the respondent (42%) opted for the last fortnight of Falgun whereas 23% sowed their field in first fortnight. For rainy season maize, the first fortnight of Jestha was pre-dominantly adopted for sowing followed by the last fortnight of Baishakh. Sowing behind the plough was the dominant method of sowing (80%) whereas dibbling was also common among 13% of the respondent. Seed rate was also found variable among the respondent where 43% used 1-1.5 kg seed per ropani whereas 34 % of the respondent used 1.5-2 kg seed per ropani. However, the overall seed rate varied from 0.5 – 2.5 kg per ropani. Regarding the spacing, only row spacing was maintained by majority of the respondent (84%) whereas just 16% of the respondent also maintained theplant to plant spacing. Among the respondents, 58% did not use irrigation during sowing whereas 42% of the respondent used the irrigation at sowing (Table 2).

Table 2. Description of sowing operations followed by respondent on maize farming in the study area, 2020.

Sowing Operations	Distribution of Respondent Based on Options Available (Percentage)			
Sowing Date (For Spring)	1-15 Magh	16-30 Magh	1-15 Falgun	16 Falgun-2 Chaitra
	15	20	23	42
Sowing Date (For Rainy)	Chaitra 15-30	Chaitra 31-Baishakh 14	Baishakh 15-30	Baishakh 31- Jestha 14
	-	6	10	84
Sowing Method	Broadcast	Behind Plough	Dibbling	Drilling
	6	80	13	1
Seed Rate Used (Per Ropani)	0.5-1 kg	1-1.5 kg	1.5-2 kg	2-2.5 kg
	10	43	34	13
Spacing Maintained	ROW-ROW		PLANT-PLANT	
	84		16	
Irrigation	Yes		No	
	42		58	

Post sowing cultivation practices

Thinning and Gap filling are the important post sowing operations to maintain the plant population. This fact was well adopted by the respondent in the study area where almost 97% of the respondent practiced the thinning process whereas the gap filling process was practiced by 83% of the respondent (Table 3). Earthing up practice was adopted by majority of the respondent (75%) among which 44% of the respondent earthed up their maize just once whereas 55% of the respondent did the earthing up twice during the maize season. Fertilizer application after sowing was very variable where 42% of the respondent used just urea after the sowing whereas 41% of the respondent used no any fertilizers. Similarly, 14% of the respondent only used FYM after sowing whereas just 2% of the respondent only used the complete set of fertilizers (NPK) i.e. Urea, DAP and MOP. Weeding was commonly carried out by majority (99%) of the respondent where 24% of the respondent weeded the field once, 66% of the respondent weeded the field twice but only 10% of the respondent weeded the field thrice during the maize season.

About 52% of the respondent used irrigation in the maize field after sowing where 44% provided the irrigation just once whereas 41% irrigated the field twice and just 15% irrigated the field thrice during maize season. Crop protection measures were adopted by majority of the respondent (52%) however it was not so common among 42% of the respondent who did not use any crop protection measure in maize. Brown leaves was the commonly assessed (58%) maturity index for harvesting whereas 32% of the respondent also looked for brown silk as the maturity index. Drying was quite common after the harvest. About 68% of the respondent dried their product prior to storage whereas 32% directly sell their produce without drying. External cob storage was the most common method for storage of maize followed by 72% of the respondent whereas grain storage was also common among 24% respondent. Bin storage and storage in sacks was followed by very low number of respondents (Table 3).

Table 3. Description of post sowing operations followed by respondent on maize farming in the study area, 2020.

Post Sowing Operation	Distribution of Respondent Based on Options Available (Percentage)						
Thinning	Yes				No		
	97				3		
Gap Filling	Yes				No		
	83				17		
Earthing Up	Yes				No		
	75				25		
	Once		Twice	Thrice			
	44		55	1			
Fertilizer Application	Urea Only	DAP Only	MOP Only	Urea, DAP and MOP	Micronutrient	FYM	None
	42	1	-	2	-	14	41
Weeding	Yes				No		
	99				1		
	Once		Twice	Thrice			
	24		66	10			
Irrigation	Yes				No		
	52				48		
	Once		Twice	Thrice			
	44		41	15			
Crop Protection	Yes				No		
	42				58		
Maturity Indices	Brown Leaves		Black Dent		Crack Test		Black Silk
	58		9		1		32
Drying	Yes				No		
	68				32		
Storage	External Storage		Grain Storage		Bin Storage		Sacks
	72		24		3		1

Problems associated with maize cultivation

From the survey, the biotic stress (weed, insect, pathogens) were identified as most prominent problem in maize cultivation followed by unavailability of irrigation, lack of technical know-how, abiotic stress (moisture, heat), unavailability of variety, unavailability of quality seed whereas the problems related to soil, fertilizers, tillage practice, plant population and planting dates were also recognized among the reasons for lower productivity of maize in the study area (Table 4). Bajracharya et al. (2016) also identified transportation, disease and pest, storage facility, irrigation and seed quality as the major problems behind the lower productivity of maize in the hills of Nepal. Similarly, Subedi et al. (2018) also found the lack of quality seeds and fertilizers as the major problem for lower productivity in maize followed by lack of advanced technology and training, lack of proper interaction between farmer and extension service provider, incidence of diseases and insect pests along with lack of proper irrigation and drainage during the field survey. K.C et al. (2015) also highlighted biological (disease and pests), management (soil fertility, plant population at harvest, weed infestation, seed, and water management) and socio-economic problems behind lower productivity of maize in the mid-hills of Nepal (Table 4).

Table 4. Description of problems associated with maize cultivation in the study area, 2020.

Problems	Ranking					Index value	Rank
	1	2	3	4	5		
Unavailability of variety	4	25	44	21	6	0.60	5th
Unavailability of irrigation	44	36	9	6	5	0.82	2nd
Unavailability of fertilizers	6	22	39	18	15	0.57	7th
Lower plant population	1	6	19	30	44	0.38	9th
Biotic stress (Weed, Insects, Pathogens)	58	23	11	6	2	0.86	1st
Abiotic stress (Moisture, Heat)	3	29	43	18	7	0.61	4th
Unavailability of quality seed	4	31	36	20	9	0.60	5th
Planting Dates	0	1	20	25	54	0.34	10th
Tillage Practice	0	3	25	36	36	0.39	8th
Soil related problems	1	24	46	25	4	0.59	6th
Lack of Technical Know How	2	32	49	11	6	0.63	3rd

CONCLUSION

Despite having tremendous potential for export promotion and import substitution, maize production in Nepal has not increased as expected in the recent years. The major maize growing areas of Nepal i.e., mid-hills are still dominated by traditional practices. Open pollinated varieties, self-stored seeds, less use of fertilizers, poor crop management practices and lack of mechanization are the key issues to be addressed in order to increase the production in the maize growing areas. Maize based cropping system in mid hills are often characterized by slopy lands, poor fertilization, lack of irrigation and subsistence farming practices. To keep pace with the growing maize demand from feed sector, the promotion of use of quality seeds, use of new high yielding varieties along with scientific crop management practices are the key. Increment of irrigation scheme in mid hill can open up new avenue for maize cultivation which can increase the overall maize production and productivity in the country.

ACKNOWLEDGEMENTS

This work was carried out with the support of Agriculture Knowledge Center, Rolpa. Students of 1st batch in CNRM-Rolpa and respondents from Madichaur, Rolpa are the candidates for special thanks for helping to conduct the field survey.

REFERENCES

AKC. (2020). Annual Report-2020. Agriculture Knowledge Center, Rolpa, Nepal.

Bajracharya, M., Sapkota, M. & Dhungana, S.M. (2016). Socio economic analysis of maize seed production in Arghakhanchi district of Nepal. *Journal of Maize Research and Development*, *2*(1), 144-150.

Bhantana P. (2019). Studying of cropping system management towards improved soil fertility in the mid hills of eastern Nepal. *Advances in Plants and Agriculture Research*, *9*(3), 372-375.

CDD. (2011). Impact of maize mission program, report prepared by Crop Development Directorate, Harihar Bhawan, Lalitpur, Nepal.

Devkota, K.P., Mcdonald, A., Khadka, A., Khadka, L., Paudel, G.P. and Devkota, M. (2015). Decomposing maize yield gaps differentiates entry points for intensification in the rainfed mid-hills of Nepal. *Field Crop Research*. *179*, 81-94.

Gaire, S., Shrestha, H.K., & Timsina, K., (2018). Dynamics of major cereals productivity in Nepal. *Journal of Nepal Agricultural Research Council*, *4*(1), 60-71.

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

Guragain M. (2019). Maize worth 71 billion imported in 10 years. My Republica.

K.C, D.B., Gadal, N., Neupane, S.P., Puri, R.R., Khatiwada, B., Ferrara, G.O., Sadananda, A.R., Bober, C. (2015). Maize seed marketing chains and marketing efficiency along supply chains of the hills in Nepal. *International Journal of Agricultural Marketing*, *2*(1), 026-033.

K.C, G., Karki T.B., Shrestha, J. Achhami, B.B. (2015). Status and prospects of maize research in Nepal. *Journal of Maize Research and Development*, *1*(1), 1-9.

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

Paudyal, K.R., Ransom, J.K., Rajbhandari, N.P., Adhikari, K., Gerpacio, R.V., & Pingali, P.L., (2001). Maize in Nepal: Production Systems, Constraints, and Priorities for Research. Kathmandu: NARC and CIMMYT.

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

Sapkota, D. & Pokhrel, S. (2010). Community based maize seed production in the hills and mountains of Nepal: A review. *Agronomy Journal of Nepal*, *1*,107-112.

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), 35-45.

Subedi, M., & Shrestha, P.K. (2016). Site selection report of farmer led participatory maize breeding program for the middle hills of Nepal. Retrieved from http://ciat-library.ciat.cgiar.org/articulos_ciat/Site_Selection_Report_Farmer_led_Participatory_Maize_Breeding_Programme_Middle_Hills_N.pdf

Subedi, S. (2015). A review on important maize diseases and their management in Nepal. *Journal of Maize Research and Development*, *1*(1), 28-52.

Subedi, S., K.C. B., Regmi, D., Bhattarai, A., Chhetri, K., & Gnawali, A. (2018). Study of performances of baby corn at different combination organic and inorganic fertilizers in mid hills of Nepal. *Agriculture Research and Technology*, *17*(3), 556027.

Timsina K.P., Ghimire Y.N. and Lamichhane J. (2016). Maize production in mid hills of Nepal: from food to food security. *Journal of maize research and development*, *2*(1), 20-29.