Archives of Agriculture and Environmental Science 6(3): 290-294 (2021)
https://doi.org/10.26832/24566632.2021.060304

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes

ORIGINAL RESEARCH ARTICLE

Status of farm mechanization and its impact on maize production in Jhapa District, Nepal

Santosh Kandel[1*], Rakshya Poudel[1], Min Thapa Saru[1], and Tulsi Parajuli[2]

[1]Department of Agriculture, [2]Department of Agronomy, Agriculture and Forestry University, Rampur, Chitwan, NEPAL
[*]Corresponding author's E-mail: santoshkandel116@gmail.com

ARTICLE HISTORY

Received: 27 June 2021
Revised received: 22 August 2021
Accepted: 13 September 2021

Keywords

Farm machineries
Mechanization
Maize production
Productivity

ABSTRACT

A survey research was carried out in 2020 in maize zone, Jhapa to identify and analyze the status of farm mechanization and its impact in the maize production. Kankai Municipality and Jhapa Rural municipality were purposively selected for the study as these areas were under the command area of prime minister agriculture modernization project, project implementation unit, maize zone Jhapa. Thereafter, a total of 70 samples were selected using random sampling method. Thirty-three samples were selected from Kankai Municipality and remaining thirty-seven were selected from remaining Jhapa rural municipality. Primary data were collected using semi-structured questionnaire, focal group discussion and key informant interview whereas secondary data were obtained through a review of relevant literature. Both descriptive and analytical statistics were used to analyze the data. It was found that the status of mechanization was still in the initial phase in the study area. Results showed that mechanization was limited to two cultural operations namely tillage and threshing of which only in case of tillage, farm machineries were adopted by more than ninety percent of the respondent farmers while in case of sowing more than ninety percent of respondent didn't use any modern equipment. Insect and pest in maize field was major problem faced by the farmers. Therefore, productivity of maize in Kankai area was higher as compared to Jhapa area as adoption of mechanization was higher in Kankai area.

Citation of this article: Kandel, S., Poudel, R., Saru, M. T., & Parajuli, T. (2021). Status of farm mechanization and its impact on maize production in Jhapa District, Nepal. *Archives of Agriculture and Environmental Science*, *6*(3), 290-294, https://dx.doi.org/10.26832/24566632.2021.060304

INTRODUCTION

Maize (*Zea mays* L.) is the world's widely grown highland cereal and primary staple food crop in many developing countries (Dawadi and Sah, 2012). It is the second most important staple food crop both in terms of area and production after rice in Nepal (Shrestha *et al*., 2009).It is grown in all ecological zones of Nepal ranging from terai to high hills (Poudel and Paudyal, 2001). Although it is grown in all part of Nepal, it is a way of life for the most of hill farmers of Nepal. It is a traditional crop grown mainly for purposes such as food, feed and fodder (K.C. *et al*., 2015). Grain is used either for human consumption or utilized to make animal feed whereas Stover is used as animal fodder. It is staple food crop of hilly region where 86% of the total produced is used for human consumption whereas in Terai only 20% is used for human consumption and rest of the produced is used to make feed for livestock and poultry (Ransom *et al*., 2003). Although statistical data shows slight increase in maize yield over decades but there has been very less yield improvement when compared to yield of last 30 years (Paudyal *et al*., 2016). The best way to meet this soaring demand is by increasing productivity of land by increasing resource and input use efficiency through technology adoption and mechanization. However, there are various challenges and barriers for mechanization and technology adoption in Nepal. Subsistence farming ,low investment, lack of machineries and lack of market are some of barriers for technology adoption.so mechanization is one of key solution to solve all above agriculture issues (Shrestha, 2012).

Mechanization helps in efficient and large scale production leading to commercialization in agriculture sector (Barman *et al.*, 2019). Mechanization can reduce labor cost, work load, time of operation and ultimately helps to increase production and productivity of farm. It covers all level of farming and processing technologies from simple and basic hand tools to more sophisticated and motorized equipment's. Mechanization not only improves efficiency and reduce women drudgery but also helps in promoting diversification in agriculture (Gauchan and Shrestha, 2017). In Nepal, the status of farm mechanization is still poor where animate power still remains the dominant source of farm power. Mechanization is mainly concentrated in the terai region. Therefore, this investigation was carried out to know the status of farm mechanization and its impact on maize production in Jhapa District, Nepal.

MATERIALS AND METHODS

The district under study was Jhapa the easternmost district of Nepal. Geographically, it covers an area of 1,606 km^2 (620 sq. mi) and lies on 87°39' east to 88°12' east longitude and 26°20' north to 26°50' north latitude. A total of 70 households were surveyed through Random sampling technique. Survey was conducted in two local bodies of Jhapa district i.e., Kankai municipality and Jhapa Rural municipality. Thirty-three respondents from Kankai Municipality and thirty-seven respondents from Jhapa Rural municipality were taken. These places were selected as these were only area that come under command area of PM-AMP maize zone Jhapa. For the study both primary and secondary data were taken. Primary data were taken through respondents' interview with the help of semi-structured questionnaire and focal group discussions (FGD) whereas secondary data were obtained through PM-AMP maize zone basic profile, Krishi diary, bulletins and relevant articles, libraries and information office. Information obtained from questionnaire filled were arranged systematically, codes were designed and units were standardized wherever necessary before entering the data into the computer. SPSS, MS -EXCEL were used for data entry. To analyze the socioeconomic characteristic descriptive statistics like mean, percentage, standard deviation and frequencies were used while for inferential statistics T-test and chi square test were done.

Scaling and indexing

Scaling and indexing were done to find out the major problems faced by farmers and for barriers in adoption of mechanization. A seven-point scaling technique using scores of 1, 0.85, 0.71, 0.57, 0.42, 0.28 and 0.14 was applied to rank the problems based by farmers in maize cultivation while five points scaling techniques using scores of 1,0.8,0.6,0.4,0.2 was to rank barriers for adoption of mechanization. An index value was calculated using following formula and final rank were obtained.

$$I_{prob} = \sum \frac{S_i F_i}{N}$$

Where

I_{Prob} = Index value for intensity Σ = Summation S_I = Scale of value of i^{th} intensity

F_i = Frequency of i^{th} response N= Total number of respondents

RESULTS AND DISCUSSION

Household characteristic

In the study area, mean age of household was found to be 49.24, whereas the mean family size was 4.92 which was higher than of Jhapa district 4.4. Average lander under maize varied significantly between two study area (Table 1). It was found that average land area under maize in Kankai area was 0.80 ha while 1.10 ha in Jhapa area. Fragmented land and low land holding can be barrier for adoption of mechanization. Similar findings have been reported by K.C. *et al.* (2015).

Education status of respondents

It was found that 3.1 percent of respondent of Kankai area while 13.5 percent of respondent from Jhapa area were illiterate. About 45.5 percent from Kankai and 24.3 percent of respondent from Jhapa were educated up to secondary level while 9.1 percent from Kankai and 8.1 percent from Jhapa had attended higher secondary level. So, achievement of higher education was associated to adoption of farm machineries (Figure 1). The findings of this investigation are in accordance with Barman *et al.* (2019).

Table 1. Household characteristic of study area.

Variables	Kankai	Jhapa	Mean difference	t-value	P value
Age of Household	47.33	50.95	-3.62	-1.16	0.24
Family size	5.30	4.54	0.76	1.76	0.083
Maize cultivated area	0.80	1.10	-0.3	-3.05	0.003***
Dependent population	3.18	3.11	0.07	0.175	0.86
Independent population	3.27	1.83	0.44	1.18	0.24

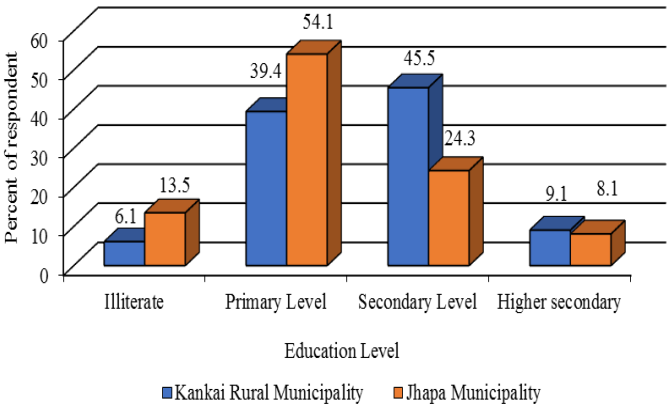

Figure 1. *Education status of respondents.*

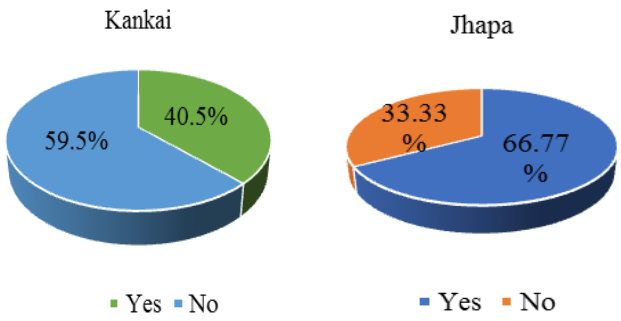

Figure 2. *Participation of respondents on training in study area.*

Table 2. Methods of sowing maize in study area.

Method of sowing	Kankai	Jhapa	Overall	x^2	P-value
Broadcasting	1(3.0)	5(13.5)	6(8.58)		
Behind the Plough	4(12.2)	8(21.6)	12(17.14)	4.092	0.129
Line sowing	28(84.8)	24(64.9)	52(74.28)		
Total	33(100)	37(100)	70(100)		

Note: Figure in parenthesis represent percentage.

Table 3. Use of farm machineries in tillage operation.

Cultural operations	Farm machines used	Address		Total	x_2 Cal	p-value
		Kankai	Jhapa			
Tillage	Wooden plough	6(18.2)	6(16.2)	12(17.1)		
	Cultivator	10(30.3)	23(62.2)	33(47.1)	8.159**	0.017
	Rotavator	17(51.5)	8(21.6)	25(35.8)		
Total		33(100)	37(100)	70(100)		

Note: Figure in parenthesis represent percentage, ** indicates significance at 5% level of significance.

Training and extension services

It was observed that about 59.5% of respondent from Kankai area had participated on different maize related training programs whereas only 33.33 % of respondent from Jhapa area had participated in any maize training (Figure 2).

Method of sowing maize

Among the three-methods line sowing was most widely adopted method of sowing in study area (74.28 percent). About 84.8 percent of respondent from Kankai and 64.9 percent of respondent from Jhapa adopted this method. Broadcasting was least adopted by farmers (8.58 percent) while behind the plough was adopted by (17.14) percent of respondents. Upon asking reason behind adoption of line sowing farmers replied that in case of line sowing it was easier to carry out different intercultural operation such as earthing up, weeding, fertilizer application. From the study it was found calculated value of chi square (4.092) was statistically insignificant. It means method of sowing of maize doesn't differ with location in study area (Table 2).

Use of farm machineries in tillage

From the study it was observed that respondent mainly used three different farm machineries to carry out the tillage operation. Modern farm machineries such as (cultivator and rotavator) were used by 82.9 percent of respondents whereas 17.1 percent of people still used wooden plough for tillage operation. The reason behind using wooden plough was they had relatively smaller farm size and were low in economic status. It was observed that cultivator was widely used (62.2 percent) in case of Jhapa area as compared to Kankai (30.3 percent) while in case of rotavator it was widely used in Kankai (51.5 percent) as compared to Jhapa (21.6 percent). In case of wooden plough about 18.2 percent of respondent of Kankai used it while 16.2 percent of people from Jhapa were found to be using wooden plough. From the study it was found calculated value of chi square (8.159) was statistically significant at 5% level of significance. It means use of farm machineries tillage operation vary significantly with location in study area (Table 3).

Table 4. Variety of maize used in study area.

Variety used	Kankai	Jhapa	Overall	x_2	p-value
TX 369	9(27.3)	24(64.9)	33(47.1)	9.915***	<0.01
Bikashe	16(48.5)	9(24.3)	25(35.7)		
Local	8(24.2)	4(10.8)	12(17.1)		
Total	33(100)	37(100)	70(100)		

Note: Figure in parenthesis represent percentage; *** indicates significance at 5% level of significance.

Table 5. Shows ranking of problems in maize in Jhapa.

	Scores							Weightage	Index	Rank
	1	0.85	0.71	0.57	0.42	0.28	0.14			
Problems of Labor	1	0	0	1	23	11	34	19.07	0.27	VII
Lack of quality of seeds	31	35	3	0	0	1	0	63.16	0.90	I
Lack of fertilizers on time	2	4	39	25	0	0	0	47.34	0.67	III
Lack of machineries	0	0	11	14	13	23	9	28.95	0.41	VI
Insect pests in maize field	32	29	5	2	1	0	1	61.6	0.88	II
Insects' pest on storage	4	3	5	17	11	14	16	30.57	0.43	V
Marketing problems	3	3	6	10	21	20	7	30.91	0.44	IV

Table 6. Major problems in adoption of mechanization.

Statement on problem in adoption	Problem level					index value	Rank
	1	0.8	0.6	0.4	0.2		
Initial cost high	30	18	13	7	6	0.802	I
Frequent maintenance and repairing	21	17	16	9	7	0.702	II
Lack of trainings	9	11	15	18	17	0.534	IV
Lack of skilled manpower	14	17	23	16	0	0.682	III
Small land holding	3	2	8	19	38	0.351	V

Variety of maize used

From the study calculated value of chi square (9.915) was statistically significant at 1 %level of significance. It means use of variety differ significantly with location in study area. Major variety used were TX369 hybrid variety along with Bikashe and local variety. It was found that about 47.1 percent of respondent from study area used Tx 369 while 35.7 percent used Bikashe variety with only 17.1 percent people used Local variety. Respondents from Jhapa area were found to use Tx 369 mostly (64.9 percent) while only (27.3 percent) of respondents from Kankai used it. But in case of Bikashe variety 48.5 percent of respondents were from Kankai and about (24.3 percent) were from Jhapa area reported several socioeconomic, environmental, and cultural factors also affect to the selection of maize varieties (Table 4). Ransom *et al.* (2003) also reported improved varieties of maize in Nepal.

Problems faced by farmers in maize production

With the help of key informant personnel and different focal group discussion conducted in study area problems in maize were identified and included in questionnaire. From the questionnaire responses of the farmers were taken and problems were ranked according to responses of farmers as shown in Table 5. Ransom *et al.* (2003) also reported various problems faced by the farmers for the production of maize in Nepal.

It was observed that lack of quality of seed was major problem faced by farmers followed by insect pests in maize field followed by lack of fertilizer on time. Due lack of available of seeds famers were obliged to buy seeds from India without any insurance on their own risk. Most of variety that was cultivated in study area were imported from India as India border was near to study area and cost was very affordable as compare to Nepal. Insects such as maize stem borer (*Chilo partellus)*, *Fall* army worm (*Spodoptera frugiperda*) were reported in higher incidence whereas maize weevil (*Sitophilus zeamis)* was major storage pest. Farmers were also facing the problems of fertilizer, as fertilizer were not available in market in time. Problems in marketing was ranked in fourth and insect pest in storage in fifth followed by lack of machineries and lack of labor on sixth and least, respectively.

Factors affecting adoption of mechanization

Different problems regarding the adoption of mechanization were listed out to respondents and their responses were taken. Based on the responses index value was calculated ranging from 0 to 5 which refers from no problem to much problem respectively. The study showed that Initial cost (0.802) was ranked first meaning major problem in adoption followed by Frequent maintenance and repairing with index 0.702 whereas small land holding was ranked fifth (0.351) meaning least problem in adoption (Table 6).

Table 7. Comparison of cost and productivity between Kankai area and Jhapa area.

Variables	Kankai (N=33) Mean ± SD	Jhapa (N=37) Mean ± SD	Overall (N=70) Mean ± SD	Mean difference	t-value	P-value
Cost of production (Rs/Katha)	2220.03±112.51	3287.56±190.67	2784.30±559.40	-1067.52	-28.88***	>0.001
Productivity (kg/Katha)	147.78±34.52	130.92±33.48	139.83±34.83	16.86	2.06**	0.042

*** indicates significance at 1% level of significance; ** indicates significance at 5% level of significance.

Comparison of cost of production and productivity between Kankai area and Jhapa area

The difference in mean cost of production per Katha between Kankai and Jhapa area was found statistically significant at 1 percent level of significance. The cost of production was NRS 2220.03 per Katha for the Kankai whereas as it was NRs 3287.56 per Katha for Jhapa. The mean difference between Kankai and Jhapa area category was NRS 1067.52 per Katha. Involvement of farmers of Kankai area in training, higher education level, access to subsidized charge of machineries were main reason for low cost of production. However, the mean productivity was significantly different between Kankai and Jhapa area at 5% level of significance. The mean productivity for Kankai area was 147.78 kg per Katha (2.66 t/ha) whereas it was 130.92 kg per Katha (3.92 t/ha) for Jhapa area (Table 7). The mean productivity of Kankai area was found higher mainly due to the use of Farm machineries in different maize production activities. Mechanization is important not only to reduce cost of production, drudgery and to increase productivity of farm but also it increases productivity and profitability of farm (Verma, 2006).

Conclusion

Although mechanization has potential to change the face of agriculture farming in Nepal but there has not been comprehensive study on effect of agriculture mechanization. This study revealed that mechanization was in the early stage of development in study area. Mechanization can be used at every step of production from land preparation to harvesting and processing; however, in case of study area it was limited to tillage and threshing of maize only. Study suggests mechanization had positive impact in maize production and productivity. Results show that cost of production and productivity was higher in case of Kankai municipality due to high adoption of machineries as compared to Jhapa rural municipality.

ACKNOWLEDGEMENTS

The authors like to extend sincere thanks to AFU and PM-AMP for funding the project. Help received from the team members of the Agronomy Department of AFU involved in this project are highly acknowledged.

Conflict of interest

There is no conflict among the authors.

REFERENCES

Barman, S., Deka, N., & Deka, P. (2019). Factors Affecting Farm Mechanization – A Case Study in Assam, India. *Asian Journal of Agricultural Extension, Economics & Sociology*, *32*(1), 1–7, https://doi.org/10.9734/ajaees/2019/v32i130146

Dawadi, D., & Sah, S. (2012). Growth and yield of hybrid maize (*Zea mays* L.) in relation to planting density and nitrogen levels during winter season in Nepal. *Tropical Agricultural Research*, *23*(3), 218, https://doi.org/10.4038/tar.v23i3.4659

Gauchan, D., & Shrestha, S. (2017). Agricultural and rural mechanisation in Nepal: Status, issues and options for future. In S. M. A. Mandal, B. S.D., & S. E. Justice (Eds.), *Rural Mechanisation. A Driver in Agricultural Change and Rural Development. Institute for Inclusive Finance and Development (InM)*, (pp. 97–118).

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, https://doi.org/10.3126/jmrd.v1i1.14239

Paudyal, K. R., Ransom, J. K., Rajbhandari, N. P., Adhikari, K., Gerpacio, R. V., & Pingali, P. L. (2001). Maize in Nepal: Production system, constraints, and priorities for research. *CIMMYT,NARC*, 1–56.

Poudel, S. K., & Paudyal, K. R. (2001). Impact of public-and private-sector maize breeding research in Nepal. In *Impact of Public-and Private-sector Maize Breeding Research in Asia, 1966 -1997/98* (pp. 66–80). International Maize and Wheat Improvement Center (CIMMYT).

Ransom, J. K., Paudyal, K., & Adhikari, K. (2003). Adoption of improved maize varieties in the hills of Nepal. *Agricultural Economics*, *29*(3), 299–305, https://doi.org/10.1016/S0169-5150(03)00057-4

Shrestha, A. K., Paudel, P., & Matsuoka, A. (2009). Socio-economic factor influencing adoption of fertilizer for maize production in Nepal. *The 83rd Annual Conference of the Agricultural Economics Society, April*.

Shrestha, S. (2012). Status of Agricultural Mechanization in Nepal. www.unapcaem.org

Verma, S. R. (2006). Impact of Agricultural Mechanization on Production, Productivity , Cropping Intensity Income Generation and Employment of Labour. In *College of Agril. Engg., Punjab Agricultural University, Ludhiana*.