FACTORS AFFECTING ADOPTION OF MAIZE VARIETIES IN NEPAL

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ABSTRACT

This study examined status of adoption of improved maize varieties in Nepal. Six hundred eighty two households were sampled from six district namely Sindhupalchowk, Lalitpur, Khotang, Dang, Chitwan and Dadeldhura. Data was analyzed through descriptive statistics. The results indicated that the slow growth rate of area, production and yield was around 2.7% p.a. and growth rate is moreover stagnant rate from 1990-2015. Adoption of modern variety was found to be 75% of household. Mean area of maize cultivation in Nepal is 0.431 ha/HH. Only seven improved variety were adopted in large scale and they were adopted in 70.60% of maize cultivating areas. Improved variety Rampur composite, Mankamana-3 and Deuti and Hybrid CP 808 were found to be highly adopted. While CP 808, Shrestha and Rajkumar hybrids were dominating hybrids. Age of household head, Caste, Migration, credit accessibility, cooperative involvement, extension visit, training, formal sector seed availability and knowledge about agricultural insurance were found positive factors affecting adoption of modern variety of maize. However education and livestock numbers found negatively contribute to adoption

Keywords: Maize, Adoption, Modern Variety, Adoption Intensity, Adoption index

INTRODUCTION

Maize is major cereal crops produced and consumed in Nepal. It is estimated that the annual per capita consumption of maize in Nepal is 43.41 Kg, and national maize consumption is 2127000 tons. It is important crop for Nepalese economy is demonstrated by fact that it accounts for 8.49% of total value of the national agricultural production at current value in 2014 and 12.79 % of total dietary calorie need per capita per day (FAOSTAT, 2013) . Over few decades the production of maize increased though area of production is moreover stagnant in Figure 1 (MOAD, 2016). In 2015/16 maize was grown in 26.97% of total cereal cultivated area and it constitutes 25.90% of total cereal production with seed replacement rate of 92%. Though five agro-ecologies has been identified for maize production i.e. the mid hills in the eastern development region, mid hills in the central and western development regions, mid hills in the mid-western and far-western development regions, all of the Terai and all of the high hills (Paudyal, Ransom, Rajbhandari, Adhikari, Gerpacio, & Pingali, 2001) , more than two third of maize produced from hill. Maize is sown under two systems: the traditional system, in which maize is associated with other crops, and a monoculture system (Sain & Martinez, 1999).
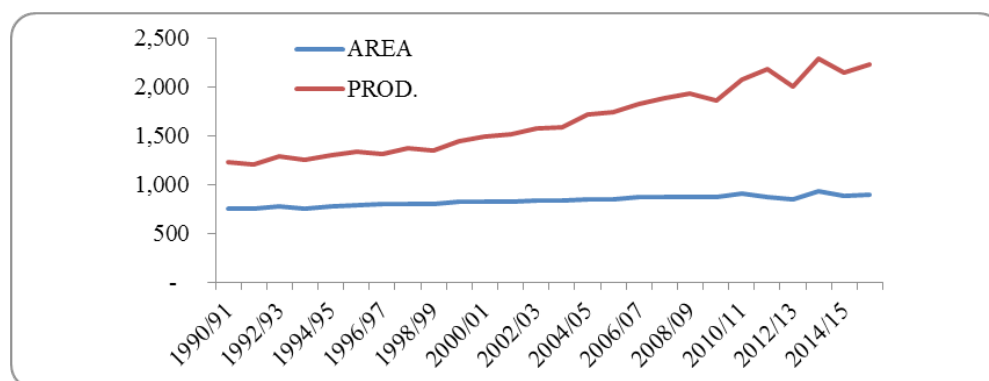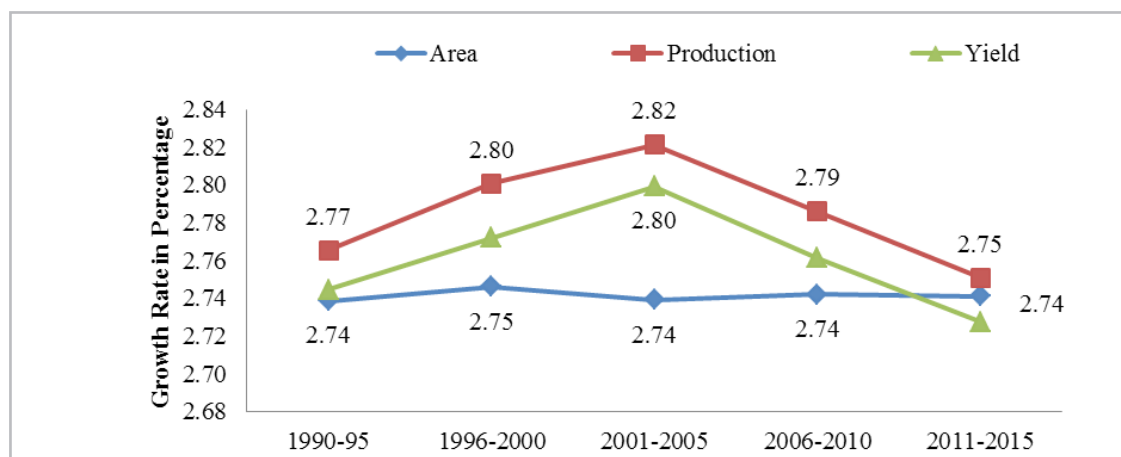

Figure 1: Maize Area and Production in Nepal 1990-2014

The maize production harvested area and yield was increased by nearly 2.73% per annum from 1990 to 2014 (table 1). The growth rate of maize production and yield was increasing up to 2005 and then after growth rate was stagnant over decade's and was lower as compared to growth rate at 2005. Table 1 summarizes the annual growth rate of maize area, production and Yield.

Table 1: Annual growth rate of Maize area, Production and Yield 1990-2015

Period	Annual Growth Rate %		
	Area	Production	Yield
1990-95	2.74	2.77	2.74
1996-2000	2.75	2.80	2.77
2001-2005	2.74	2.82	2.80
2006-2010	2.74	2.79	2.76
2011-2015	2.74	2.75	2.73
Overall Growth	2.73	2.75	2.73

In Nepal maize research for developing technologies started since 1972 with establishment of National Maize Development Program (NMDP) at Rampur Chitwan. National maize research program has made significant contribution increasing food production.

Figure 2: Maize area and production in Nepal (1990-2014)

The present study was carried out to find out the adoption status of maize variety released by NARC. Agricultural technology adoption study has many policy implications in agricultural development. It serves as a tool for evaluating the distributional impacts of new innovations, for documenting the impact of an innovation or extension effort, for identifying and reducing the constraints to adoption, and as a research guide to focusing innovation priority (Langyintuo & Mungoma, 2008) .

MATERIALS AND METHODS

Sampling procedure

Study used both primary and secondary source of information. Secondary source of information was collected from data published from Ministry of Agricultural Development and NARC. Most of the data was however generated through survey and focus group discussion. Six districts (Sindhupalchowk, Khotang, Lalitpur, Dadeldhur, Dang and Chitwan) were selected purposively according to production and accessibility. 682 farmers were selected randomly from these districts.

To increase validity and reliability, farmers were interviewed by researchers and experience extension officers using a structured questionnaire developed by panel of agricultural economist and agronomist. The interview was conducted in 2016.

Analytical framework

The adoption of new agricultural technology is influenced by three factors like i) farm and farmers' associated attributes like farmer's education, age, family size and farm size.II) attributes associated with the technology Adesina *et al.,*1992; Mishra *et al.,*1993) and the farming objectives (CIMMYT, 1988). In this study tobit analysis was done to test factor affecting intensity of adoption.

$$Y_{ij} = \beta_{ij} \ X_{ij} + \varepsilon_i$$
$i = 1$ if farmers grows improved maize variety; $j = 0$ otherwise

where Y_{ij} = the proportion of maize area allocated to improved maize variety
β_{ij} = parameter to be estimated
ε_i = error term

RESULTS AND DISCUSSION

Demographic Characteristics

Table 2 summarizes the demographic characteristics of sampled households of maize farmers. Out of all 35% of sample was taken from Terai and rest of from hilly districts. The mean age of household head was found to be 45.68 and 25% of household had at least one member migrated. The mean age of household head was found to be 70 years. 56% have credit accessibility, 25% were involved in the cooperative, 38% visit to DADO for getting information related to maize, 16% get training related maize farming, 36% get input support, 50% about knows insurance and 62% of seed comes from formal source like Agrovet, DADO, NARC etc and average livestock standard unit was found to be 2. Out of these variables gender, migration, credit availability, cooperative involvement, training and livestock standard unit are significantly different at 1% among hill terai agro ecology and education was significant at 10%.

Table 2: demographic characteristics of respondents

Demographic Characteristics	Sample	Hill (n=422)	Terai (n =240)	MD	t value
Agro-ecological zone (if Terai 1 otherwise 0)	45.67742	45.090	46.758	-1.668	-1.567
Age of Household head (Years)	0.702346	0.661	0.779	-0.119	-3.253***
Gender of Household Head (if male 1, otherwise 0)	0.703812	0.719	0.675	0.044	1.214
Ethnicity (if Brahmin/Chettri 1 otherwise 0)	0.788856	0.767	0.829	-0.062	-1.903*
Education of household head (if literate 1 otherwise 0)	0.247801	0.208	0.321	-0.113	-3.276***
Migration status (if Migrated 1, otherwise 0	0.56305	0.500	0.679	-0.179	-4.567***
Credit availability (if Available 1, otherwise 0)	0.252199	0.285	0.192	0.093	2.693***
Involvement in Cooperative (If yes 1, Otherwise 0)	0.376833	0.360	0.408	-0.049	-1.251
Farmers visit to extension office (If Yes=1 otherwise 0)	0.16129	0.190	0.108	0.082	2.782***
Training taken (if yes 1, Otherwise 0)	0.363636	0.364	0.363	0.002	0.045
Get input support (If yes 1, Otherwise 0)	0.498534	0.507	0.483	0.023	0.584
Information about agriculture insurance (if yes 1, otherwise 0)	2.007639	2.121	1.800	0.321	2.589***
Livestock standard Unit	0.618768	0.613	0.629	-0.016	0.411

Incidence of Adoption

The incidence of adoption was measured as percentage of farmers growing improved variety at specific point in time The disaggregate data shows 56.3% of farmers used *solely* seeds for OPVs, 11.29% of the farmers used only local seed and 14.22% sowed only hybrids (Table 3). Note that almost 11.73% planted OPVs in addition to their local varieties but little bit different case was found in hybrid i.e. percentage of farmers who planted hybrid as well as local varieties was 1.32%. This difference suggests that the improved varieties are more often sown in addition to the local materials, while the hybrids tend to be sown alone.

Table 3: Incidence of adoption of maize varieties

S.N.	Maize Variety	Number of household	1Incidence of Adoption
1	Only hybrid	97	14.22
2	Only Improved	384	56.3
3	Only local	77	11.29
4	Hybrid and Improved	33	4.84
5	Hybrid and local	9	1.32
6	Improved and local	80	11.73
7	Hybrid, improved and local	2	0.29
Total		682	100

Farmers reported using 18 types of hybrids, 14 types of Open pollinated varieties and 10 types local varieties. Out of 18 hybrids, only three variety; CP808, Rajkumar and Shrestha were used by more than two third farmers. Similarly most popular four variety of OPVs were Deuti, Rampur Composite, Mankamana-3 and Arun-2 which consititues about 98% of total OPVs. In local variety, only three were most popular i.e.. Phelo local (15.20%), Seti (9.36), Local Seto (8.19%) which constitutes about 33% of total local maize growing farmers. It should be noted that in a few instances, the variety if not known was classified as "Unknown."(Table 4).

Table 4: Adopted OPVs, Hybrids and Local Varieties

S.N.	Open Pollinated Variety		Hybrid Variety		Local Variety	
	Variety	Total	Variety	Total	Variety	Total
1	Deuti	120 (22.9)	CP 808	84 (57.93)	Unknown	102(59.65)
2	Manakamana-3	99 (18.89)	Unknown	20 (13.79)	Pahelo local	26(15.20)
3	Rampur Composite	251 (47.90)	Khumal 3	3 (2.07)	Seti	16(9.36)
4	Arun-2	25 (4.77)	Shrestha	11 (7.59)	Local Seto	14(8.19)
5	Ganesh 1	9 (1.72)	9220	3 (2.07)	Thuli Paheli	3(1.75)
6	Sarlahi Seto	4 (0.76)	Bio Seed	3 (2.07)	Local rato	2(1.17)
7	Poshilo Makai	3 (0.57)	Pioneer	4 (2.76)	Thimaha (local)	2(1.17)
8	Other OPVs	13 (2.48)	Rajkumar	8 (5.52)	Other Variety	6(3.51)
9			Other Variety	9 (6.21)		
Total		524(100)		145 (100)		171(100)

Intensity of Adoption

Table 5 shows intensity of adoption of different category of maize. Intensity of adoption at the farm level reflects percentage of area planted to particular category of maize. Looking at land allocation by the type of seed sown, 86% of the study area was cropped with modern varieties (15.35% with hybrids and 70.60 % with OPVs) and 14.01% of local variety. The area occupied by hybrid and local variety is significantly different among hill and terai. The research revealed that hybrid maize occupied more area in terai (26.43%) as compared to hill (8.85%) while open pollinated occupied more area in hills (73.21%) as compared terai (66.52%).

Table 5: Type of Maize variety Adopted in Different agro-ecological zones

Type of Variety	Sample (N =682)	Hill (n=442)	Terai (n=240)	MD	t value
Maize Cultivated land	0.431	0.418	0.454	-0.036	1.04***
Hybrid	0.0662 (15.35)	0.037 (8.85)	0.120(26.43)	-0.084	-6.135***
Open Pollinated	0.3043 (70.60)	0.306(73.21)	0.302(66.52)	0.004	1.18
Local	0.0604 (14.01)	0.076(18.18)	0.032(7.05)	0.044	2.983***

Cropping Area, land Allocation

Land is an important factor of production. Generally it is short in supply therefore farmer's tries to allocate its resources in order to gain maximum profit. In table total cultivated land is 0.667 ha/HH out of which only 64.48% land was cultivated by maize. The cultivation of winter maize was found significantly higher in terai as compared to Hills. Data shows that farmer prefer summer cultivation of maize as farmers allocated 64.17% of total cultivated land for summer which is higher than winter maize cultivation i.e 2.7%.

Table 6: Land Allocation Based on Season (Ha)

Season of Maize Production	Sample (n=682)	Hill (n=422)	Terai (n=240)	MD	T value
Total cultivated Land	0.667	0.560	0.862	-0.302	5.965***
Maize Cultivated land	0.431 (64.48)	0.418	0.454	-0.036	1.04
Summer Maize	0.428 (64.17)	0.428	0.430	-0.002	0.06
Winter Maize	0.018(2.70)	0.004	0.045	-0.041	5.48***
Fallow Land	0.027	0.035	0.013	0.022	-1.78*

Factor affecting adoption of modern maize variety

The table 7 shows the factors affecting the adoption of modern maize varieties in Nepal. The data shows that the household head who are older, male, Brahmin/chetteri, migrated member, have credit accessibility, involved in co-operative , extension visits, training taken and get input support and seed availability from formal sectors, have knowledge about agricultural insurance have positively affect adoption of modern maize varieties. However higher education and livestock numbers in household negatively contribute to adoption.

Table 7: Tobit analysis of factor affecting adoption of modern maize variety

Number of observation = 682	LR chi2(14) = 184.12				
	Prob > chi2 = 0.0000				
	Log likelihood = -291.89089		Pseudo R2 = 0.2398		

IMV	Coef.	dy/dx	Delta-method Std. Err.	Z	P>z
Agro-ecological zone (if Terai 1 otherwise 0)	0.097659	0.096986	0.0288547	3.36***	0.001
Age of Household head (Years)	0.002339	0.002323	0.0010574	2.2**	0.028
Gender of Household Head (if male 1, otherwise 0)	0.044986	0.044676	0.0303646	1.47	0.141
Ethnicity (if Brahmin/Chettri 1 otherwise 0)	0.099699	0.099012	0.0290046	3.41***	0.001
Education of household head (if literate 1 otherwise 0)	-0.02525	-0.02507	0.0349778	-0.72	0.473
Migration status (if Migrated 1, otherwise 0	0.05995	0.059537	0.030379	1.96**	0.05
Credit availability (if Available 1, otherwise 0)	0.114945	0.114153	0.0322129	3.54***	0
Involvement in Cooperative (If yes 1, Otherwise 0)	0.054867	0.054489	0.0353512	1.54	0.123
Farmers visit to extension office (If Yes=1 otherwise 0)	0.075032	0.074515	0.0295046	2.53**	0.012
Training taken (if yes 1, Otherwise 0)	0.00263	0.002612	0.0374198	0.07	0.944
Get input support (If yes 1, Otherwise 0)	0.068462	0.06799	0.0294303	2.31**	0.021
Information about agriculture insurance (if yes 1, otherwise 0)	0.024579	0.02441	0.0275318	0.89	0.375
Livestock standard Unit	-0.01694	-0.01682	0.0084433	-1.99**	0.046
Source of Seed Availability (1=formal 0= informal	0.194226	0.192888	0.0289552	6.66***	0
_cons	0.349779				

CONCLUSION

59.65% of local varieties were identified at local level. Therefore there is ample space for maize breeder to work in this field. NARC had released more than 20 maize varieties but only seven open pollinated variety were adopted, therefore there is a great need of better extension services. The hybrid released by NARC was adopted only in 2.07%. Out of total hybrid maize adopted varieties, about 98% were Indian hybrids. Area allocated for local maize was still 14% therefore there is need of maize program to increase their adoption rate. About 25% people were involved in co-operative, 16% of maize farmers get training related to maize farming and 36% have got some sort

of support from government. There is still need of government intervention to promote improved maize adoption in Nepal.

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